Science Annex 1st and 2nd Floor Renovation
BUILDING #20
525 S BEAVER ST
FLAGSTAFF, AZ 86011

PROJECT MANUAL

VOLUME 1 OF 1

LIGHTVOX

4602 EAST THOMAS ROAD
PHOENIX, AZ 85018

100% CD ISSUANCE

NAU PROJECT NO.: 09.200.201
LIGHTVOX PROJECT NO.: 3001.19.02

DATE: 06.23.2020
SECTIONS 00 0107 – SEALS PAGE

1.01 DESIGN PROFESSIONALS OF RECORD

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NORTHERN ARIZONA UNIVERSITY
FLAGSTAFF, ARIZONA

PROJECT MANUAL
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FOR
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<tr>
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<td>ELECTRICAL SYMBOLS AND GENERAL NOTES</td>
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<td>E3.01</td>
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<td>E3.02</td>
<td>LEVEL 2 HVAC &amp; PLUMBING POWER PLAN</td>
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<td>PANEL SCHEDULES (CONTINUED)</td>
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<td>LUMINAIRE SCHEDULE &amp; LIGHTING COMPLIANCE</td>
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<td>PONS LEVEL 1 FLOOR PLAN</td>
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<td>ET101.2</td>
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<td>ET101.3</td>
<td>PONS SYSTEM DETAILS</td>
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<td>ET101.4</td>
<td>PONS SYSTEM DETAILS</td>
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</tbody>
</table>
Sealed bids are being solicited by Facility Services, Office of Planning, Design and Construction, Northern Arizona University, for and on behalf of the Arizona Board of Regents, for the furnishing of all labor, material, transportation and services required for Project Number: 09.200.201, Project Name: Science Annex 1st and 2nd Floor Renovation on the Campus of Northern Arizona University, Flagstaff, Arizona, in accordance with the plans and specifications on file with Facility Services, Office of Planning, Design and Construction.

Bids will be received at Facility Services, Building #77, Main Reception Desk, Northern Arizona University, Flagstaff, Arizona, until Friday, July 17 at 2:00PM Arizona Local Time.

Offerors dropping off bids in person are required to wear a face mask. When dropping off bids in person, social distancing measures apply. NAU reserves the right to turn away Offerors who do not comply with these requirements.

Bids will be opened publicly directly thereafter and read aloud via a ZOOM meeting. The ZOOM meeting invitation for the bid opening is provided in Section 00 21 14.6 of the Division 00 bidding document. No public attendance at the bid opening meeting is allowed.

A mandatory Pre-Bid Conference will be held via ZOOM on Tuesday, June 30, 2020 at 2:00PM Arizona Local Time. Pre-Registration for the Pre-Bid Conference ZOOM meeting is required. Registration for this meeting can be done at the following link: [https://nau.zoom.us/meeting/register/tJwvde6vqzsG9PmxxcNW8vApdpw4y1WNNPN](https://nau.zoom.us/meeting/register/tJwvde6vqzsG9PmxxcNW8vApdpw4y1WNNPN).

After registering, you will receive a confirmation email containing information about joining the meeting.

Plans and Specifications for the proposed work may be inspected online at [https://in.nau.edu/facility-services/bids-rfq/](https://in.nau.edu/facility-services/bids-rfq/). The scope of work for this project is renovation of the 1st and 2nd floors of Building 20, Science Annex, to facilitate relocation of the CSTL program to the 2nd floor and expanded and updated classrooms on the 1st floor. Work on the 2nd floor entails a nearly complete demolition and rebuild to include classroom, light lab, storage and office spaces. Work on the 1st floor entails partial demolition of the space for expanded and renovated classrooms and offices, with add alts. for ADA upgrades to lecture halls. Both floors will receive new HVAC and electrical systems. A more detailed scope of work is included in the plans and specifications and will be reviewed at the mandatory pre-submittal meeting.

Accompanied pre-submittal site visits will be scheduled individually with interested firms. Site visits will be conducted observing public health guidance with regards to Covid-19. Information on scheduling these visits will be published on the NAU website.
A certified check, cashier’s check or NAU Bid Bond Form FS#9 for ten percent (10%) of the amount of bid, must accompany each proposal, as a guarantee that the Contractor will enter into a contract to perform the proposal in accordance with the plans and specifications or as Liquidated Damages in the event of failure or refusal of the Contractor to enter into the contract. Checks or bonds will be returned to the unsuccessful bidders, and to the successful bidder upon the execution of a satisfactory bond and contract, as prescribed by Arizona Revised Statutes.

The Contractor, to whom the contract is awarded, shall, after receipt of Notice of Intent to Award, furnish to the aforesaid Board of Regents a satisfactory performance and payment bond in an amount equal to one hundred percent (100%) of the full amount of the bid, such bond not to be expressly limited as to time in which action may be instituted against the surety company for possible nonperformance of the Contractor. Bonds must be from a corporate surety company licensed to issue surety bonds in the State of Arizona. Individual sureties will not be accepted.

Work shall commence immediately after receipt of an executed contract or a Notice to Proceed. Phase 1 of the project shall be Substantially Complete by March 1, 2021, and shall be Finally Complete by June 1, 2021. Phase 2 of the project shall be Substantially Complete by January 10, 2021 and Finally Complete by April 10, 2021. More detailed scheduling information will be included in the bid package. Bonds and insurance certificates must be submitted and approved prior to commencement of work.

The Board of Regents reserves the right to reject any or all bids, to waive or decline to waive irregularities in any bid, or to withhold the award for any reason it may determine, and also reserves the right to hold any or all bids for a period of 60 days after the date of the opening thereof. No bidder may withdraw a bid during this 60-day period without forfeiture of the bid bond.

Women owned and minority owned firms are encouraged to apply. Persons with a disability may request a reasonable accommodation by contacting Facility Services, (928) 523-4227.

ARIZONA BOARD OF REGENTS
Bids should be addressed to:
NAU Planning, Design and Construction
Attention: Judith Scholar Winfield
PO Box 5637
Flagstaff, Arizona 86011-5637
Phone: (928) 523.4468
Facsimile: (928) 523.9441
Email address: Judith.scholarwinfield@nau.edu
Publication Date: June 25, 2020
INSTRUCTIONS FOR PROCUREMENT

00 21 00 Instructions
00 21 13 Instructions to Bidders
00 21 13.1 Correspondence

Address all correspondence relating to the project to:
Facility Services
Planning, Design, and Construction
Attn: Judith Scholar Winfield
Northern Arizona University
P.O. Box 5637
Flagstaff, AZ 86011
judith.scholarwinfield@nau.edu

Reference the Project by both name and NAU project number in all correspondence.

00 21 13.2 Sealed Bids
Owner (Northern Arizona University) will receive sealed bids (at the time and place specified in Section 00 11 16, Invitation to Bid) for the labor, equipment, transportation and materials necessary to perform all functions and work indicated on the drawings and specified herein. Proposals shall be submitted on the required forms included in Section 00 43 00 of these specifications.

00 21 13.3 Execution of Contract and Bonds
The Contract Agreement, which the successful bidder, as Contractor, will be required to execute, is referenced in Section 00 52 00 of this manual. The form of Bonds and Insurance certificates required to be furnished are included in Section 00 62 16 of this manual and shall be carefully examined by the bidder. The successful bidder will be required to execute the Standard Form Agreement between Owner and Contractor (Contract) and submit completed bonds and insurance certificates within five (5) working days after Notice of Intent to Award. Failure to execute a Contract Agreement and to file satisfactory payment and performance bonds and insurance certificates issued by companies deemed qualified by the Owner shall be just cause for the cancellation of the Award of Project and the forfeiture of the Bid Bond which shall become the property of the Owner, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsible bidder, canceled, or re-advertised as the Owner may elect.

Owner reserves the right to waive irregularities in consideration of award to the lowest responsive and responsible bidder.

00 21 13.4 Bidding Documents
Bidders may obtain from Owner’s website (Planning, Design, and Construction Bids and RFQs page), a complete set of Bidding Documents stated in the Invitation to Bid, Section 00
General Contractors shall be responsible for distribution of bidding documents to Subcontractors.

Complete sets of bidding documents are to be used in preparing Bids. Neither Owner nor Design Professional (DP) assumes any responsibility for errors or misinterpretations resulting from using incomplete sets of bidding documents.

Owner or DP, in making copies of bidding documents available on above terms, does so only for purpose of obtaining bids on the work and does not confer a license or grant for any other use.

Interpretation or Correction of Bidding Documents

Bidders shall notify Owner and/or DP promptly of any ambiguity, inconsistency or error discovered upon examination of bidding documents or of site and local conditions. Failure to so notify Owner/DP is deemed a waiver of any claim by Contractor, based upon any such ambiguity, inconsistency or errors. The DP shall maintain a log of all inquiries and shall provide written notification of such to Owner (Facility Services Project Manager).

Interpretation, correction or change of bidding documents will be made by written Addendum. Interpretations, corrections or changes of bidding documents made in any other manner will not be binding; Bidders may not rely upon such interpretations, corrections and changes.

Bidder's Representation

Each Bidder by making their Bid represents that:

They have read and understand the bidding documents and all Contract Documents and that Bid is made in accordance therewith.

They have visited the site and are familiar with local conditions under which Work is to be performed, including verification of all field measurements, and have inspected all accessible spaces.

They have thoroughly familiarized themselves with all specific products and their proposed uses.

Their bid is based upon the materials, systems and equipment described in the bidding documents without exceptions.
They have satisfied themselves that the products specified are appropriate for the uses proposed.

Their subcontractors with project involvement exceeding $100,000 are bondable.

They have advised each subcontractor to become thoroughly familiar with the Contract Documents, including the specifications and referenced standards, insofar as they affect each subcontractor.

They will install all Work properly, will place their warranty on the Work, and provide guarantees required.

00 21 13.7 Bid Period
Unless otherwise noted, all bids and bid prices shall remain firm for a period of sixty (60) days after the date of Bid opening and the Contractor shall be prepared to begin construction within ten (10) calendar days of receipt of notice of intent to award.

00 21 13.8 Contractor Qualifications
The Contractor shall submit with bid package the Statement of Qualifications (FS #2) included in Section 00 45 13 of these specifications.

The competency and responsibility of Bidders, of their proposed Subcontractors, and of the Surety issuing the Contractor’s performance and payment bonds, will be reviewed prior to award.

00 21 14 Bidding Procedure
00 21 14.1 Form and Style of Bids
Bids must be submitted on Form of Bid (FS#1) provided in Section 00 41 13 of these specifications.

Blanks on the Form of Bid shall be typed in or printed legibly in ink.

Where indicated on Form of Bid, express sums both in words and digits; in case of discrepancy between the two, the written amount shall govern.

Signer of Bid must initial any insertion, alteration or erasure.

Each copy of Bid shall include (on the Contractor Statement of Qualifications - FS #2) the legal name of Bidder and statement whether Bidder is sole proprietor, partnership, corporation or other legal entity. Each copy shall be signed by person, or persons, legally authorized to bind Bidder to a contract. Bid by a corporation shall give the state of incorporation and have corporate seal affixed.
Bid bonds submitted by agent must have current Power of Attorney attached certifying agent's authority to bind Bidder.

The list of **required bid forms** is:
1. Form of Bid (FS#1)
2. Contractor Statement of Qualifications (FS#2)
3. Subcontractor List (FS#3)
4. Bid Bond (FS#9)
5. Notification & Confirmation of Asbestos Containing Materials (FS#13)
6. 00 73 38 – Sudan, Iran & Israel

All additional forms that are standard for Owner that **must** be used throughout the Contract for Construction are noted in Section 00 52 00 and 00 60 00 of these specifications and available through the office of Facility Services, Planning, Design and Construction.

00 21 14.2 Bid Bond
A Certified or Cashier's Check or Bid Bond (NAU form FS#9, see Section 00 43 13) of a corporate surety acceptable to the Arizona Board of Regents, payable to Northern Arizona University for Ten (10%) percent of the amount of the bid, is required as a guarantee that the bidder will enter into the contract if awarded. It shall be declared forfeited as Liquidated Damages if the successful bidder refuses to enter into said contract after being requested to do so by the Arizona Board of Regents/Northern Arizona University.

00 21 14.3 Bidders Qualifications
Bids will be accepted only from those Contractors who are licensed in the State of Arizona and qualified under the laws of the State of Arizona to perform the work specified. All work performed under the Contract by such licensed Contractors must be made to comply with all applicable laws and requirements of any governing bodies or regulatory agencies having jurisdiction over such Work.

The Contractor shall determine that subcontractors are licensed, insured, and qualified to perform their respective work under the contract and shall determine that they are bondable, as required in Section 00 43 36. Each Bidder shall also submit a Subcontractor List (form FS #3 - included in Section 00 43 36 of these specifications) as outlined below in Section 00 21 14.31.

00 21 14.4 Subcontractors

00 21 14.4.1 Subcontractor List Form
In compliance with Contract, the Contractor shall list on the Subcontractor list form provided in Section 00 43 36, the names of **all** qualified subcontractors and/or suppliers he will employ for the various portions of the work indicated for this Project. **All technical**
sections of this specification shall be included. Failure to provide complete list of subcontractors (FS#3) may be considered non-responsive. In addition to the general information required on that form, the Contractor shall provide the license number and class for each subcontractor proposed to do work under the contract. Failure on the part of the Contractor to completely list the names of all anticipated subcontractors may constitute sufficient grounds to reject the bid.

If the Contractor is going to do any portions of the work themselves, they shall enter the word "Self" opposite that item in the list; list only one name for each item.

Include the Subcontractor List inside bid packet. No subcontractor substitutions will be permitted without prior written approval by the Owner.

A complete up-to-date revised list of Subcontractors shall be submitted to the Owner with indications of any work performed by Subcontracting firms classified as minority owned or small businesses, and final contract values, as part of the close-out procedures prior to Final Payment.

The Owner will promptly reply to the Contractor in writing stating if the Owner or the DP, after due investigation, has any objection to any such proposed subcontractor or supplier. The Contractor shall not employ any subcontractor or supplier against whom the Owner or the DP has reasonable objection. If, prior to the award of the Contract, the Owner or DP has a reasonable objection to any subcontractor or supplier and refuses in writing to accept such person or organization, the apparent low bidder may, prior to the award, either withdraw his bid without forfeiture of bid security or may propose an acceptable substitution thereof provided that same results in no change in the bid price. Failure of the bidder to submit an acceptable substitute in a timely manner shall render its bid non-responsive.

No substitution or change shall be made by the Contractor in the subcontractor/supplier list after its submission to the Owner without prior written approval by the Owner. Unapproved or untimely substitutions may be cause for invalidation of the Contractor's bid in the Owner's discretion, thereby rendering the Contract voidable.

All work performed for the Contractor by a subcontractor shall be pursuant to an appropriate written agreement which specifically binds the subcontractor to all applicable terms and conditions of the Contract Documents, but no contractual relationship shall exist between any subcontractor or supplier of any tier and the Owner. Upon request, the Contractor shall provide fully executed copies of any subcontracts and purchase orders to the Owner.
The Owner may require each Subcontractor whose subcontract amount will be $100,000 or more to furnish payment and performance bonds on Owner’s form or on a form approved by Owner, which provides equal or better coverage, for the full amount of its subcontract. These bonds shall be obtained by the Subcontractor as a separate entity and the cost shall be included in the Subcontractor’s bid to the Contractor. Bonds will guarantee the faithful performance of the subcontract and the payment of all obligations thereunder by the subcontractor. The Contractor shall provide Owner with a copy of each required Subcontractor’s bond, within fourteen (14) calendar days after the Notice to Proceed is issued by the Owner. Copies of all applicable bonds must be received before processing of the first pay application will occur.

00 21 14.4.3 Subcontractor Insurance
All Subcontractors are required to maintain insurance in force according to the Construction Agreement.

00 21 14.5 Addenda
Any addenda issued by the Owner during the time of bidding shall be considered to be included in the bid and will become a part of the executed contract. Acknowledgement of receipt of Addenda shall be made on the Form of Bid (FS #1) in the space provided.

Final Addenda shall be issued a minimum of three (3) days prior to the bid date.

If a Bidder should fail to receive any addendum, or should fail to acknowledge receipt of same, the Bidder shall have the option of accepting a contract, if offered, including all addenda, at the Bid price, or withdrawing the bid without penalty. NAU and/or the DP are not responsible for ensuring delivery of addenda to any Bidder. Failure to receive addenda or failure to acknowledge receipt shall not constitute a basis for claim, protest, or re-issue of the invitation to bid.

00 21 14.6 Submittal of Bids
Copies of the Form of Bid (FS#1), Bid Bond (FS#9) or Certified Check or Cashier’s Check for ten percent of the amount of the bid, Subcontractors List (FS#3), and other documents required to be submitted with Bid per Section 00 43 13 (see required forms, Section 00 43 13) shall be enclosed in sealed, opaque envelope. Address envelope to Facility Services, identifying project name, Bidder’s name and address.

If Bid is sent by mail to PO BOX 5637, Flagstaff, AZ, 86011, a sealed envelope shall be enclosed within a separate mailing envelope with "BID ENCLOSED" and identification of the Project and date and time for bid opening plainly indicated on the face thereof.

Offerors dropping off bids in person are required to wear a face mask. When dropping off bids in person, social distancing measures apply. NAU reserves the right to turn away Offerors who do not comply with these requirements.
Bids must be received at the designated location prior to time and date for receipt of Bids indicated in advertisement. If received after the time and date for receipt of Bids, or any extension thereof made by Addendum, the bid package will be returned unopened.

Bidder assumes full responsibility for timely delivery of bids. Bids sent by mail that have not been delivered to Facility Services, Building 77, Front Reception Desk by the designated time of the bid opening will not receive consideration; including specifically, but not limited to, bids received by NAU Post Office but not delivered to the bid opening location.

Electronic, oral, telephonic, FAXES, or telegraphic Bids are invalid and will be considered non-responsive.

Immediately following the bid submittal deadline, the bids will be publicly opened via a ZOOM meeting. Attendance in person by Offerors or the public is not allowed. The weblink to attend the ZOOM meeting is below.

**Supplementary Instructions**

**Drawings and Schedules**
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>00 22 11.1</td>
<td>Complimentary Drawings</td>
</tr>
<tr>
<td></td>
<td>Upon award of Contract, the Contractor will be furnished any available sets of Plans, Specifications, and project manuals, if any. Additional sets may be printed from: <a href="https://in.nau.edu/facility-services/bids-rfq/">https://in.nau.edu/facility-services/bids-rfq/</a>.</td>
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<tr>
<td>00 22 11.2</td>
<td>Interpretation of Drawings and Specifications</td>
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<tr>
<td></td>
<td>The Contractor shall study and compare the Contract Documents sufficiently in advance of bidding the work to be performed and immediately report any material error, inconsistency, conflict, ambiguity, or omission that is discovered.</td>
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<td></td>
<td>The Contract Document specifications for the applicable Contract in use can be found at <a href="https://in.nau.edu/facility-services/dp-contract/">https://in.nau.edu/facility-services/dp-contract/</a>.</td>
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<td>The Drawings are intended to show general arrangements, design and extent of Work and are not intended to serve as Shop Drawings. Where required, the Contractor shall perform no portion of the Work without approved Shop Drawings, Product Data or Samples; any Work performed in violation of this provision will be solely at the Contractor’s risk regardless of DP’s and/or Owner’s knowledge of such Work.</td>
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<td>Contract Documents shall be interpreted as being complementary, requiring a complete project or designated portion thereof. Generally, the specifications address quality, types of materials and contract conditions while the drawings show placement, sizes, and fabrication details of materials. In the event of conflict in the Contract Documents, the priorities stated below shall govern:</td>
</tr>
<tr>
<td>A.</td>
<td>Addenda shall govern over all other Contract Documents;</td>
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<tr>
<td>B.</td>
<td>Subsequent addenda shall govern over prior addenda, but only to the extent modified;</td>
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<tr>
<td>C.</td>
<td>In case of conflict between drawings and specifications, the specifications shall govern;</td>
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<tr>
<td>D.</td>
<td>Conflicts within the plans:</td>
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<td></td>
<td>(1) Schedules, when identified as such, shall govern over all other portions of the plans.</td>
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<td>(2) Specific notes shall govern over all other notes and all other portions of the plans, except the schedules described in 00 22 11.2 D (1) above.</td>
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<td>(3) Larger scale drawings shall govern over smaller scale drawings.</td>
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<td>(4) Figured or numerical dimensions shall govern over dimensions obtained by scaling.</td>
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<td>E.</td>
<td>Conflicts within the specifications:</td>
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<td>Contract General Conditions shall govern over all sections of the specifications except for specific Modifications thereto that may be stated in Supplementary General Conditions or addenda. No other section of the specifications shall modify the Contract General Conditions.</td>
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<td>Section Number</td>
<td>Title</td>
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<td>F. In the event provisions of codes, safety orders, Contract Documents, referenced manufacturer's specifications or industry standards are in conflict, the more restrictive or higher quality shall govern.</td>
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<td>G. In the event of any conflict or ambiguity, the Contractor shall request an interpretation by the DP before performing the Work.</td>
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<td>H. In the event of any conflict between the Specifications and Northern Arizona University Technical Standards, the Contractor shall notify the Owner for direction prior to bid. Otherwise the more restrictive or higher quality shall govern.</td>
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<td>If the Contract Documents are not complete as to any minor detail of a required construction system or with regard to the manner of combining or installing of parts, materials, or equipment, but there exists an accepted trade standard for good and skillful construction, such detail shall be deemed to be an implied requirement of the Contract Documents in accordance with such standard.</td>
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<td>“Minor detail&quot; shall include the concept of substantially identical components, where the price of each such component is small even through the aggregate cost or importance is substantial, and shall include a single component which is incidental, even though its cost or importance may be substantial.</td>
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<td>The quality and quantity of the parts or material so supplied shall conform to trade standards and be compatible with the type, composition, strength, size, and profile of the parts or materials otherwise set forth in the Contract Documents.</td>
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<tr>
<td>00 23 00</td>
<td>Definitions</td>
</tr>
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<td>Definitions set forth in General Conditions of the Standard Form Agreement Between Owner and Contractor, or in other Contract Documents are applicable to Bidding Documents. Definitions below are in addition to the definitions of the Contract Documents and are not considered a replacement.</td>
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<td>Alternate Bid(s): A sum stated in addition to the Base Bid for which Bidder offers to perform Work described as the alternate. The Owner may select all, none or any combination of alternates.</td>
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<td>Approved: Where used in conjunction with the DP’s response to Submittals, requests, applications, inquiries, reports and claims by the Contractor, the meaning of the term &quot;approved&quot; will be held to the limitations of the DP’s responsibilities and duties as specified in the General and Supplementary Conditions. In no case will &quot;approval&quot; by the DP be interpreted as a release of the Contractor from responsibilities to fulfill the requirements of the Contract Documents.</td>
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<td>Base Bid: A sum stated in the Bid for which Bidder offers to perform Work described as base, to which Work may be added or deducted for sums stated in Alternate Bid(s).</td>
</tr>
</tbody>
</table>
Bid: A complete and properly signed proposal to do the Work or designated portion thereof for some stipulated sum therein supported by data required in Bidding Documents.

Bidder: One who submits a Bid for prime Contract with Owner for Work described in the Contract Documents.

Bidding Documents: Include Advertisement for Bids, Instructions to Bidders, Bid Form, other bidding and Contract forms and Contract Documents including Addenda issued prior to receipt of bids.

Contract Documents: Are further defined per Agreement at the following link: https://in.nau.edu/facility-services/dp-contract/, and also include, but are not limited to, the Agreement, amendments, change orders, these Design-Builder General Conditions, any supplementary or special conditions referenced in the Agreement and any other items stipulated to as being included in the Contract Documents, including the complete design as accepted by the Owner.

Furnish: Except as otherwise defined in greater detail, the term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

Install: Except as otherwise defined in greater detail, the term "install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

Installer: The entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application, cleaning and similar required operations.

Provide: Except, as otherwise defined in greater detail, the term "provide" means furnish and install, complete and ready for the intended use, as applicable in each instance.

Work: Is comprised of all activities (including design, other related services and construction activities) required to complete the Project as defined by the Project Criteria and Contract Documents, including procuring and furnishing all materials, equipment, services, and labor reasonably inferable from the Contract Documents, or from prevailing trade usage and custom.
This project consists of a renovation of the 1st and 2nd floors of the Science Annex Building (#20) on the NAU Flagstaff Mountain Campus. The basement level of the Science Annex will also require incidental work, mainly for mechanical infrastructure and fire protection.

The 1st floor will be converted to classroom spaces, offices and labs. The exterior entrances will be renovated as well as the existing restrooms as part of the base scope package.

The 1st floor lobby was completed in a previous phase and will remain. Renovation work in two large lecture halls on the first floor will be bid as Add Alternates.

The 2nd floor renovation will create space for the relocation of the Center for Science Teaching and Learning (CSTL), which is currently housed on the 5th floor of Building #36. The scope of work for the 2nd floor includes creation of classrooms, storage area, conference room, team rooms and general office space, in what will be a near total demolition and renovation of the interior space.

The scope of work includes:

- Demolition of existing interior partitions and finishes throughout with the exception of the existing floors to be encapsulated.
- Full interior architectural renovation of 1st and 2nd floors including existing restrooms.
- Removal of old and installation of new mechanical and electrical systems on 1st and 2nd floors.
- New A/V and data system for 1st and 2nd floor with tie-in to existing PONS.
- New fire protection system for basement, 1st and 2nd floors.

Alternate #1: (Lecture Hall 106)
Alternate #2: (Lecture Hall 113)
Alternate #3: (High Density Storage Room 221)
Alternate #4: (Resilient Flooring at Wet Lab 220)

A mandatory Pre-Bid Conference will be held via ZOOM on Tuesday, June 30, 2020 at 2:00PM Arizona Local Time. Pre-Registration for the Pre-Bid Conference ZOOM meeting is required. Registration for this meeting can be done at the following link: https://nau.zoom.us/meeting/register/tJwvde6vqzsG9PmxxcNW8vApdpw4y1WNNPN.

After registering, you will receive a confirmation email containing information about joining the meeting.
Facility Services, Planning, Design, and Construction Staff and DP will be present to discuss technical aspects of the project. **All Bidders are required to be represented in order for their bid to be accepted by Owner.**

**00 25 13.1 Pre-Bid Site Inspection**

**OPTIONAL PRE-BID SITE VISITS:** Site visits are optional and will be held on July 6 and 7, 2020, between the hours of 9:00 AM and 4:00 PM Arizona Local Time. Offerors interested in attending a site visit need to contact Kelly Davis (O: 928-523-2481, C: 928-386-9171, kelly.davis@nau.edu) to arrange. Visits will be held with each Offeror individually and Offerors shall bring no more than 3 attendees. NAU Covid-19 protocol applies (masks required, social distancing measures).

No other formal inspection tours should be anticipated. Bidders should come prepared to gather all on-site information necessary for preparing proposal. A Bidder may arrange for supplemental site visits as necessary to prepare a responsive proposal. It is the responsibility of the Bidders to thoroughly familiarize themselves with all conditions and matters, which may in anyway affect the Work or cost thereof.

No allowance shall be made on behalf of any contractor or subcontractor for errors due to his/her negligence in not being familiar with existing site and/or project conditions.

**00 25 13.1.1 Supplementary Site Visits**

Arrangements for supplemental visits to the job site are to be made through:

NAU Facility Services
Planning, Design and Construction
Contact Kelly Davis per contact information in 00 25 13.1
Northern Arizona University
Flagstaff, Arizona  86011

**00 26 00 Substitution Procedures**

For Competitive Sealed Bid Procurements (Hard Bid and Task Order Procurement):

If Bidder wishes to submit a product for consideration, refer to the Substitution Request Form (located in 00 43 25). Product Substitution Requests must be received 10 days before bid opening. Product Substitution Requests shall be submitted in accordance with 00 21 13.1. All other process of the below section will be followed.

Requests shall clearly describe the product for which approval is asked, including data necessary to demonstrate acceptability. The Owner and DP shall consider and either approve or reject proposals submitted. The Bidder’s request for approval shall include the following:

a. Complete data substantiating compliance of the proposed substitution with the Contract Documents.
b. Product identification, including manufacturer's name, address and phone number.
c. Manufacturer's literature showing complete product description, performance and test data, and all reference standards.
d. Samples and colors in the case of articles or products, as appropriate.
e. Name and address of similar projects on which the product was used and date of installation.
f. For construction methods, include a detailed description for proposed method and drawings illustrating same.
g. Itemized comparison of proposed substitution with product or method specified.

Substitution requests shall be made on the Substitution Request Form included with the Bid Forms.

The decision of the Owner or DP regarding the approval of items for which substitution is requested will be final. In the event an approved substitution is later determined by the Owner or Design Professional to be unacceptable for any reason, including the necessity to perform extended redesign or rework of the project in order to accommodate the substitution, or if it becomes apparent to the Design Professional that the substituted item will not perform or function as well as the specified item, the Bidder will be required to furnish the original specified item or request approval to use another substitution. The Bidder will pay all costs, expenses or damages associated with or related to the unacceptability of a substitution and the resultant utilization of any item. The Bidder further understands and agrees that a time extension will not be granted due to delays associated with or related to the unacceptability of a substitution.

If a substitution is approved, no subsequent change in brand or make will be permitted unless satisfactory written evidence is presented to the Design Professional and approved by the Owner that the manufacturer cannot make scheduled delivery of the approved substitute item.

**END OF SECTION**
00 30 00  Available Information
00 31 00  Available Project Information
00 31 13  Preliminary Schedule
00 31 13.13  Preliminary Project Schedule

First Advertisement:  June 25, 2020
Pre-Bid Conference:  June 30, 2020 at 2:00 PM Arizona Local Time via ZOOM
Bid Date:  July 17, 2020 by 11:00 AM Arizona Local Time
Construction Start:  September 1, 2020
Phase 1 Substantial Completion:  March 1, 2021
Phase 1 Final Completion:  June 1, 2021
Phase 2 Substantial Completion:  January 10, 2021
Phase 2 Final Completion:  April 10, 2021

00 31 13.16  Preliminary Construction Schedule
NA

00 31 19  Existing Condition Information
Building is existing facility.

00 31 21  Survey Information
NA

00 31 24  Environmental Assessment Information
NA

00 31 25  Existing Material Information
NA

00 31 26  Existing Hazardous Material Information (see next page)
NORTHERN ARIZONA UNIVERSITY FORM FS-13: WORKPLACE HAZARD NOTIFICATION
FOR CONTRACTORS AND SUBCONTRACTORS:

- ASBESTOS/LEAD/PCBs
- RADIATION
- BIOLOGICAL
- CHEMICAL
- OTHER

PROJECT NAME: ______________________________ NAU PROJECT#: __________

This form is used to provide Contractors and Subcontractors working at Northern Arizona University. NAU maintains comprehensive material/safety inspections and safety programs for campus buildings. Test results and safety programs are available for review in the NAU Office of Environmental Health & Safety (EH&S). The following known and assumed hazards have been identified to be present in the work area located in Building(s):

_________________________________________________________

Room(s): __________

_________________________________________________________

_________________________________________________________

_________________________________________________________

_________________________________________________________

NAU is responsible for informing you of the presence of hazards in your project work area on the NAU campus. If you encounter any other previously unidentified hazards, stop all work immediately and contact the NAU Project Manager or EH&S. By law, Employers must provide training and/or protection for employees who will be working with or near hazards, including those covered by this notification. The responsible party signing below agrees that it is the Contractor's or Subcontractor's responsibility to be knowledgeable of and comply with all applicable local, state, federal laws and university policies related to the hazards detailed in this form.

Your signature below acknowledges that you have received notice from NAU that hazardous materials are or may be present in your work area(s), and that you agree to fully assume the responsibility for ensuring the safety of yourself and your employees, which includes ensuring that you comply with all applicable local, state, and federal laws, and university policies governing hazardous materials.

If you have questions, please contact NAU EH&S at 928-523-6435.

Company Name: ______________________________

Name of Responsible Party: ___________________________ Title: ___________________________

Signature: ___________________________ Date: ___________________________

Contractor shall complete, sign, and submit Form FS-13 to:
Northern Arizona University
Purchasing and Contract Services
Box 4124
Flagstaff, AZ 86011
Telephone: 928-523-4557
Fax: 928-523-1343

No work shall be authorized nor shall it commence prior to completion and return of Form FS-13 to the University at the address above by the contractor.

Approved EH&S Preparer ___________________________ Date: ___________________________
<table>
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<tr>
<th>Section Number</th>
<th>Title</th>
<th>NA</th>
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<tbody>
<tr>
<td>00 31 31</td>
<td>Geophysical Data</td>
<td>NA</td>
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<tr>
<td>00 31 32</td>
<td>Geotechnical Data</td>
<td>NA</td>
</tr>
<tr>
<td>00 31 43</td>
<td>NAU Permit Application</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>The NAU permit application and procedure can be found at <a href="https://in.nau.edu/facility-services/dp-contract/">https://in.nau.edu/facility-services/dp-contract/</a>.</td>
<td></td>
</tr>
<tr>
<td>00 31 46</td>
<td>Other Permits</td>
<td>NA</td>
</tr>
</tbody>
</table>

**END OF SECTION**
The undersigned hereby proposed, and agrees to furnish all labor, material, transportation, supervision and services necessary to complete all work as called for in the plans and specifications, and that the lump sum bid includes all applicable costs of bonds, insurance, permits, and fees, and sales tax, or any applicable taxes. The Owner’s selection will be made on a Bid (pre-tax) price per ABOR policy 3-803 A 7. The contract will be issued for the lump sum amount, inclusive of the tax.

We acknowledge the following addenda and have included their provisions in this proposal.

**Addendum No.** | **Dated**
--- | ---

**BASE BID:** The undersigned proposes to complete all work as required per the Specifications, for a Lump Sum of:

Bid (pre-tax): \( \text{Dollars} \)

\( ($\ ) \).

Taxes: \( \text{Dollars} \)

\( ($\ ) \).

Cumulative Bid: \( \text{Dollars} \)

\( ($\ ) \).

**Additive Alternatives:**

**Alternate #1:** (Lecture Hall 106) The undersigned proposes to complete all work as required per the Specifications, for a Lump Sum of:

Bid (pre-tax): \( \text{Dollars} \)

\( ($\ ) \).

Taxes: \( \text{Dollars} \)

\( ($\ ) \).

Cumulative Bid: \( \text{Dollars} \)

\( ($\ ) \).
Alternate #2: (Lecture Hall 113) The undersigned proposes to complete all work as required per the Specifications, for a Lump Sum of:
Bid (pre-tax): ___________________________ Dollars
($) ___________________________.
Taxes: ___________________________ Dollars
($) ___________________________.
Cumulative Bid: ___________________________ Dollars
($) ___________________________.

Alternate #3: (High-Density Storage Room 221) The undersigned proposes to complete all work as required per the Specifications, for a Lump Sum of:
Bid (pre-tax): ___________________________ Dollars
($) ___________________________.
Taxes: ___________________________ Dollars
($) ___________________________.
Cumulative Bid: ___________________________ Dollars
($) ___________________________.

Alternate #4: (Resilient Flooring at Wet Lab 220) The undersigned proposes to complete all work as required per the Specifications, for a Lump Sum of:
Bid (pre-tax): ___________________________ Dollars
($) ___________________________.
Taxes: ___________________________ Dollars
($) ___________________________.
Cumulative Bid: ___________________________ Dollars
($) ___________________________.

All Additive Alternates are additive to the Base Bid. For each Additive Alternate, Bidders are instructed to provide only the incremental difference in cost of adding that particular work to the project scope of work. Do not provide cumulative costs that include values already included in the Base Bid as NAU will be evaluating bids and considering bid award based on the sum of the Base Bid and any combination of Additive Alternates.

Enclosed herewith is a cashier's check or Bid Bond (NAU form FS#9) made payable to the Owner in the amount of $ __________, which is not less than 10% of the amount of the total bid proposal, as a guarantee that the undersigned will furnish required Performance Bond and Labor and Material Bond, and enter into contract, on basis of above proposal.

Undersigned further agrees that said check (or Bid Bond) shall be forfeited as Liquidated Damages (no penalty) if undersigned fails to enter into contract after requested to do so by Owner.
Bids shown above are valid for a period of 60 days after the date of opening bids, and may be withdrawn following that date if no contract has been awarded.

The undersigned understands that the Owner reserves the right to reject any or all bids, or to waive any informality in receipt of the above Proposal. **Owner reserves the right to award by Base Bid alone, by the sum of Base Bid and any combination of Additive Alternate Amounts, or as the sum of the Base Bid and all the Additive Alternate Amounts, whichever is deemed most advantageous to Owner.**

It is hereby understood and mutually agreed by and between the Contractor and the Owner that the date of beginning, rate of progress, and time of completion of the Work as set forth in the contract documents are of the essence of the contract. The amount of **$50.00 per calendar day for Phase 1** and **$500.00 per calendar day for Phase 2** will be assessed against the contract for work not completed at the Substantial Completion date. Said amounts shall accrue until such time that the Work covered under this contract is complete, not as a penalty, but as Liquidated Damages.

In addition, it is mutually agreed by and between the Contractor and the Owner, the amount of **$50.00 per calendar day for each phase** will be assessed against the contract for work not completed at the Final Completion date. Said amounts shall accrue until such time that the Work covered under this contract is complete, not as a penalty, but as Liquidated Damages.

The Proposer hereby certifies that he/she is the holder of a valid Contractor's License in accordance with Arizona State Law and that such license classification allows the Contractor to perform the type of construction identified by these Bid Documents. **The proposer also certifies that he/she holds all of the required certifications and licenses outlined in the bidding documents and shall provide proof of all certifications, licenses and warranties within 5 days of Owner notification to the apparent low bidder with the Intent to Award.**

If corporation, __________________________________________

Company/Corporation

________________________________________________________________________

Signature Date

________________________________________________________________________

Signature Arizona License Class and Number
KNOW ALL MEN BY THESE PRESENTS, that we

(Here insert full name and address or legal title of Contractor)

as Principal, hereinafter called the Principal, and

(Here insert full name and address or legal title of Surety)

a corporation duly organized under the laws of the State of

(Here insert the name of the State of incorporation)

as Surety, hereinafter called the Surety, are held and firmly bound unto

(Here insert full name and address or legal title of Owner)

as Obligee, hereinafter called the Obligee, in the sum of Dollars ($__ ), for the payment of

(Here insert full name, address and description of project)

which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for

(Here insert full name, address and description of project)

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contractor and give such bond or bonds, it the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this __________________ day of ______________________, 20__.  

(Principal)   (Seal)

(Witness)

(Title)

(Surety company)   (Seal)

(Witness)
MATERIAL/EQUIPMENT SUBSTITUTION REQUEST FORM

TO: ________________________________

PROJECT: ________________________________

We hereby submit for your consideration the following product instead of the specified item for the above project:

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
<th>Paragraph/Line</th>
<th>Specified Item</th>
</tr>
</thead>
</table>

Proposed Substitution: **Product Identification** – include manufacturer’s name, address, and phone number

Attach complete product descriptions, drawings, photographs, performance and test data, manufacturer literature, samples and colors in the case of articles or products, and other information necessary for evaluation.

Similar projects on which the product was used (include Project, Owner, Owner’s Contact information, Location, and date):

1. __________________________________________
2. __________________________________________
3. __________________________________________

A. Will changes be required to building design in order to properly install proposed substitution?
   Yes ___ No ___. If Yes, explain: ________________________________

B. Will the undersigned pay for changes to the building design, including engineering and drawing costs, caused by requested substitution? Yes ___ No ___.

C. What differences exist between proposed substitution and specified item?
   ________________________________
   ________________________________

D. Does substitution affect Drawing dimensions: Yes ___ No ___. If yes, explain: ________________________________

E. What affect does substitution have on other trades?
   ________________________________
   ________________________________
F. Does Manufacturer's warranty of proposed substitution differ from that specified?  
Yes ___ No ___. If yes, explain. ______________________________________________________________

G. Will substitution effect progress schedule? Yes ___ No ___. If yes, explain: __________________________

H. Will substitution require more license fees or royalties than specified product?  
Yes ___ No ___. If Yes, explain ______________________________________________________________

I. Will substitution differ in cost from the specified product? Yes ___ No 
If yes, explain how much __________________________

J. Will maintenance and service parts be locally available for substitution?  
Yes ___ No ___. If no, explain __________________________

K. What is the code impact of this substitution request? Specify the section(s) of the applicable code(s) this impacts. 
__________________________________________________________________________________________

__________________________________________________________________________________________
Proposer is to list every subcontractor and supplier proposed to be employed on the above project as required by the bidding documents. All Sections of the specifications must be included below. Any work proposed to be done by the Bidder should be listed as a line item with the word "Self" inserted under firm name. Designation of subcontractors is subject to University approval. No change in subcontractor's list will be permitted without the University's prior written consent. Failure to provide a complete list with all information may be considered non-responsive. Subcontractor List must be enclosed inside bid package per Section 00 43 36. All bidders must sign page 2 of this subcontractor list, even if all work will be self-performed.

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<th>WORK</th>
<th>LICENSE #</th>
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<th>CONTACT PERSON</th>
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I submit that the preceding is correct and current as of ________________________________.

[BID OPENING DATE]

[COMPANY] [AUTHORIZED REPRESENTATIVE] [DATE]
| Section Number | Title                                      | Notes  
<table>
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<tr>
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<tbody>
<tr>
<td>00 43 83</td>
<td>Proposed Construction Schedule Form</td>
<td>N/A</td>
</tr>
</tbody>
</table>
CONTRACTOR STATEMENT OF QUALIFICATIONS (FS#2)

(Failure to include the Statement of Qualifications within the bid packet will be considered non-responsive)

Fill in all blanks. If not applicable, insert "N.A."

COMPANY NAME:

CONTACT: __________________________ PHONE: __________________________ FAX: __________________________

YEARS IN BUSINESS UNDER ABOVE NAME: ___________________ YEARS IN BUSINESS IN ARIZONA: ___________________

ADDRESS:

CITY, STATE, ZIP: ________________________________________________________________

[ ] SOLE PROPRIETORSHIP  [ ] PARTNERSHIP  [ ] CORPORATION  [ ] STATE OF INCORPORATION
[ ] WOMEN-OWNED BUSINESS  [ ] MINORITY-OWNED BUSINESS  [ ] SMALL BUSINESS (LESS THAN $4M GROSS/YR OR LESS THAN 100 FTE)  CHECK ANY THAT APPLY TO YOUR BUSINESS

CONTRACTOR LICENSE NO: _______________________________ CLASS: _______________________________ STATE: _______________________________

BONDING COMPANY: _______________________________ AGENT: _______________________________

ANY OTHER BUSINESS NAMES USED: _______________________________ YEARS __ TO _______________________________

PAST PROJECT SIZE EXPERIENCE:

1. $10,000 - $100,000  # OF PROJECTS COMPLETED IN PAST 5 YEARS_______________________________
2. $100,000 - $500,000  # OF PROJECTS COMPLETED IN PAST 5 YEARS_______________________________
3. $500,000 - $2,000,000  # OF PROJECTS COMPLETED IN PAST 5 YEARS_______________________________
4. $2,000,000+  # OF PROJECTS COMPLETED IN PAST 5 YEARS_______________________________

PERCENTAGE OF WORK NORMALLY ACCOMPLISHED WITH YOUR OWN FORCES:

PRESENT NUMBER OF PERSONNEL:

WILL YOU EXPAND YOUR WORK FORCE FOR THIS PROJECT?  __________  HOW MANY?  __________________________

COMPUTER SOFTWARE USED FOR SCHEDULING PURPOSES: _______________________________

COMPUTER SOFTWARE USED FOR DOCUMENT TRACKING PURPOSES: _______________________________
REFERENCES: (BANK, TRADE, PROFESSIONAL)

1. [NAME] [ADDRESS] [PHONE NO.]

2. [NAME] [ADDRESS] [PHONE NO.]

3. [NAME] [ADDRESS] [PHONE NO.]

BY MY NOTARIZED SIGNATURE BELOW I HEREBY SWEAR THAT THE ANSWERS TO THE FOREGOING QUESTIONS AND ALL STATEMENTS HERE CONTAINED AND ATTACHED ARE TRUE AND CORRECT.

[CONTRACTOR NAME OR AGENT] [DATE]

SUBSCRIBED AND SWORN BEFORE ME THIS __________ DAY OF ____________, 20___.

NOTARY PUBLIC: ________________________________

MY COMMISSION EXPIRES: __________________________
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>00 50 00</td>
<td>Contracting Forms and Supplements</td>
</tr>
<tr>
<td>00 52 00</td>
<td>Agreement Forms</td>
</tr>
<tr>
<td>00 52 13</td>
<td>Agreement Form</td>
</tr>
</tbody>
</table>

The form of agreement between the Owner and Contractor shall be the Construction Agreement Between Owner and Contractor, Arizona Board of Regents. A copy of the latest version is available for review at on the website for information purposes only.

The aforementioned forms are hereby made a part of this Document and shall be binding to the same extent as if they were written in full herein.

**END OF SECTION**
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
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<tbody>
<tr>
<td>00 60 00</td>
<td>Project Forms</td>
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<tr>
<td>00 61 00</td>
<td>Bond Forms</td>
</tr>
<tr>
<td>00 61 13</td>
<td>Performance and Payment Bond Forms (see next two pages)</td>
</tr>
</tbody>
</table>
KNOW ALL MEN BY THESE PRESENTS:

That, ________________________________ (hereinafter called the Principal), as Principal, and ________________________________ a corporation organized and existing under the laws of the State of ________________________________, with its principal office in the City of ________________________________ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Arizona Board of Regents, (hereinafter called the Obligee), in the amount of ________________________________ Dollars ($____________________), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ day of _____________________________, 20___, to construct and complete a certain work described as ________________________________, which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extension thereof, with or without notice to the Surety and during the life of any guaranty required under the contract, and shall also perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived; then the above obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Board of Regents Policy Section 3-804E, and all liabilities on this bond shall be determined in accordance with the provisions of the section, to the same extent as if copied at length herein.

The prevailing party in a suit on this bond, including any appeal thereof, shall recover as a part of his judgment such reasonable attorneys' fees as may be fixed by a judge of the Court.

Witness our hands this _______ day of ________________________________, 20__.

__________________________          ____________________________
PRINCIPAL               SEAL                  SURETY               SEAL

By: ____________________________  

__________________________
Bond Number

Agent Name & Telephone

Agent Address

Bonding Company Address
Arizona Board of Regents PAYMENT BOND FS#5
PURSUANT TO BOARD OF REGENTS POLICY 3-804E
(Penalty of this bond must be 100% of the Contract Amount)

KNOW ALL MEN BY THESE PRESENTS:
That, ________________________________ (hereinafter called the Principal), as Principal, and ________________________________ a corporation organized and existing under the laws of the State of ________________________________, with its principal office in the City of ________________________________ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Arizona Board of Regents, (hereinafter called the Obligee), in the amount of ________________________________ Dollars ($__________________), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ ______ day of ________________________________, 20___, to construct and complete a certain work described as ________________________________, which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall promptly pay all monies due to all persons supplying labor or materials to him/her or his/her subcontractors in the prosecution of the work provided for in said contract, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Board of Regents Policy Section 3-804E, and all liabilities on this bond shall be determined in accordance with the provisions of the section, to the same extent as if copied at length herein.

The prevailing party in a suit on this bond, including any appeal thereof, shall recover as a part of his judgment such reasonable attorneys' fees as may be fixed by a judge of the Court.

Witness our hands this ______ day of ____________, 20__.

_______________________  __________________________
PRINCIPAL                SEAL                         SURETY        SEAL

BY: ______________________   BY: ______________________

_______________________
Bond Number

Agent Name & Telephone

Agent Address

Bonding Company Address

NORTHERN ARIZONA UNIVERSITY – Technical Standards
Updated 07/01/2018
CONTRACTORS SUBMITTAL TRANSMITTAL FORM

<table>
<thead>
<tr>
<th>PROJECT #:</th>
<th>CONTRACTOR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT NAME:</td>
<td>DATE:</td>
</tr>
</tbody>
</table>

TO (OWNER): Northern Arizona University
Facility Services
Planning, Design, & Construction
PO Box 5637
Flagstaff, AZ 86011

SUBMITTAL NO:
- [ ] New Submittal
- [ ] Resubmittal

THE FOLLOWING ITEMS ARE HEREBY SUBMITTED:

<table>
<thead>
<tr>
<th>Number of Copies</th>
<th>Description of Item Submitted (Type, Size, Model Number, Etc.)</th>
<th>Spec and Para. No.</th>
<th>Drawing or Brochure Number</th>
<th>Contains Variation to Contract</th>
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</thead>
<tbody>
<tr>
<td></td>
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</table>

CONTRACTOR hereby certifies that (i) CONTRACTOR has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

CONTRACTOR            SIGNATURE  PRINT         DATE

Arizona Board of Regents

OWNER         SIGNATURE  PRINT         DATE
## Certificate of Insurance Form (FS#6)

**ARIZONA BOARD OF REGENTS**

**CERTIFICATE OF INSURANCE (FS#6)**

**PROJECT NAME:** Science Annex 1st and 2nd Floor Renovation  
**NAU PROJECT #:** 09.200.201

<table>
<thead>
<tr>
<th>PRODUCER</th>
<th>COMPANIES AFFORDING COVERAGE</th>
<th>CURRENT A.M. BEST RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Insurance is to be placed with duly licensed or approved non-admitted insurers in the State of Arizona with an A.M. Best rating of not less than A- VII</td>
<td></td>
</tr>
</tbody>
</table>

| A      | B | C |

Contractor shall furnish Northern Arizona University with certificates of insurance (ACORD form or equivalent approved by the State of Arizona). The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates of endorsements are to be received and approved by Northern Arizona University before work commences. Each insurance policy required by this Contract must be in effect at or prior to commencement of work under this Contract and remain in effect for the duration of the project. Failure to maintain the insurance policies as required by this Contract, or to provide evidence of renewal, is a material breach of contract.

<table>
<thead>
<tr>
<th>CO LTR</th>
<th>TYPE OF INSURANCE</th>
<th>POLICY NUMBER</th>
<th>POLICY EFFECTIVE DATE (MM/DD/YY)</th>
<th>POLICY EXPIRATION DATE (MM/DD/YY)</th>
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<tbody>
<tr>
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<td>COMMERCIAL GENERAL LIABILITY</td>
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<td>PERSONAL &amp; ADV INJURY</td>
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<td>FIRE DAMAGE (Any one fire)</td>
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<td>AUTOMOBILE LIABILITY</td>
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<td>LIMITS</td>
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<td>ANY AUTO</td>
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<td>LIMITS</td>
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<td></td>
<td>PROFESSIONAL LIABILITY</td>
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<td>AGGREGATE</td>
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<td></td>
<td>EXCESS LIABILITY</td>
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<td>EACH OCCURRENCE</td>
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<td>AGGREGATE</td>
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<td>UMBRELLA FORM</td>
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<td>OTHER THAN UMBRELLA FORM</td>
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<td>WORKERS COMPENSATION AND</td>
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<td>STUDENT LIMITS</td>
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<td></td>
<td>EMPLOYERS' LIABILITY</td>
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<td>DISEASE-POLICY LIMIT</td>
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<td>DISEASE-EA EMPLOYEE</td>
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<td>$1,000,000</td>
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<td>BUILDERS RISK</td>
<td></td>
<td>FACE AMOUNT OF CONTRACT</td>
<td>$</td>
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</tbody>
</table>

THIS CERTIFICATE APPLIES TO ANY AND ALL PROJECTS AT NORTHERN ARIZONA UNIVERSITY. DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS:

> THE POLICIES FOR GENERAL LIABILITY AND AUTOMOBILE LIABILITY SHALL BE ENDORSED TO INCLUDE THE FOLLOWING ADDITIONAL INSURED LANGUAGE: "THE STATE OF ARIZONA, ITS DEPARTMENTS, AGENCIES, BOARDS, COMMISSIONS, UNIVERSITIES AND ITS OFFICERS, OFFICIALS, AGENTS, AND EMPLOYEES SHALL BE NAMED AS ADDITIONAL INSUREDS WITH RESPECT TO LIABILITY ARISING OUT OF THE ACTIVITIES PERFORMED BY OR ON BEHALF OF THE CONTRACTOR."

> IT IS AGREED THAT COVERAGES AFFORDED UNDER THE POLICIES CERTIFIED IN THIS CERTIFICATE SHALL BE PRIMARY FOR THE PERSON OR ORGANIZATION SHOWN IN THE SCHEDULE, BUT ONLY WITH RESPECT TO LIABILITY ARISING OUT OF YOUR WORK FOR THAT INSURED BY OR FOR YOU. OTHER INSURANCE AFFORDED TO THAT INSURED WILL APPLY AS EXCESS AND NOT CONTRIBUTE AS PRIMARY TO THE INSURANCE AFFORDED BY THIS ENDORSEMENT.

> IT IS FURTHER AGREED THAT SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL Endeavor TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER. THIS CERTIFICATE IS NOT VALID UNLESS COUNTERSIGNED BY AN AUTHORIZED REPRESENTATIVE OF THE INSURANCE COMPANY.

> POLICIES FOR GENERAL LIABILITY, AUTO LIABILITY, AND WORKERS’ COMPENSATION SHALL CONTAIN A WAIVER OF SUBROGATION AGAINST THE STATE OF ARIZONA, ITS DEPARTMENTS, AGENCIES, BOARDS, COMMISSIONS, UNIVERSITIES & ITS OFFICERS, OFFICIALS, AGENTS, & EMPLOYEES FOR LOSSES ARISING FROM WORK PERFORMED BY OR ON BEHALF OF THE CONTRACTOR.

<table>
<thead>
<tr>
<th>CERTIFICATE HOLDER/ADDITIONAL INSURED</th>
<th>AUTHORIZED REPRESENTATIVE OF THE INSURANCE COMPANY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORTHERN ARIZONA UNIVERSITY</td>
<td>FACILITY SERVICES</td>
</tr>
<tr>
<td>THE ARIZONA BOARD OF REGENTS</td>
<td>BOX 5637</td>
</tr>
<tr>
<td>THE STATE OF ARIZONA</td>
<td>FLAGSTAFF, AZ 86011</td>
</tr>
</tbody>
</table>

| SIGNATURE DATE |
00 62 23 Construction Waste Diversion Form
Owner participates annually in the best international sustainability assessment conducted by the Association for the Advancement of Sustainability in Higher Education (AASHE). Owner has been participating in AASHE’s Sustainability Tracking, Assessment, and Rating System (STARS) since 2011 and currently maintains a Gold Ranking. Participation in this program continuously gets NAU great rating’s in Sierra Club’s “Cool Schools” issue the Princeton Review’s “Greenest Schools” issue. This report collects information on, “Construction and Demolition Waste Diversion” which requires detailed tracking of all construction waste on campus. Contractors are required to track waste on certain projects. Confirm with Owner at the beginning of each project on whether or not it is needed. The FS 49 Construction Waste Tracking Log is located online at: https://in.nau.edu/facility-services/forms-index/.

00 62 34 Recycled Content of Materials Form
00 62 76 Application for Payment Form
All payments shall be made in accordance with the Agreement, and utilize the FS #11 for Contractors, the FS #60 for Design Builders, and the FS #98 for Design Professionals.

00 63 00 Clarification and Modification Forms
Many of the NAU forms are located at: https://in.nau.edu/facility-services/forms-index/

00 63 13 Request for Interpretation Form
00 63 19 Clarification Form
00 63 25 Substitution Request Form (During Construction)
Any substitutions to the specifications must be approved by Owner and DP using the Substitution Request Form in Section 00 43 25.

00 63 33 Supplemental Instruction Form
00 63 36 Field Order Form
00 63 43 Written Amendment Form
00 63 46 Construction Change Directive Form
This form can be located on the NAU Facility Services website.

00 63 57 Construction Change Proposal Request
This form can be located on the NAU Facility Services website, as FS #12.

00 63 63 Change Order Form
00 63 66 Contingency Use Authorization Form
This form can be located on the NAU Facility Services website.

00 63 69 Allowance Use Authorization Form
00 65 00  Closeout Forms

Closeout Forms and Other Project Closeout Requirements - may include but are not limited to the following:

A. Substantial Completion
   1. Fire Marshal Acceptance Alarm/Sprinkler and State Fire Marshal Acceptance Report
   2. State Elevator Inspection Report
   3. Insurance Carrier Certificate for Boiler Inspection
   4. Preliminary Balance Report
   5. Preliminary As-Builts
   6. Attic Stock
   7. Substantial Completion Project Inspection (FS #15)
   8. Punchlist Issued (FS#24)
   9. Certificate of Substantial Completion (FS#81)
   10. Schedule of Required Maintenance (FS#88)

B. Final Completion
   1. Final Balance Report
   2. Final As-Builts
   3. First Season Commissioning Complete
   4. Second Season Commissioning Complete
   5. Operations and Maintenance Manuals
   6. Electronic Copy of All Approved Submittals and Shop Drawings
   7. Special Warranties
   8. Keys Returned (FS#10)
   9. Project Final Inspection (FS#15)
   10. Punchlist Complete (FS#24)
   11. Project Warranty (FS#80)
   12. Certificate of Final Completion (FS#81A)
   13. Affidavit Non Use Asbestos Certificate (FS#83)

C. Final Payment
   1. Contractor Final Payment Application
   2. Final Subcontractor List (FS#82)
   3. All Subcontractor Lien Releases (FS#84)
   4. Consent of Surety to Final Payment Received (FS#88)
   5. General Contractor Lien Release (FS#89)
   6. Contractor Affidavit of Payment (FS#99)

Templates of the forms (FS#) can be found at: https://in.nau.edu/facility-services/forms-index/
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 65 14</td>
<td>Punchlist Form (FS#24)</td>
</tr>
<tr>
<td>00 65 15</td>
<td>Project Inspection Form (FS#15)</td>
</tr>
<tr>
<td>00 65 16</td>
<td>Certificate of Substantial Completion Form (FS#81)</td>
</tr>
<tr>
<td>00 65 17</td>
<td>Schedule of Required Maintenance Form (FS#88)</td>
</tr>
<tr>
<td>00 65 19</td>
<td>Certificate of Final Completion Form (FS#81A)</td>
</tr>
<tr>
<td>00 65 19.13</td>
<td>Affidavit of Payment (FS#99)</td>
</tr>
<tr>
<td>00 65 19.16</td>
<td>General Contractor Lien Release Form (FS#89)</td>
</tr>
<tr>
<td>00 65 19.17</td>
<td>Subcontractor Lien Release Form (FS#84)</td>
</tr>
<tr>
<td>00 65 19.19</td>
<td>Consent of Surety to Final Payment Form (FS#87)</td>
</tr>
<tr>
<td>00 65 19.19</td>
<td>Final Subcontractor List (FS#82)</td>
</tr>
<tr>
<td>00 65 36</td>
<td>Warranty Form (FS#80)</td>
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</tbody>
</table>

**END OF SECTION**
The General Conditions of the Standard Form Agreement Between Owner and Contractor, Arizona Board of Regents are hereby made part of the Contract Documents, as if they are included in the following pages. A copy is appended to the construction agreement and available for review at https://in.nau.edu/facility-services/dp-contract/ or information purposes only.

The General Conditions are a part of the Contract and shall be binding on the General Contractor and all Subcontractors as if bound into this document.

**Supplementary Conditions**

**Bonds and Certificates**

The Bid price shall include the cost of Payment and Performance Bonds. Bonds shall cover the faithful performance, labor and material (100%) of the Contract and payment of all obligations (100%) arising thereunder in the form prescribed in Arizona Board of Regents Policy 3-804E. Bonds shall be executed by Corporate Sureties licensed in Arizona. **Bonds must be submitted on the forms included in Section 00 61 13.**

**Performance Bond**

Pursuant to Arizona Board of Regents Policy, the Contractor shall file with the Owner, prior to the time of execution of the Contract, a Performance Bond on the Owner approved Form, referenced in, Section 00 61 13, in a penal sum equal to one hundred percent (100%) of the Contract. The Performance Bond must be executed on the above noted form. Substitutions will not be allowed. The Surety furnishing this bond shall be satisfactory to the Owner and shall be authorized to do business in the State of Arizona.

**Payment Bond**

Pursuant to Arizona Board of Regents Policy, the Contractor shall file with the Owner prior to the time of execution of the Contract, a Payment Bond on the Owner approved Form, referenced in Section 00 61 13, in a penal sum equal to one hundred percent (100%) of the Contract. The Payment Bond must be executed on the above noted form. Substitutions will not be allowed. The Surety furnishing this bond shall be satisfactory to the Owner and shall be authorized to do business in the State of Arizona.

**Certificates of Compliance with Applicable Laws and Regulations**

**Lien Releases**

Upon completion of this Project, and before final payment is made, the Contractor will furnish to the Owner one hundred percent (100%) Unconditional Lien Releases from all subcontractors, material dealers and other participants doing work under this Contract.
If payment to Subcontractors is outstanding pending final payment by the University to Contractor, or if for any other reason 100% Unconditional Lien Releases cannot be obtained from all subcontractors, the Contractor may provide the University with an indemnity bond.

00 73 16 Insurance Requirements
Insurance Requirements are defined by the contract.

00 73 19 Health and Safety Requirements
Beginning July 1, 2016, the use of all tobacco products, including those not approved by the FDA for cessation is prohibited on university property, facilities, grounds, parking structures, privately-owned vehicles and structures owned or leased by the University. This includes, but is not limited to, the use of cigarettes, e-cigarettes, hookah, e-hookah, chew, dip, snuff, cigars, pipes, vaporizers, etc.

00 73 34 Affirmative Action for Disabled Workers
Refer to [https://in.nau.edu/facility-services/dp-contract/](https://in.nau.edu/facility-services/dp-contract/) for specific requirements within the Construction Agreement.

00 73 36 Equal Employment Opportunity Requirements
Northern Arizona University is an equal opportunity employer and all contracts with the University are subject to the conditions and requirements of Executive Order No. 99-4 as stated below.

**EXECUTIVE ORDER No. 99-4**

PROHIBITION OF DISCRIMINATION IN STATE CONTRACTS, NON-DISCRIMINATION IN EMPLOYMENT BY GOVERNMENT CONTRACTORS AND SUBCONTRACTORS

**PART I:**

Non-discrimination in employment by government contractors and subcontractors.

All government contracting agencies shall include in every government contract hereinafter entered into the following provisions:

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

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

C. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding a notice to be provided by the agency contracting officer advising the labor union or workers' representative of the contractor's commitments under this Executive Order and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

D. The contractor will furnish all information and reports required by the contracting agency and will permit access to his books, records and accounts by the contracting agency and the Civil Rights Division for purposes of investigation to ascertain compliance with such rules, regulations and orders.

E. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations or order of the Arizona Civil Rights Division said noncompliance will be considered a material breach of the contract and this contract may be canceled, terminated or suspended in whole or in part, and the contractor may be declared ineligible for further government contracts until said contractor has been found to be in compliance with the provisions of this order and the rules and regulations of the Arizona Civil Rights Divisions, and such sanctions may be imposed and remedies revoked as provided in Part II of this order, and the rules and regulations of the Arizona Civil Right Division.

F. The contractor will include the provisions of paragraphs A through E in every subcontractor purchase order so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect in the subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in the event the contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the contractor may request the State of Arizona to enter into such litigation to protect the interests of the State of Arizona.

G. Each contractor having a contract containing the provisions prescribed in this section shall file and shall cause each of his subcontractors to file compliance reports with the contracting agency or the Civil Rights Division, as may be directed. Compliance reports shall be filed within such ties and shall contain such information as the practices, policies, programs and employment policies, programs and employment statistics of the contractor and each subcontractor and shall be in such form as the Arizona Civil Rights Division may prescribe.
H. Bidders or prospective contractors or subcontractors shall be required to state whether they have participated in any previous contract subject to the provisions of this order or any preceding similar Executive Order and in that event to submit on behalf of themselves and the proposed subcontractors compliance reports prior to, or as an initial part of negotiation of a contract.

I. Whenever the contractor or subcontractor has a collective bargaining agreement or other contract or understanding with a labor union or an agency referring workers or providing or supervising apprenticeship or training for such workers, the compliance report shall include such information from such labor unions or agency practices and policies affecting compliance as the contracting agency or Civil Rights Division may prescribe; provided that, to the extent such information is within the exclusive possession of a labor union or an agency referring workers or providing supervision apprenticeship or training and such labor union or agency shall refuse to furnish such information to the contractor, the contractor shall so certify the contracting agency as part of its compliance report and shall set forth what efforts he has made to obtain such information.

J. The contracting agency or the Civil Rights Division shall require that the bidder or prospective contractor or subcontractor shall submit as part of his compliance report a statement in writing signed by an authorized officer or agent on behalf of any labor union or any agency referring works or providing or supervising apprenticeship or other training with which the bidder or prospective contractor deals with supporting information to the effect that the signer’s practices and policies do not discriminate on the ground of race, color, religion, sex or national origin, and that the signer either will affirmatively cooperate in the implementation of the policy and provisions of this order or that it consents and agrees that recruitment employment and the terms and conditions of employment under the proposed contract shall be in accordance with the purpose and provisions of this order. In the event that the union or the agency shall refuse to execute such a statement, the compliance shall so certify and set forth what efforts have been made to secure such a statement and such additional factual material as the contracting agency or the Civil Rights Division may require.

PART II.

Enforcement

The parties to the contract agree that the Civil Rights Division may investigate the employment practices of the contractor or any subcontractor employed by the contractor or initiate an investigation by an appropriate contracting agency or determine whether or not any of the contractual provisions pertaining to discrimination in this contract have been violated. Such investigations shall be conducted in accordance with the procedures established by the Civil Rights Division, and the investigation agency shall report to the Civil Rights Division any action taken or recommended. The Civil Rights Division may receive and investigate or cause to be investigated complaints by employees or prospective employees of the contractor or subcontractor under this agreement which allege discrimination contrary to the contractual
provisions of this agreement. If the investigation is conducted for the Civil Rights Division by an agency other than the Civil Rights Division, that agency shall report to the Civil Rights Division what action has been taken or is recommended with regard to such complaint.

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
<th>URL</th>
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<tr>
<td>00 73 37</td>
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### Sudan, Iran & Israel

Refer to [https://in.nau.edu/facility-services/dp-contract/](https://in.nau.edu/facility-services/dp-contract/) for specific requirements within the Construction Agreement.

**No Boycott of Goods or Services from Israel.** If the Goods/Services provided under this Agreement include the acquisition of services, supplies, information technology or construction with a value of at least $100,000 and Supplier is engaged in for-profit activity and has 10 or more full-time employees, then, to the extent required by ARS § 35-393.01, Supplier certifies it is not currently engaged in, and during the term of this Agreement will not engage in, a boycott of goods or services from Israel.

By signing this form, Bidder certifies that it is not currently engaged in and agrees, for the duration of the Contract, to not engage in a Boycott of Israel.

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AN AUTHORIZED AGENT OF THE OFFEROR
SHALL SIGN THE PARTICIPATION IN BOYCOTT OF ISRAEL
Minority Business Enterprise Requirements
Refer to https://in.nau.edu/facility-services/dp-contract/ for specific requirements within the Construction Agreement.

Liquidated Damages
It is hereby understood and mutually agreed, by and between Contractor and Owner, that the date of beginning, rate of progress and the time for completion of the work to be done hereunder are essential conditions of this Contract; and it is further mutually understood and agreed that the work embraced in this Contract shall be commenced on the date to be specified in the Notice to Proceed, Notice of Award, Contract and/or Agreement.

The Contractor agrees that said work shall be prosecuted regularly, diligently and uninterruptedly at such rate of time he specifies. It is expressly understood and agreed, by and between the Contractor and Owner, that the time for completion of the work will be set by the Substantial and Final completion dates as identified in Notice to Proceed, Notice of Award, Contract and/or Agreement.

Now, if the said Contractor shall neglect, fail, or refuse to complete the Work by the specified date, then the Contractor does hereby agree, as a part consideration for the awarding of the Contract, to pay the Owner a certain sum, as outlined hereafter, per calendar day, until the Project is completed, not as a penalty, but as Liquidated Damages for each breach of contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the Contract for completing the work.

For each calendar day that any part of the work remains uncompleted after the expiration of the time specified and/or allowed for completion of the work stipulated in the contract or approved increase by the additional work or materials ordered after the contract is signed, effecting the critical path schedule of the project, the sum per day shall be deducted from any monies due the Contractor, or if no money is due the Contractor, the Owner shall have the right to recover said sum or sums from the Contractor, from the surety or from both.

It shall be understood that the time to complete the Project, beyond the contractual date of completion is in itself prima facie evidence of actual damages incurred, and the amount of these deductions are to cover the Liquidated Damages caused by the loss of use, or limited use, of the building and other additional Owner incurred losses, or expenses, including supervisory and consulting services, due to the failure of the Contractor to complete the work within the time specified.

The said amount is fixed and agreed upon by and between Contractor and Owner because of the impracticality and extreme difficulty of fixing and ascertaining the actual damages Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain.
It is further agreed that time is of the essence of each and every portion of this contract and of the specifications where a definite and certain length of time is fixed for the performance of any act whatsoever; and when under the Contract an additional time is allowed as hereinbefore mentioned for the completion of any Work, the new time limit fixed by such extension shall be of the essence of this Contract, provided that the Contractor shall not be charged with Liquidated Damages or any excess cost when the delay in completion of Work is due:

To unforeseeable cause beyond the control and without fault or negligence of the Contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather. The unusualness of the weather shall be determined by statistics from the local Weather Bureau over a period of the last 10 years. Upon request of the DP, the Contractor shall obtain statistical information from the Weather Bureau to support his claim for extension caused by unusual weather condition.

If the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or the DP, or by any separate Contractor employed by the Owner, or by changes in the Work, or by labor disputes, fire, unusual delay in transportation, unusually severe weather conditions, adverse soil conditions, unavoidable casualties, delays specifically authorized by the Owner, or by causes beyond the Contractor's control, avoidance, or mitigation, and without any fault or negligence of the Contractor or Subcontractor or Supplier at any tier, then the Contract Time shall be extended by Change Order for such reasonable time as the Owner may determine that such event has delayed the critical path of the Work or individual milestone or overall completion of the Work after considering the advice of the DP, if the Contractor complies with the notice and documentation requirements set forth below. The Contractor shall pay any additional fees or costs incurred by the Owner or DP as the result of delays caused by the Contractor for circumstances not excused as provided herein.

Initial notice of any delay in the Work shall be made in writing to the DP and Owner immediately but in no event later than 24 hours after discovery of the event giving rise to the delay. Then, Contractor shall provide additional details of the delay in writing to the DP and the Owner within seven (7) calendar days from the beginning of the delay. Failure to meet these time requirements shall absolutely bar any and all later claims. The detailed notice shall indicate the cause of the delay, the anticipated length of the delay, the probable effect of such delay upon the progress and cost of the Work, and potential mitigation plans. If the cause of the delay is continuing, the Contractor must give written notice every month at the same time it submits the updated progress Narrative Report to the DP. Within fifteen (15) days after the elimination of any such delay, the Contractor shall submit further documentation of the delay and, if applicable, a formal written request covering an extension of time for such delay. The written request for time extension shall state the cause of the delay, the number of days extension requested and provide a fully documented analysis of the Progress Schedule, including a fragment and any other data demonstrating a delay in the critical path of the Work or individual milestone or the overall...
project completion. If the Contractor does not comply with the notice and documentation requirements set forth above, the claim for delay is absolutely barred.

Schedule of Liquidated Damages shall be as follows:

Substantial Completion:  
Phase 1 $50.00  
Phase 2 $500.00  

(Dollar Amount)

for every day beyond the scheduled date of Substantial Completion through to and including the date indicated on the Official Certificate of Substantial Completion when issued by the DP.

Final Completion:  
$50.00  

(Dollar Amount)

for every day beyond the date of Final Completion as established in the Contract Documents and per the Construction Agreement. Work to be completed prior to a determination of Final Completion includes the fulfillment of all Contractual requirements, including the completion of all punch list items and Contract Closeout documents.

**Value Engineering Change Proposals (VECP)**

**General**
This clause applies to any cost reduction proposal (hereinafter referred to as a Value Engineering Change Proposal (VECP)) initiated and developed by the Contractor for changing the drawings, designs, specifications, or other requirements of this contract. This clause does not, however, apply to any such proposal unless it is identified as a VECP by the Contractor at the time of its submission to the Owner.

**Definition**
All VECP’s must:
Result in a savings to the Owner by providing a decrease in the cost of the performance of this contract without impairing any required functions and characteristics such as service life, reliability, economy of operation, ease of maintenance, desired appearance, standardized feature, fire protection features, safety features.

Require, in order to be applied to this contract, a change order to this contract.

**Proposal Screening**
The Contractor will present anticipated proposals to the DP for proposal screening. During this screening, the DP will render an opinion as to the relative merits of the proposal.

The DP will provide as a part of the screening, the minimum technical content requirements to be submitted by the Contractor as a part of the formal VECP.
CONCURRENCE by the Owner and the DP with merits of the proposal during the screening is not to be assumed that the VECP will automatically be accepted.

In the event a VECP is received which has not had the proposal screening, it may be rejected without review.

VECP Content
As a minimum, the following information must be submitted by the Contractor with each VECP.

A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance. A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

A separate, detailed cost estimate for (1) the affected portions of the existing contract requirement and (2) the VECP.

A description and estimate of costs the University may incur in implementing the VECP, such as test and evaluation and operating and support costs.

A prediction of any effects the proposed change would have on collateral costs to the agency.

A statement of the time by which a Change Order accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous University actions, if known.

The Contractor may withdraw, in whole or in part, a VECP that has not been accepted by the Owner within the period specified in the VECP.

Owner Action
The DP shall notify the Contractor of the status of the VECP within 30 days after submitted for review. If additional review time is required, the DP shall notify the Contractor of this within the original 30-day period. The Owner or DP shall not be held liable for any delays in acting upon a VECP.

If a VECP is not accepted, the DP shall notify the Contractor in writing, explaining the reasons for rejection. The notice of rejection shall be submitted within the review period referenced above.
Any VECP may be accepted, in whole or in part by the Owner. The Owner may modify a VECP, with the concurrence of the Contractor, to make it more acceptable. If any modification increases or decreases the savings resulting from the VECP, the Contractor's fair share will be determined on the basis of the VECP as modified. Unless and until a change order applies a VECP to this contract, the Contractor will remain obligated to perform in accordance with the terms of the existing contract. The Owner may accept in whole or in part any VECP submitted pursuant to this clause by issuing a change order which will identify the VECP on which it is based.

**END OF SECTION**
DIVISION 1 – GENERAL REQUIREMENTS

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Northern Arizona University is seeking a qualified contractor to carry our renovations to the 1st and 2nd floors of the Science Annex Building (#20) on the NAU Flagstaff Mountain Campus. The basement level of the Science Annex will also require incidental work, mainly for, demolition, mechanical infrastructure and fire protection.

The 1st floor will be converted to classroom spaces, offices and labs. The exterior entrances will be renovated as well as the existing restrooms as part of the base scope package. With the exception of MEP upgrades, the 1st floor lobby was renovated as part of a previous project and will not require further renovation as part of this project. Renovation work in two large lecture halls on the 1st floor will be bid as Add Alternates.

The 2nd floor renovation will create space for the relocation of the Center for Science Teaching and Learning (CSTL), which is currently housed on the 5th floor of Building #36. The scope of work for the 2nd floor includes creation of classrooms, storage area, conference room, team rooms and general office space, in what will be a near total demolition and rebuilding of the interior space.

The scope of work includes:

- Demolition of existing interior partitions and finishes throughout with the exception of the existing floors to be encapsulated.
- Full interior architectural renovation of 1st and 2nd floors including existing restrooms.
- Removal of old and installation of new mechanical and electrical systems on 1st and 2nd floors.
- New A/V and data system for 1st and 2nd floor with tie-in to existing PONS.
- New fire protection system for basement, 1st and 2nd floors.

If using Division 1 for subcontractor bid packages the Contractor shall incorporate applicable language from Contractor’s Construction Agreement with Owner.
01 14 16  Coordination with Occupants
Communication with the occupants is to be sent through the Owner. Impact requests shall be requested a minimum of 5 business days prior to the proposed starting time. Requests may not be approved and may be rescheduled to meet occupant needs.

01 14 19  Use of Site
Use of the site is restricted to materials and equipment necessary to completion of the Work. It is the Contractor’s responsibility to ensure enclosure of the site from the general public.

01 18 00  Project Utility Sources

01 18 13  Utility Service Connections
The Contractor shall prearrange time with the DP and Owner whenever it becomes necessary to energize new services or interrupt any service to make connections, alterations or relocations and shall fully cooperate with the Owner in doing Work so as to cause the least annoyance and interference with the continuous operation of the Owner’s business or official duties. Following this meeting the Contractor shall submit a work authorization request that will include a detailed description and procedure for each task, schedule for each task, any safety controls being implemented and signoff locations for tasks completed. The work authorization request will be similar to the document identified in 29 CFR 1910.147 App A and must be approved by the Owner (trade supervisor for the intended utility). The work authorization document is considered a submittal subject to the review periods indicated in the contract but in no case less than 5 business days and must be approved prior to scheduling work.

Any existing utility distribution or internal plumbing, heating, ventilating, air conditioning or electrical disconnections which may affect portions of existing buildings or other construction projects must be coordinated with the DP and Owner to avoid any disruption of operation. While bidding, the Contractor shall assume that all shutdowns shall occur during afterhours and/or weekends unless specifically stated otherwise in the contract documents. In no case, unless previously approved in writing by Owner, shall utilities be left disconnected at the end of a workday or over a weekend. Any interruption of utilities shall be reported immediately to the Owner (Project Manager). Such interruptions, whether negligently, intentionally, or accidentally, shall not relieve the Contractor’s responsibility for the interruption or from liability for loss or damage caused by such interruption even though such loss or damage was not foreseeable by Contractor or subcontractor, or from responsibility for repairing and restoring the
utility to normal service. Repairs and restoration shall be made before the Contractor leaves the project site.

**END OF SECTION**

01 20 00 PRICE AND PAYMENT PROCEDURES

01 21 00 Allowances
The Contractor's price for the Work shall include all of the Contractor's costs associated with such allowance or allowances. If the actual costs to the Contractor of such allowance or allowances is different from the specified sum, increases or decreases in the cost of the allowance and associated Contractor's cost shall be adjusted in accordance with the Construction Agreement.

Use of Allowances must be requested and approved through the Allowance Use Authorization form.

00 21 00.1 List of Allowances
High Density Storage Structural Upgrades: $16,000 (this allowance should be included as part of Add Alternate #3)

01 22 00 Unit Prices
Lighting Fixtures: per type in Luminaire Schedule
Ceiling Fans in Lecture Halls: per fan

01 23 00 Alternates
Alternate #1: (Lecture Hall 106)
Alternate #2: (Lecture Hall 113)
Alternate #3: (High Density Storage Room 221)
Alternate #4: (Resilient Flooring at Wet Lab 220)

01 26 00 Contract Modification Procedures

01 26 13 Requests for Interpretation
Requests for Interpretation (RFI) will be sent electronically to the Owner (Project Manager) and the DP concurrently. The RFI must indicate the Owner’s project number, RFI #, spec section and plan sheet impacted, trades involved, images if applicable, a proposed solution and potential cost or time impact.

01 26 46 Construction Change Directives
Use Owner form FS #16 for all Construction Change Directives (CCD).
No changes in the work shall be undertaken by the Contractor without written direction by the Owner and DP (if a DP is on the project), either as a CCD or a Change Order.

**Proposal Requests**
Refer to Section 01 26 57

**Proposal Worksheet Summaries**
Refer to Section 01 26 57

**Construction Change Proposal Request**
The CCPR form is required to be completed by the Contractor with a detailed description and cost breakdown for each individual requested change. Please refer to FS#12 available at: [https://in.nau.edu/facility-services/forms-index/](https://in.nau.edu/facility-services/forms-index/). Refer to construction agreement for specific provisions.

**Change Orders**
No changes in the work shall be undertaken by the Contractor without written direction by the Owner and DP (if a DP on the project), either as a CCD or a Change Order. Any changes made without such written direction are done so at the Contractor's own risk. Change Orders shall be processed as identified in the construction agreement.

Change procedures must follow the requirements outlined in the Construction Agreement Between Owner and Contractor. A copy of the latest version of the Construction Agreement between Owner and Contractor is available at [https://in.nau.edu/facility-services/dp-contract/](https://in.nau.edu/facility-services/dp-contract/). Change orders are on Owner form FS #14.

**Payment Procedures**

**Schedule of Values**
Individual construction activities which are indicated by the Schedule of Values shall coincide with activities presented on the Contractor’s Construction Schedule. Contractor shall submit proposed schedule of values for review and approval by DP and by Owner, per the Construction Agreement between Owner and Contractor, prior to submission of first pay application.

**Progress Payment Procedures**
Contractor will submit requests for payment electronically to the Project Manager, DP and Owner (project manager and project assistant) concurrently.
Payments will be measured against the Schedule of Values as approved by the DP, Owner and CM (as applicable).

For all Testing and Inspection Services, the Testing and Inspection Log (FS#105) shall be completed and shall accompany each pay app for that billing period.

Payment procedures shall be per the Construction Agreement or by other method as directed by Owner. The Pay Application form can be found at: https://in.nau.edu/facility-services/dp-contract/.

**END OF SECTION**

01 30 00  ADMINISTRATIVE REQUIREMENTS

01 31 00  Project Management and Coordination

01 31 13  Project Coordination
Project coordination and communication procedures will be discussed in detail at the preconstruction meeting. The minutes of this meeting shall serve as reference and documentation of proper coordination and communication channels.

01 31 14  Facility Services Coordination
An emergency contact sheet will be provided to the Contractor with contacts for the Owner’s different departments in Facility Services. The Contractor will fill out with their emergency numbers and return to the Owner for distribution.

01 31 16  Multiple Contract Coordination
The Owner reserves the right to award other contracts related to the Project, or to perform certain work itself. Any such other work may or may not be known to the Owner or disclosed to the Contractor prior to execution of the Agreement. The Contractor shall allow the Owner and such other additional contractors to deliver and store the additional contractors’ or Owner’s materials and equipment and to execute the additional contractors’ or Owner’s work, and shall properly coordinate the Contractor’s Work with the additional contractors’ or Owner’s work in such manner as the Owner or Design Professional may direct. The Contractor shall also assure at the Contractor’s own cost reasonable access of additional contractors to the Contractor’s site and the Contractor’s work.

01 31 19  Project Meetings
Refer to the required project meetings in the Construction Agreement.

01 31 19.13  Preconstruction Meetings
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 31 19.14</td>
<td>Inspection Meeting</td>
</tr>
<tr>
<td>01 31 19.15</td>
<td>Blue Stake Meeting</td>
</tr>
<tr>
<td>01 31 19.16</td>
<td>Site Mobilization Meetings</td>
</tr>
<tr>
<td>01 31 19.23</td>
<td>Progress Meetings</td>
</tr>
<tr>
<td>01 31 19.33</td>
<td>Pre-Installation Meetings</td>
</tr>
</tbody>
</table>

A preconstruction meeting shall be held for all projects. Notification of the time and date of such conference shall be made to the selected Contractor in the Notice of Intent to Award, or via other coordination methods. The preconstruction meeting agenda (FS #21) is located online at: [https://in.nau.edu/facility-services/forms-index/](https://in.nau.edu/facility-services/forms-index/).

01 31 19.14 Inspection Meeting
A meeting will be held between Owner (including Project Manager, Building Official, applicable Trades Inspectors) and the Contractor to discuss inspection procedures and establish expectations. This may be a separate meeting from the preconstruction meeting or may be covered in the preconstruction meeting.

01 31 19.15 Blue Stake Meeting
Contractor and earthwork/underground foreman will coordinate a Blue Stake Kickoff Meeting prior to the start of Work to review the proposed schedule and blue stake requirements. This is a separate meeting from the preconstruction meeting.

01 31 19.16 Site Mobilization Meetings

01 31 19.23 Progress Meetings
Progress meetings shall occur on a regular basis (weekly) according to a schedule determined at the pre-construction conference or as established in the contract.

01 31 19.33 Pre-Installation Meetings
The Contractor shall schedule a pre-installation meeting before starting any trade work in the field, between the Owner’s Trade Inspector(s), the Contractor and subcontractor(s). The contractor performing the work (which may be the Contractor if self-performing or a subcontractor) must be in attendance at this meeting. The pre-installation meeting will review the installation and inspection protocol (quality control, workmanship expectations, means and methods etc.) and review project specifications and drawings with the Contractor and subcontractor(s). The pre-installation meetings shall be specified when applicable for the following work:
- Concrete formwork and placing
- Waterproofing
- Mortar / masonry
- Flashing
- Roofing
- Sealant
- Vapor Barrier
- Painting and Drywall
• Fire Sprinkler
• Fire Alarm
• HVAC
• Plumbing
• Electrical
• Datacomm/ITS
• Site Utilities
• Refer to FS#15 for additional requirements
• Owner may require additional pre-installation meetings depending on the scope of work.

Acknowledgement of the Pre-Installation Meeting is required on the FS#15 form prior to any inspections being performed.

Contractor shall schedule a subsequent inspection when 10 – 15% of the work reviewed in the pre-installation meeting to verify proper installation practices are implemented.

01 31 26 Electronic Communication Protocols
All communications on the project are to go through the Owner’s Project Manager.

01 32 00 Construction Progress Documentation

01 32 13 Scheduling of Work
In general, hours of construction activity shall be limited to 7 a.m. until 7 p.m., Monday through Friday, unless written approval is obtained from Owner (Project Manager). Additionally, the Contractor shall agree to limit any noisy activities during “reading week” and “finals week”. Reading Week and Finals Week generally occur during the first weeks of May and December.

Year-round, project work adjacent to or within Residence Halls shall be more strictly limited to the hours of 8:00 a.m. until 6:00 p.m., unless written approval is obtained from the Owner. In addition to these hours, work performed on weekends will not be permitted without prior authorization from Owner.

01 32 16 Construction Progress Schedule
The following requirements shall support and amplify the requirements of the Construction Agreement between Owner and Contractor.
In conjunction with the Contractor’s construction schedule, the Contractor shall provide a procurement schedule for all major project components to be purchased and incorporated by the Contractor into the project.

The procurement schedule shall indicate scheduled delivery of major project components, both equipment and materials, in support of the activities included on the Contractor’s construction schedule.

Revisions to the Contractor’s construction schedule shall be coordinated with revisions to the procurement schedule.

In the event significant delays or lags in schedule, as determined by the Owner, are encountered, the Contractor shall provide to the Owner a revised Contractor’s Construction Schedule indicating proposed rescheduling of subsequent activities to achieve project completion by the Contract Completion Time or Amended Completion Time.

Additions to or deletions from the Contract, authorized through Change Orders, shall be reflected in the Contractor’s construction schedule.

**Owner’s Approval of Phasing**

The Owner reserves the right to review and approve scheduling or phasing of construction activities.

Contractor shall be aware of the impact of construction activities on Owner’s functions and operations and shall advise the Owner when they may be impacted by the schedule. The Contractor shall act to lessen or avert impact to Owner operations through alternative phasing of activities or other measures.

01 32 19 Submittals Schedule

The Contractor is required to make submittals for the DP and Owner review in a prompt and timely manner. A schedule of submittals is to be delivered to the Owner within 10 days of the notice to proceed. Submittals are required for each subsection detailed in the individual sections of Divisions 2 through 48.

01 32 23 Survey and Layout Data

All underground utilities installed or exposed by Contractor shall have GPS points taken and indicated on the as-builts with utility descriptor, pipe size, material, and any other pertinent data. Points shall include any connections, valves, bends, rises/falls and points where other utilities are crossed. In the event that existing utilities are exposed during construction then 1 GPS point will be taken for every
10’ of exposed surface in addition to any connections, valves, bends, rises/falls and points where other utilities are crossed.

01 32 26 Construction Progress Reporting
The Contractor shall maintain a written daily log in accordance with the Construction Agreement.

01 32 33 Photographic Documentation
Photos are required on projects as determined by Owner, submitted electronically with pay application, and representative of the work for which the pay application is for. Photographs shall be a minimum of 5 megapixels. A description of photos required will be discussed at the preconstruction meeting. Each photo’s file name shall be labeled with first the location of the photo, direction of view and then description. Exterior locations must provide the location with GPS coordinates.

01 32 43 Procurement Tracking
Included in the Contractor’s critical path schedule, the Contractor shall provide procurement durations for all major project components (equipment and material) to be purchased (regardless if purchased by Owner or Contractor).

Expediting reports/schedule corrections shall be provided by the Contractor to the Owner in the event that scheduled deliveries, of a significant nature, do not arrive as planned and the Contractor shall make all reasonable effort to expedite deliveries in accordance with the original schedule.

Time submitted by the Contractor on the basis of delayed material or equipment deliveries, shall be accompanied by documentation from the vendor/supplier indicating the date order was placed, usual time required for delivery and the date of scheduled delivery.

01 33 00 Submittal Procedures
Provide complete submittals. Diagrams shall show installed component model numbers; block diagrams do not constitute an acceptable schematic. There shall be a separate submittal for each of the first-4 digits of the CSI divisions, as needed. For example, a separate submittal is needed for Division 26 05 as opposed to a submittal for Division 26 09.

01 33 13 Certificates
NA

01 33 16 Design Data

01 33 19 Field Test Reporting
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 33 23</td>
<td>Shop Drawings, Product Data, and Samples&lt;br&gt;The Submittal Procedure shall be per the requirements of the Construction Agreement.</td>
</tr>
<tr>
<td>01 33 29</td>
<td>Sustainable Design Reporting</td>
</tr>
<tr>
<td>01 33 29.06</td>
<td>Reused Product Form&lt;br&gt;NA</td>
</tr>
<tr>
<td>01 35 00</td>
<td>Special Procedures</td>
</tr>
<tr>
<td>01 35 13</td>
<td>Special Project Procedures&lt;br&gt;NA</td>
</tr>
<tr>
<td>01 35 13.26</td>
<td>Special Project Procedures for Clean Rooms&lt;br&gt;NA</td>
</tr>
<tr>
<td>01 35 13.43</td>
<td>Special Project Procedures for Contaminated Sites&lt;br&gt;NA</td>
</tr>
<tr>
<td>01 35 23</td>
<td>Owner Safety Requirements&lt;br&gt;The Contractor's responsibility for project safety is according to the Construction Agreement, which includes submitting a written safety plan to Owner and DP. This safety plan shall include the name and contact information of the contractor/vendor safety officer, emergency contact information, information on hazards likely to be encountered on the work site, work site PPE requirements, and any safety training requirements, training logs or proof of certification, and Job Hazard Analyses (JHA’s) for the planned activities (Blank JHA forms may be downloaded from <a href="https://in.nau.edu/facility-services/contractor-safety-plans/">https://in.nau.edu/facility-services/contractor-safety-plans/</a>). The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with Contractor's Work. The Contractor shall designate an employee as Safety Officer at the Project Site whose duties shall include prevention of accidents and monitoring/enforcement of the Contractor's safety program. The Contractor's Safety Officer shall attend the preconstruction meeting. The Contractor's Safety Officer will be responsible for continued monitoring of the job site to maintain safe working conditions in strict compliance with State of Arizona Occupational Safety and Health Standards for the Construction Industry.</td>
</tr>
</tbody>
</table>
(29 CFR Part 1926). Specific attention is called to Housekeeping (Section 1926.25, ADOSH, 29 CFR Part 1926).

The Contractor and all subcontractors shall clear away all debris which poses an unsafe condition as required in Section 1926.25 on a daily basis.

Failure of the Contractor to promptly correct unsafe conditions, subsequent to written notification by the Owner, shall constitute violation of the standards indicated herein. The Owner reserves the right, in the event of such violation, to correct unsafe conditions through the most expedient means available. Any costs incurred by the Owner for such corrective work shall be reimbursed by the Contractor, via deductive Change Order.

01 35 26 Governmental Safety Requirements
All employees of the Contractor or subcontractors shall have adequate safety training for their respective facets of the work as specifically required by document #2254, Training Requirements and OSHA Standards and Training Guidelines (USDA, OSHA 1985).

01 35 29 Health, Safety, and Emergency Response Procedures
NAU's Emergency Response Call Sheet can be found at: https://in.nau.edu/environmental-health-and-safety/.

01 35 29.13 Health, Safety, and Emergency Response Procedures for Contaminated Sites
This information can be obtained from the Owner’s Office of Environmental Health & Safety.

01 35 43 Environmental Procedures
The Owner shall have first right of refusal on all materials and equipment which are removed as part of the Project construction process to include materials both above and below the existing ground surface.

Contractor shall notify the Owner prior to disposing of such materials and equipment. Owner will notify the Contractor promptly if possession is to be taken by the Owner.

Materials not claimed by the Owner within three working days shall be removed from the Project site by the Contractor and disposed of appropriately.

Hazardous Materials Procedures
The Contractor shall inform Owner (Office of Environmental Health & Safety (EH&S) and the Project Manager) of any hazardous chemicals they will be using on campus. The Contractor shall comply with the requirements specified in OSHA's
Hazard Communication program (29 CFR 1910.1200). The Contractor shall assume responsibility for the safe and legal disposal of all chemicals used on the job site. If any hazardous waste is generated on site as a result of a project, please contact Owner (EH&S) for determination of whether the waste must be disposed of in accordance with EPA regulations.

**Lead Abatement**
This information can be obtained from the Owner (EH&S).

**Asbestos Abatement**
NAU has completed asbestos surveys for the majority of buildings currently present on the Flagstaff Campus and remote campuses. Survey results are housed in the NAU Asbestos Program office and are available for review or notification purposes.

To maintain compliance with all applicable state and Federal EPA and OSHA regulations, Owner’s policy requires that a site-specific asbestos inspection be completed to determine the need for abatement before any work involving the disturbance of pre-existing building components is conducted. This inspection and any other required asbestos information and guidance may be requested directly by calling the Material Safety office at (928) 523-6435, or by completing the online asbestos inspection request (https://in.nau.edu/facility-services/asbestos-lead-and-pcbs/). Asbestos inspections may involve additional sampling of previously untested materials, and may facilitate the need for NESHAP notified abatement work, so an appropriate amount of lead time must be allotted in the project schedule.

All asbestos-containing materials (ACM) which are scheduled for disturbance are to be removed, containerized, and disposed of in accordance with all applicable Federal, State, and Local regulations. This work must be performed by NAU or by a licensed asbestos abatement contractor before any other work which may impact the materials in question. Work must be scheduled and performed in a manner which minimizes the chance of contamination of non-asbestos materials. The asbestos removal work must comply with the NESHAP (40 CFR 61, subpart M), AHERA (40 CFR 763, subpart E), and OSHA Asbestos construction standard (29 CFR 1926.1101) and general industry standard (29 CFR 1910.1001), whichever may apply.

Abatement activities are the responsibility of Owner and may not be subcontracted as part of the larger construction project without prior authorization from the Owner’s Material Safety Office. In cases which abatement is performed by the Contractor, or by a subcontractor retained by the Contractor, the Contractor or abatement subcontractor must meet the minimum
qualifications and insurance for abatement contractors under the Arizona state purchasing system. When abatement is necessary, the Owner’s Project Manager will work in cooperation with Owner’s EH&S to develop specifications, collect bids, and contract/comlete any necessary abatement independently from the larger construction contract and unless otherwise authorized by Owner (EH&S), abatement shall be completed prior to any other construction activities at the work site.

Oversight for abatement services shall be conducted by Owner, or by an approved third-party oversight contractor. No additional demolition or renovation activities may proceed in the selected abatement area until appropriate clearance of the work by the oversight contractor and/or Owner. The oversight contractor or Owner will have the authority to stop work immediately if abatement or demolition procedures are found to be inadequate to control the release of asbestos fibers, or if asbestos is being disturbed in an uncontrolled or unsafe manner.

Owner will issue a written or verbal authorization to proceed with non-asbestos demolition/renovation activities following achievement of acceptable clearance of the asbestos abatement. Prior to authorization to proceed, the oversight contractor or Owner (Asbestos Program Manager) must complete a visual inspection and/or analytical sampling of the area to document completeness of the work. If contamination is found following abatement, the abatement contractor will be required to perform additional cleaning until acceptable levels are achieved, at no additional cost to the Owner. No other non-asbestos work may commence until all necessary abatement has been completed and authorization to proceed has been furnished by the Owner (Material Safety office).

It is the responsibility of the construction or demolition contractor to furnish an accurate work schedule to the Owner in order to allow for timely abatement and good coordination between vendors. The construction/demolition contractor may be held accountable for additional fees incurred by the Owner due to improper scheduling or communication on the part of the Contractor.

Following completion of all abatement activities, the abatement/oversight contractor shall provide copies of closeout documents including the date, location, and scope of work, negative exposure assessment and air sampling data, daily logs, and waste shipment records. Copies of all closeout documents shall be furnished to both the Owner’s Project Manager and Owner’s Material Safety office.

To satisfy its obligations under OSHA, Owner will issue a written notification of the presence of asbestos and other hazards in the work area and building which work
is being conducted in; and specific abatement requirements which may be required for the project. The Contractor is responsible for the health and safety of its own employees and for meeting OSHA communication of hazard, training, and PPE requirements. Worker compliance with all applicable regulations will be enforced by the Contractor.

The Contractor shall comply with:

The National Emission Standard for Hazardous Air Pollutants (NESHAP), 40 CFR 61, subpart M, enforced by the Arizona Department of Environmental Quality, regulating the removal and disposal of asbestos-containing materials.

The abatement contractor will be required to notify the State of Arizona Department of Environmental Quality NESHAP office 10 business days before removal of threshold amounts of friable asbestos or RACM as specified in 40 CFR 61.145. The Contractor shall send a copy of this notice to the Owner’s Asbestos Program Manager. A NESHAP notification is also required 10 days prior to commencement of demolition of any building on Owner campus even if no asbestos abatement is required. Filing of the Demolition NESHAP notification is the responsibility of the demolition or construction contractor.

During and following completion of the renovation, all newly installed building materials shall be analyzed for asbestos and a report containing the analytical results shall be furnished to the Owner’s Material Safety Office to maintain complete records of NAU buildings in the future. Testing shall conform to the guidelines set forth in the EPA AHERA regulation. This testing shall be conducted by an AHERA certified building inspector and if requested, shall be conducted by the renovation/construction contractor. This is an inspection sign off item in the Owner’s FS #15 form and final sign off will not be furnished without completion of the inspection and review of the resulting report by the Owner’s Material Safety office.

**Blasting Policy**

Blasting is not a preferred process on campus. Any use of explosives must be approved in writing by NAU Fire Marshal and must conform to The City of Flagstaff policies and procedures. The City of Flagstaff maintains jurisdiction for all blasting.

The Contractor shall submit to Owner prior to any blasting, appropriate employee certification for use of explosives.
No explosives will be stored on the campus overnight or weekends. No quantity of explosives will be brought to the campus beyond that which will be used on the day blasting operations are to be performed.

No blasting shall take place earlier than 8 a.m. or later than 5 p.m.

01 35 43.13 Environmental Procedures for Hazardous Materials
NA

01 35 43.16 Environmental Procedures for Toxic Materials
NA

01 35 46 Indoor Air Quality Procedures
NA

01 35 53 Security Procedures
Contractor is responsible for securing access to all construction areas to prevent damage or theft. This may include but is not limited to securing site fencing, temporary construction and building entrances. Work within tunnels must be in accordance with 01 41 19 Rules.

Refer to Construction Agreement for any additional security requirements.

01 35 63 Sustainability Certification Project Requirements
NA

01 35 66 Sustainability Certification Project Procedures
NA

01 35 91 Historic Treatment Procedures
NA

**END OF SECTION**
01 40 00  QUALITY REQUIREMENTS

01 41 00  Regulatory Requirements

Any work performed on or within the boundaries of the Northern Arizona University campus shall be subject to special inspections, periodic inspections, Code compliance inspections, and pre-occupancy and/or final inspections by the following agencies as applicable:

- State Fire Marshal's Office
- Arizona Corporation Commission
- State Boiler Inspector
- State Risk Management Division
- City of Flagstaff, including Dark Sky ordinance
- Coconino County
- State Elevator Inspector
- NAU Facility Services
- National Emissions Standards for Hazardous Air Pollutants (NESHAP)
- Arizona Department of Environmental Quality

It is the responsibility of the Contractor to provide a complete copy of the construction plans, specifications and other pertinent documents as necessary for review and approval by the necessary agencies.

No construction shall commence until the Contractor receives from NAU Fire Marshal and NAU Building Official the approved stamped copy of the construction plans, permit, and other documents provided.

01 41 13  Codes and Standards

All design and construction work shall be done in such a manner that the completion of project is in compliance with the following codes and standards the Owner has adopted as code. When reference is made to "this code" it shall mean all the codes listed below. In the event there is a conflict between any of these codes and standards, the most restrictive code shall apply.

- International Building Code 2018 (IBC)
- International Existing Building Code 2018 (IEBC)
- International Plumbing Code 2018 (IPC)
- International Mechanical Code 2018 (IMC)
- National Electrical Code 2017 (NEC) (NFPA 70)
- International Fuel Gas Code 2018 (IFGC)
- International Fire Code 2018 (IFC)
- National Fire Alarm Code 2016 (NFPA 72)
- Installation of Sprinkler Systems 2016 (NFPA 13)
**DIVISION 1 – GENERAL REQUIREMENTS**

- NAU Fire Code (Most recent edition unless otherwise required)
- Arizona State Fire Code
- 2010 ADA Standards for Accessible Design as approved by the Department of Justice on July 26, 2010 (published in the Federal Register on September 15, 2010) and any more recent related Federal and State requirements with their related standards as they may apply.
  - FYI: Please be advised that where there is a conflict between any applicable accessibility requirements the most restrictive shall apply (e.g. 2017 IBC, 2010 ADA, 2017 ICC/ANSI A117.1, other NAU, State & Federal requirements, etc.).
- 2007 American Society of Mechanical Engineers (ASME) A17.1, Safety Codes for Elevators and Escalators (unless otherwise required)
  - AZ Elevator Act (Title 23, Chapter 2, Article 12)
  - Latest ADOSH Arizona Elevator Rules
- AZ Executive Order 2008-29 (FYI: Reaffirms Executive Order 2005-05. Requires all new state-funded buildings to meet the Silver LEED standard, at a minimum.)
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 55 2010
- ASHRAE 62.12010
- ASHRAE 90.1 - 2010
- ASHRAE 189.1 - 2014
- ASHRAE 202 (Most recent edition unless otherwise required by Owner)
- Arizona Revised Statutes (ARS)
- Occupational Safety and Health Administration Regulations
- NAU Material Safety Policies (e.g. Program Manuals such as Asbestos, Lead, PCB, etc.) (Most recent edition unless otherwise required) http://nau.edu/Research/Compliance/Environmental-Health-and-Safety/
- IAQ Guidelines for Occupied Buildings Under Construction (Most recent edition unless otherwise required)
- ACGIH Industrial Ventilation Manual of Recommended Practices (Most recent edition unless otherwise required)
- ANSI/AIHA Z9.5 Laboratory Ventilation (Most recent edition unless otherwise required)
- NAU Design Guidelines and Technical Standards (Most recent edition unless otherwise required)

Compliance shall conform to the requirements of the latest editions of all state regulations and the various codes which have been adopted by the University at the time of selection of the Design Professional (or at time of bid if the University does not designate a Design Professional), unless otherwise required by Federal or State regulation (such as ADA code compliance which is required at time of bid).
Contractor will be held to have examined and to have become familiar with these regulations in all ways they apply to the project.

If a conflict is found between any Code requirement and information given in written or graphic specifications, Contractor will abide by the more stringent of the two. Such conflict shall be reported in writing to the DP and to Owner (NAU Fire Marshal, Building Official, and PM).

The issuance of approved plans, specifications, and computations shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of the above-listed codes, the NAU Fire Prevention Manual or the NAU Design Guidelines and Technical Standards.

The issuance of approved plans, specifications, and other data shall not prevent Owner from thereafter requiring the correction of errors in said plans, specifications and other data, nor shall issuance of such approved plans, specifications, or other data preclude the prevention of building operations being carried on there under when in violation of the above-listed codes.

By signing a contract with Owner or as a subcontractor to a general contractor that has a contract with Owner, the Contractor agrees to follow Owner’s Blue Stake procedure under ARS 40-360.22.

It is the responsibility of the Contractor to make all utility staking requests. To request utility staking for any project the Contractor must submit an E-Stake request through the Arizona811 Center (http://www.arizona811.com/e-stake/) and email Owner, per Blue Stake request form and process. All requests are given a log number. It is the Contractor’s responsibility to note that number for future reference.

For the complete Blue Stake Procedure, Contractor shall refer to https://in.nau.edu/facility-services/dp-contract/.

DO NOT DIG UNTIL BLUE STAKING HAS BEEN CLEARED! ALL KNOWN UTILITIES MUST BE POTHOLED!

If the excavation phase is completed more than a month prior to substantial completion, Contractor shall remove the blue stake marks outside of the fenced area in a manner that does not damage finished surfaces. All projects will remove
blue stake marks at substantial completion in a manner that does not damage finished surfaces. Note that the longer that the paint is on the ground the harder it is to remove.

01 41 19 Rules
The tunnels on campus are generally considered a non-permit required confined space. However, conditions may change without Owner knowledge. Prior to entry, contractors must supply their own atmospheric tester/monitor, complete an NAU Confined Space Entry Checklist, and submit this checklist to their safety officer and the Owner’s project manager. If through utilization of the checklist the area is to be considered a confined space, then the contractor is responsible for their confined space safety program. This must be submitted to the Owner’s project manager for documentation. Owner’s confined space program is located here: [https://in.nau.edu/wp-content/uploads/sites/226/2020/03/Confined-Space-Entry-Program.pdf](https://in.nau.edu/wp-content/uploads/sites/226/2020/03/Confined-Space-Entry-Program.pdf).

No one may enter the tunnel system alone. Anyone entering the tunnel system must make contact with Owner (PM and appropriate plant operator) to provide the section of tunnel being accessed, time of entry, purpose of work and approximate time frame. Contact must be made with the appropriate Owner (plant operator) when leaving the tunnels as well.

The entry checklist can be found at: [https://in.nau.edu/wp-content/uploads/sites/226/2020/03/NAUentrychecklist.pdf](https://in.nau.edu/wp-content/uploads/sites/226/2020/03/NAUentrychecklist.pdf)

01 41 23 Fees
If a Contractor requires a reinspection because the Contractor is unprepared for the initial inspection, a fee will be assessed. The fee will be charged at the inspector’s chargeout rate per hour spent, and no less than $200. This will be the Contractor’s expense.

01 41 26 Permit Requirements
NAU permit requirements and applications can be found at: [https://in.nau.edu/facility-services/dp-contract/](https://in.nau.edu/facility-services/dp-contract/).

01 43 00 Quality Assurance

01 43 23 Installer Qualifications
Reference Div 2-28

01 43 26 Testing and Inspecting Agency Qualifications
Reference Div 2-28
01 43 29  Code-Required Special Inspector Qualifications
NA

01 45 00  Quality Control

01 45 23  Testing and Inspecting Services
Please refer to https://in.nau.edu/facility-services/dp-contract/ for the complete detail of inspection procedures.

Re-inspection of uncompleted work shall be at the Contractor’s expense. See 01 41 23.

All Work must be inspected and accepted by Owner. Any work required to be inspected which is covered prior to inspection, must be uncovered by Contractor at Contractor’s expense.

Reinforcing steel or structural framework of any part of any building or structure shall not be covered or concealed without first obtaining approval of the DP or Structural Engineer.

Foundation Inspection: To be made after excavations for footings are complete and any required reinforcing steel is in place. For concrete foundations, any required forms shall be in place prior to inspection.

Concrete Slab or Under-Floor Inspection: To be made after all in-slab or under-floor building service equipment, conduit, piping accessories and other ancillary equipment items are in place, but before any concrete is placed or floor sheathing installed, including the sub-floor.

Frame and Rough-In Mechanical, Plumbing and Electrical Inspection: To be made after the roof, all framing, fire blocking and bracing are in place and all pipes, chimneys and vents are complete and the rough electrical, plumbing, and heating, pipes and ducts, and fire sprinkler piping are approved.

Lath and/or Gypsum Board Inspection: To be made after all lathing and gypsum board, interior and exterior, is in place but before any plastering is applied or before gypsum board joints and fasteners are taped and finished.

Substantial Completion Inspection: Prior to issuance of the Substantial Completion Certificate, all required in progress inspections listed in form FS#15 shall be passed. The Contractor must schedule a walkthrough with each trade inspector
individually to sign off on the substantial completion lines of the FS#15 and provide a punch list.

Final Completion Inspection: Prior to Final Payment the Contractor must schedule an additional walk with each trade inspector ensure that all punch work is completed and inspected, and all required inspections listed in form FS#15 shall be passed.

01 45 26  Plant Inspection Procedures
Materials must be inspected by Owner (Landscape Architect) prior to install.

01 45 33  Code-Required Special Inspections and Procedures
NA

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

01 51 00  Temporary Utilities
Temporary construction utility connections are to be approved by Owner (Utility Services department) and shall be metered.

01 51 13  Temporary Electricity
GC to specify.

01 51 16  Temporary Fire Protection
GC to specify.

01 51 23  Temporary Heating, Cooling, and Ventilating
GC to specify.

01 51 26  Temporary Lighting
GC to specify.

01 51 29  Temporary Natural-Gas
Temporary natural gas is not allowed. Propane may be used for temporary heating.

01 51 33  Temporary Telecommunications
Temporary telephone service is available through Owner. Contractor is responsible for all connection, maintenance, and service fees.

01 51 36  Temporary Water
Temporary water connections must have a backflow prevention device with meter, obtained from Owner (Plumbing department) and installed by the Contractor.

01 52 00  Construction Facilities
The Contractor shall provide a staging plan/site logistic plan at the preconstruction meeting. The staging plan shall clearly identify the following items:
- Construction Trailer
- Material Staging
- Wash down areas (concrete, mud, etc.)
- Dumpsters
- Traffic Control including signals and barricades
- Signage
- Site Fencing including gate locations and height of the fence
- Site Access for contractors, material delivery and waste haul off
• Sanitary Facilities
• Temporary Utilities
• Temporary Parking
• SWPPP measures
• ADA accessible routes
• Pedestrian/bikes routes
• Vehicle routes
• Emergency Access

Any other provision, direction or accommodation agreed to and approved by Owner, the Contractor and DP, shall be clearly noted and conveyed on the staging/site demolition plan.

01 52 13  Field Offices and Sheds
Location of field office must be approved by Owner. All utilities to the field office must be metered. Area must be restored to its original condition when field office is removed, including demolition of utilities back to the source.

01 52 19  Sanitary Facilities
Contractors shall not use Owner’s sanitary facilities. Contractors are responsible for providing and maintaining adequate temporary sanitation facilities and indicate location(s) on the site logistics plan.

01 55 00  Vehicular Access and Parking

01 55 13  Temporary Access Roads
Optimum truck routes and access roads, including fire department access, to the Project site shall be identified at the pre-construction conference and noted in the site logistics plan.

01 55 19  Temporary Parking Areas
All persons driving or parking on the NAU campus are subject to NAU parking regulations. Owner’s parking policies are available at https://in.nau.edu/university-transit-services/.

All vehicles parking within campus boundaries must display permits. Vehicles without permits will be ticketed by the NAU Police Department or Parking Services. Vehicles parked within the fenced staging / storage area, identified on the Construction Documents, do require parking permits. The Contractor will be required to make a written request to the Owner (Project Manager) at the preconstruction meeting for parking permits for all vehicles to be parked within the campus boundaries. NAU Parking Services will attempt to meet requests for specific parking areas, however, due to availability; alternative parking areas may
<table>
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<th>Section Number</th>
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<tr>
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<td>be assigned. Storage / Staging areas will be requested in writing to the Owner (Project Manager) prior to bidding. They are not guaranteed to be approved where requested, but Owner will attempt to make the best accommodations possible.</td>
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<tr>
<td>01 55 26</td>
<td>Traffic Control</td>
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<td>All traffic control shall be coordinated with the Owner’s Project Manager, and shall be approved by: NAU Parking Services, NAU Shuttle Services, NAU Police Department, NAU Fire Marshal, NAU Office of Environmental Health &amp; Safety and City of Flagstaff Fire Department. All proposed traffic control plans or modifications shall be submitted to the Owner’s Project Manager five (5) working days prior to the change and receive approval, as stated above.</td>
</tr>
<tr>
<td>01 55 29</td>
<td>Staging Areas</td>
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<td></td>
<td>The Contractor shall submit a site logistics plan at the preconstruction meeting. Storage / Staging Areas must be maintained and returned to the condition they were in prior to occupation by the Contractor. Patch, repair or replace any and all damaged areas upon completion of the work. The area must receive final inspection and approval by the Owner prior to final payment.</td>
</tr>
<tr>
<td>01 56 00</td>
<td>Temporary Barriers and Enclosures</td>
</tr>
<tr>
<td>01 56 16</td>
<td>Temporary Dust Barriers</td>
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<td>Dust control is the Contractor’s responsibility at no additional cost to the Owner. The Contractor shall address complaints regarding dust control within four (4) hours. Air, water, surface, and subgrade conditions shall be protected from pollution by the Contractor. Such protection requirements as detailed in all State and Federal regulations shall apply. Arizona State DEQ, OSHA, and NAU Office of Environmental Health &amp; Safety may inspect for compliance without notice.</td>
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<tr>
<td>01 56 19</td>
<td>Temporary Noise Barriers</td>
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<td></td>
<td>Reference Phasing Plan</td>
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<tr>
<td>01 56 26</td>
<td>Temporary Fencing</td>
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<tr>
<td></td>
<td>Project Site Fencing</td>
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<td>Contractor shall erect and maintain in good condition a six-foot high chain link fence of standard construction surrounding the Project site and enclosing the area of work and materials staging. Location of the fence shall be approved by the Owner prior to erection. Fence gates shall remain locked when unattended to discourage access by unauthorized persons.</td>
</tr>
</tbody>
</table>
This applies to large construction projects and small projects with multiple locations.

**Staging Area Fencing**
A commercial grade chain-link fence around the entire perimeter of the staging area will be required.

The fence may be ground-set or tee supported but must remain stable in high or gust wind conditions and scaling by pedestrians. The Contractor shall coordinate all fence pole locations that are to be pounded into the ground with Owner’s Landscape and Outdoor Services and Blue Stake to avoid shallow utilities and irrigation. The Contractor is responsible for all repairs required to return to area to original condition after fencing is removed, including, but not limited to, sod, asphalt and concrete repair.

Post holes in asphalt will be repaired using Fastpatch DPR Pourable Asphalt Repair. Using a hot or cold patch for the post holes is not allowed.

An 8’ wide, two section chain-link access gate shall be required in the fence and the Facility Services’ Project Manager and Construction Manager (as applicable) shall be given a key(s) to the gate lock by the Contractor for emergency access.

Fencing shall be placed immediately after or during site preparation and remain in place for the entire duration of construction.

The staging plan shall note that the Contractor is to maintain the fence in a neat and orderly appearance.

**Temporary Tree and Plant Protection**
Existing trees and plants designated to remain shall be fenced off outside the drip line (this includes all memorial trees). “Snow” or “Cyclone” fencing shall be green; orange is prohibited. No construction activity shall occur within fenced area. Provide site maintenance and control of erosion, weeds, snow, debris, etc. Irrigation is not a standard part of the blue stake procedure. The contractor is responsible for coordinating with Owner (Landscape and Outdoor Services) to determine location prior to bid. The Contractor shall be responsible for relocating/repairing any irrigation equipment.

Owner is a Tree Campus USA designated school, and specific guidelines to follow are located at: [https://in.nau.edu/green-nau/tree-campus-usa/](https://in.nau.edu/green-nau/tree-campus-usa/).
01 58 13  Temporary Project Signage
Free-standing or hanging signs for Contractors, Sub-contractors or suppliers are not allowed on University property. Site safety signage is allowed but must be approved by the NAU Project Manager.

01 58 16  Temporary Interior Signage

**END OF SECTION**
01 60 00 PRODUCT REQUIREMENTS

01 61 00 Common Product Requirements

01 61 13 Software Licensing Requirements

01 66 00 Product Storage and Handling Requirements
Refer to Agreement for information regarding on-site and off-site storage.

**END OF SECTION**
DIVISION 1 – GENERAL REQUIREMENTS

Section Number  Title

01 70 00  EXECUTION AND CLOSEOUT REQUIREMENTS

01 73 00  Execution

01 73 29  Cutting and Patching
Cutting and patching of asphalt and concrete may necessitate removal of embedded utility survey markers. The Contractor is required to field verify marker locations prior to bidding and include replacement of markers where necessary. Refer to Division 33 for installation standards. Verification of marker location requires signoff on the FS#15 prior to substantial completion.

01 74 00  Cleaning and Waste Management

01 74 13  Progress Cleaning
The Contractor shall maintain all work and staging areas in a clean and orderly condition to enhance the safety and appearance of the jobsite. Accumulations of refuse will not be permitted except as specifically approved in writing by the Owner.

Contractor is responsible for removal of Blue Stake markings and returning the site to its original condition.

01 74 16  Site Maintenance

01 74 19  Construction Waste Management and Disposal
The Contractor will identify waste diversion opportunities and track waste and recycling figures for each of their respective projects. Waste and waste diversion totals should be tracked on a monthly basis and entered into the project-specific spreadsheet FS #49.

The Contractor will provide proper and adequate trash containers at no additional cost to the Owner. These containers will be emptied at regular intervals so that trash will not be allowed to overflow and/or collect around the dump area.

The placing of trash or debris in any Owner trash container by the Contractor or any subcontractor is expressly forbidden. Contractor shall be responsible for costs incurred by the Owner for the removal of trash placed in Owner trash containers.

01 74 23  Final Cleaning
Provide final cleaning of the Work prior to Owner occupancy. Final cleaning shall mean cleaning each surface or unit of work to conditions expected in a new building and high-level maintenance program. Comply with manufacturer's
instructions for cleaning operations. Cleaning shall include but not be limited to all of the following as applicable:

- Clean transparent/reflective surfaces to a polished, streak free condition including all mirrors, windows and door glass. Remove all paint, putty, labels or other vision obscuring materials. Replace any broken or damaged surfaces.
- Remove marks, stains, fingerprints, other soil and dirt from painted, decorated or stained work.
- Clean polish and/or wax woodwork as preferred by Owner.
- Clean light fixtures and lamps so as to function at full efficiency. Remove dirt, dust, fingerprints, excess lubrication, drywall, paint etc. and all non-permanent labels.
- Wipe clean all mechanical and electrical equipment; remove excess lubrication and other substances.
- Clean exposed interior and exterior surface finishes to condition free of dirt, dust, stains, films or other noticeable distracting substance.
- Clean exterior and interior metal surfaces, including doors and windows, of oil, stains, dust, dirt, paint and the like.
- Clean and polish all hard floors, remove dirt, material or water stains, scratches etc.; clean and vacuum all carpeted areas.
- Clean plumbing fixtures to polished, sanitary condition free of stains including those resulting from water exposure.
- Except as otherwise indicated or requested by Owner, remove all temporary protection devices and facilities which were installed during the course of the work.

Make building ready for occupancy in all respects. Protect cleaned areas until final inspection and acceptance.

All existing improvements inside or outside the property which have been disturbed, damaged or destroyed by the Work under the Contract shall be restored to the condition in which they originally were, including all storage and staging areas. Final inspection of storage / staging areas used during construction is required prior to final payment.

If the Contractor fails to clean up during, or at the completion of the Work, or fails to enforce such clean up by subcontractors, the Owner, subsequent to advising the Contractor in writing, may after five (5) working days proceed to perform clean-up of areas which pose a threat to life/safety or are excessively unsightly. The cost of cleaning provided by the Owner under this condition shall be borne by the Contractor, via deductive Change Order.
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<tr>
<th>Section Number</th>
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<tbody>
<tr>
<td>01 75 13</td>
<td>Checkout Procedures</td>
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<td>NA</td>
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<tr>
<td>01 75 16</td>
<td>Startup Procedures</td>
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<td></td>
<td>Signoff from the Owner (Utility Services department) on the FS #15 is required before any utility is energized. Refer to Division 33 for individual utility requirements.</td>
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<td>The Preliminary Balance Report shall have been submitted by the Contractor to the Owner prior to, and as a requirement of, Substantial Completion.</td>
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<tr>
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<td>The Final Balance Report shall have been submitted by the Contractor to the Owner prior to, and as a requirement of, Final Completion.</td>
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<td>Systems start-up, commissioning, and balancing shall be 100% complete prior to, and as a requirement of, Final Completion.</td>
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<td>Any additional information to be provided by the Design Professional.</td>
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<tr>
<td>01 77 00</td>
<td>Closeout Procedures</td>
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<tr>
<td>01 77 13</td>
<td>Preliminary Closeout Reviews</td>
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<tr>
<td></td>
<td>The Contractor shall request the Owner to schedule a closeout meeting to be scheduled 30 days prior to substantial completion.</td>
</tr>
<tr>
<td>01 77 16</td>
<td>Final Closeout Review</td>
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<td>The Contractor will schedule a meeting with the Owner and DP when the all the document packages are ready for the individual substantial completion, final completion and final payment phases.</td>
</tr>
<tr>
<td>01 77 19</td>
<td>Closeout Requirements</td>
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<td>For all closeout requirements, please refer to the Construction Agreement located at <a href="https://in.nau.edu/facility-services/dp-contract/">https://in.nau.edu/facility-services/dp-contract/</a>.</td>
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<td>All contracts are listed under “Contracts”. Please refer to the appropriate contract’s closeout requirements specific to the project you are contracted for.</td>
</tr>
<tr>
<td>01 78 00</td>
<td>Closeout Submittals</td>
</tr>
<tr>
<td>01 78 23</td>
<td>Operation and Maintenance Data</td>
</tr>
<tr>
<td>01 78 23.13</td>
<td>Operation Data</td>
</tr>
</tbody>
</table>
Upon completion of the installation of all work specified in Construction Documents, and prior to Final Completion, Contractor shall furnish to the DP for review; one (1) complete bound copy and one (1) electronic copy of operating and maintenance instructions and parts lists for all material and equipment, including electrical and control items, being supplied. Upon receipt of review, the Contractor shall submit three (3) complete bound corrected copies and one (1) electronic corrected copy of the operating and maintenance instructions and parts list for all material and equipment in divisions 2-48. **Operation and maintenance manuals for all specified equipment and systems shall be provided as part of the contractor's base bid.**

Assemble Operation and Maintenance (O&M) Manuals in hard-back 3-ring loose leaf binders. Manuals will be organized by division will all warranties in a separate section at the back of the manual. Suitably label and index all material contained therein for ready reference.

Operating instructions shall include complete operating sequence, control diagrams, description of method of operating machinery, machine serial numbers, factory order numbers, parts lists, instruction books, suppliers’ phone numbers and addresses and individual equipment guarantee. Parts lists shall be complete in every respect, showing all parts and part numbers for ready reference.

O&M materials related to any of the following building components (as applicable for each project) are to be provided by the Contractor to the project manager to then be submitted to the Office of Regulatory Compliance:

- boilers
- emergency generators
- acid neutralization tanks
- grease interceptors
- sand/oil separators
- cooling towers
- chillers (documenting refrigerant type used)
- pre/post construction stormwater controls/NOI’s
- emergency showers
- bulk chemical storage locations
- fume hoods/bio-safety cabinets
- location of sanitary sewer drains

**01 78 23.16 Maintenance Data**

Close-out submittals shall include a completed “Maintenance Check List” (FS#88) indicating all maintenance and frequency required for warranty purposes.
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<th>Section Number</th>
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<tr>
<td>01 78 29</td>
<td>Final Site Survey</td>
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</tbody>
</table>

At the completion of underground utilities and final site work, the Contractor shall provide an as-built drawing of all work completed. An as-built drawing for underground utilities shall be provided within 30 days of completion of utility work. The final site work drawing shall be provided after all site work is complete. The as built drawings shall consist of the following:

- Design Professional is to put as-builts in CAD format.
- All buried and concealed items must be located with GPS coordinates. This includes tie-in locations, pipe alignments, change in direction, valves, manholes, utility crossings, and depth of utility.
- The site survey shall also include site as built grades which have been surveyed and verified by a licensed surveyor.
- The as-builts must be certified by a licensed surveyor who is currently registered in the State of Arizona certifying the drawing and GPS coordinates are accurate. Refer to Division 01 32 23.

<table>
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<tr>
<th>Section Number</th>
<th>Warranties</th>
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<tr>
<td>01 78 36</td>
<td>Reference Div 2-28</td>
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</table>

The Contractor’s warranty shall commence on the date of Substantial Completion and remain in effect for two years. Prior to Final Completion the Contractor shall schedule a 1-year and 2-year warranty walkthrough with the Owner.

All other warranties shall commence at Substantial Completion unless otherwise specified by manufacturer. These warranties are to remain in effect per the Construction Documents, including as specified throughout these Design Guidelines and Technical Standards.

The Contractor shall provide 24-hour response to all critical building systems, i.e., loss of heating, cooling and control systems. If applicable, the Contractor shall provide at Substantial Completion, service agreements between service companies and the Owner for all critical areas. The service agreement shall include 24-hour phone numbers and contact persons’ names the Owner may use in case of emergency. The emergency service agreement shall remain in effect for the two-year warranty period. The Contractor shall provide a contact person’s name and phone number for Contractor’s bonding company for use if the Owner experiences problems during the warranty.

All other, noncritical warranty items will be corrected within five (5) working days; unless the Contractor notifies the Owner in writing that a delay will be experienced due to shipping of materials. A shipping date must be provided to advise the Owner of the approximate date of warranty repair. All warranty work
<table>
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<th>Section Number</th>
<th>Title</th>
<th>Details</th>
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<tbody>
<tr>
<td>01 78 39</td>
<td>Project Record Documents</td>
<td>For all project record documentation procedures, please reference the Construction Agreement located at <a href="https://in.nau.edu/facility-services/dp-contract/">https://in.nau.edu/facility-services/dp-contract/</a>. Refer to Owner’s form FS #76 at <a href="https://in.nau.edu/facility-services/forms-index/">https://in.nau.edu/facility-services/forms-index/</a> for example of As-Builts required.</td>
</tr>
<tr>
<td>01 78 43</td>
<td>Spare Parts</td>
<td>Reference Div 2-28</td>
</tr>
<tr>
<td>01 78 46</td>
<td>Extra Stock Materials</td>
<td>Refer to Owner’s form FS #76 at: <a href="https://in.nau.edu/facility-services/forms-index/">https://in.nau.edu/facility-services/forms-index/</a></td>
</tr>
<tr>
<td>01 78 53</td>
<td>Sustainable Design Closeout Documentation</td>
<td>NA</td>
</tr>
<tr>
<td>01 79 00</td>
<td>Demonstration and Training</td>
<td>Refer to Owner’s form FS #76 at: <a href="https://in.nau.edu/facility-services/forms-index/">https://in.nau.edu/facility-services/forms-index/</a>.</td>
</tr>
</tbody>
</table>

**END OF SECTION**
01 80 00   PERFORMANCE REQUIREMENTS
Reference Div 2-28

01 81 00   Facility Performance Requirements

01 81 13   Sustainable Design Requirements
The Owner’s Project Manager will be designated as an alternate project administrator for all sustainable design programs.

**END OF SECTION**
**LIFE CYCLE ACTIVITIES**

Intentionally left blank.

**Commissioning**

General Commissioning Requirements
Commissioning Agent is typically hired directly by Owner. Commissioning Agent is shall adhere to ASHRAE Standards and Guidelines.

**Facility Operation**

Facility Operation Procedures
Reference Div 2-28

**Facility Maintenance**

Facility Maintenance Procedures
Reference Div 2-28

**END OF SECTION**
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected portions of building or structure.
   2. Demolition and removal of selected site elements.
   3. Salvage of existing items to be reused or recycled.

1.02 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.03 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Predemolition Photographs or Video: Submit before Work begins.

1.05 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

3.02 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

2. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
   a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
   f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.03 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 01 50 00 “Temporary Facilities and Controls.”

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.04 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame—cutting operations. Maintain portable fire—suppression devices during flame—cutting operations.
   4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   5. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner’s storage area designated by Owner.
   5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition[ and cleaned] and reinstalled in their original locations after selective demolition operations are complete.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner’s property, remove demolished materials from Project site and legally dispose of them in an EPA—approved landfill.
   1. Do not allow demolished materials to accumulate on—site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner’s property and legally dispose of them.
3.06 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION
SECTION 03 36 00

SPECIALTY CONCRETE FINISHES

PART 1 – GENERAL

1.01 SUMMARY
A. This section includes the following.
   1. Applying Sealer and Hardener, and polishing concrete to specified finish level.

1.02 SUBMITTALS
A. Product data:
   1. Submit special concrete finishes manufacturer’s specifications and test data.
   2. Submit special concrete finishes describing product to be provided, giving manufacturer’s name and product name for the specified material proposed to be provided under this section.
C. Test Reports:
   1. Provide certified test reports, prepared by an independent testing laboratory, confirming compliance with specified performance criteria.

1.03 QUALITY ASSURANCE
A. Installer Qualifications:
   1. Use an experienced installer and adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.
   2. The special concrete finish manufacturer shall certify applicator.
   3. Applicator shall be familiar with the specified requirements and the methods needed for proper performance of work of this section.
B. Manufacturer’s Certification:
   1. Provide letter of certification from concrete finish manufacturer stating that installer is certified applicator of special concrete finishes, and is familiar with proper procedures and installation requirements required by the manufacturer.
C. Mock-ups:
   1. Apply mock-ups of each type finish, to demonstrate typical joints, surface finish, color variation (if any), and standard of workmanship.
      a. Build mock-ups approximately 50 square feet in the location indicated or if not indicated, as directed by the Architect or Owner Representative.
      b. Notify Architect or Owner Representative seven days in advance of dates and times when mock-ups will be constructed.
      c. Obtain from the Architect or Owner Representative approval of mock-ups before starting construction.
      d. If the Architect or Owner Representative determines that mock-ups do not meet requirements, demolish and remove them from the site and cast others until mock-ups are approved.
      e. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
      f. Approved mock-ups may become part of the completed work if undisturbed at time of substantial completion.
1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original containers, with seal’s unbroken, bearing manufacturer labels indicating brand name and directions for storage.

B. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

1.05 PROJECT CONDITIONS

A. Environmental limitations:
   1. Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.
      a. Concrete Floor Flatness rating recommended at least 40, where possible.
      b. Concrete Floor Levelness rating recommended at least 30, where possible.
      c. Concrete must be cured a minimum of 45 days or as directed by the manufacturer before application of Retro Plate can begin.
      d. Application of Retro-Plate shall take place 10 days prior to installation of equipment and substantial completion, thus providing a complete, uninhibited concrete slab for application.

B. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

PART 2 – PRODUCTS

2.01 MATERIALS AND MANUFACTURERS

A. SCT-1: GROUND EXPOSED CONCRETE
   1. Basis—of—Design: Retro-Plate 99, manufactured by Advanced Floor Products, Inc.
      a. Performance Criteria:
         i. Abrasion Resistance: ASTM C779
         ii. Impact Strength: ASTM C805
         iii. Ultra Violet Light and Water Spray: ASTM G23–81
         iv. Coefficient of Friction: Wet 0.48 or greater

2.02 RELATED MATERIALS

A. Neutralizing Agent:
   1. Tri—sodium Phosphate

B. Water:
   1. Potable
PART 3– EXECUTION

3.01 SURFACE CONDITIONS:
A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
B. Prior to application, verify that floor surfaces are free of construction latents.

3.02 APPLICATION
A. Start any of the floor finish applications in presence of manufacturer’s technical representative.
B. Sealing, Hardening and Polishing of Concrete Surface
   1. Concrete must be in place a minimum of 45 days or as directed by the manufacturer before application can begin.
   2. Grind Concrete to Fine Aggregate Exposure.
   3. Application is to take place at least 10 days prior to racking and other in–store accessory installation, thus providing a complete, uninhibited concrete slab for application
   4. Only a certified applicator shall apply Retro–Plate 99. Applicable procedures must be followed as recommended by the product manufacturer and as required to match approved test sample.
   5. Achieve waterproofing, hardening, dust–proofing, and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.
   6. Finish to Level 3 Semi–Polished (800+ grit)

3.03 WORKMANSHIP AND CLEANING:
A. The premises shall be kept clean and free of debris at all times.
B. Remove spatter from adjoining surfaces, as necessary.
C. Repair damages to surface caused by cleaning operations.
D. Remove debris from jobsite
   1. Dispose of materials in separate, closed containers in accordance with local regulations.

3.04 PROTECTION:
A. Protect finished work until fully cured in accordance with manufacturer’s recommendations.

END OF SECTION
SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Wood blocking and nailers.

PART 2 – PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules—writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.02 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.

B. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
   1. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

2.03 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Where carpentry is exposed to weather, in ground contact, pressure—preservative treated, or in area of high relative humidity, provide fasteners with hot—dip zinc coating complying with ASTM A 153/A 153M.

B. Screws for Fastening to Metal Framing: ASTM C 1002 or ASTM C 954 as required for framing with length as recommended by screw manufacturer for material being fastened.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit.
B. Securely attach carpentry work to substrate by anchoring and fastening as indicated.

END OF SECTION
SECTION 06 41 16

PLASTIC LAMINATE FACED ARCHITECTURAL CABINETS

PART 1 — GENERAL

1.01 SUMMARY

A. Section Includes:
   2. Wood furring, blocking, shims, and hanging strips for installing plastic—laminate—faced architectural cabinets unless concealed within other construction before cabinet installation.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large—scale details, attachment devices, and other components.
C. Samples:
   1. Plastic laminates, for each color, pattern, and surface finish.
   2. Thermoset decorative panels, for each color, pattern, and surface finish.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.04 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 — PRODUCTS

2.01 PLASTIC—LAMINATE—FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic—laminate cabinets indicated for construction, finishes, installation, and other requirements.
B. Grade: Custom.
C. Type of Construction: Frameless.
D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
E. High—Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
F. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGS.
   2. Vertical Surfaces: Grade VGS.

G. Materials for Semiexposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade CLS.
   2. Drawer Sides and Backs: Solid-hardwood lumber.
   3. Drawer Bottoms: Hardwood plywood.

H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As selected by Architect from laminate manufacturer’s full range.

2.02 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Wood Moisture Content: 4 to 9 percent.

B. Composite Wood: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   2. Particleboard: ANSI A208.1, Grade M–2, made with binder containing no urea formaldehyde.

2.03 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 11 “Door Hardware (Descriptive Specification).”

B. Butt Hinges: 2–3/4–inch (70–mm), five–knuckle steel hinges made from 0.095–inch– (2.4–mm–) thick metal, and as follows:
   1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Wire Pulls: Back mounted, solid metal, 5 inches (127 mm) long, 2–1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.

D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

E. Drawer Slides: BHMA A156.9.
   1. Grade 1: Side mounted; full–extension type; zinc–plated steel with polymer rollers.
   3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
   4. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD–100.
   5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD–100.

F. Door Locks: BHMA A156.11, E07121.

G. Drawer Locks: BHMA A156.11, E07041.

H. Door and Drawer Silencers: BHMA A156.16, L03011.
I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Satin Stainless Steel: BHMA 630.

2.04 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous—metal or hot—dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
   1. Adhesive for Bonding Edges: Hot—melt adhesive or adhesive specified above for faces.

2.05 FABRICATION

A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop—cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing—in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

C. Install glass to comply with applicable requirements in Section 08 80 00 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

PART 3 – EXECUTION

3.01 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

3.02 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.
E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1–1/2–inch (38–mm) penetration into wood framing, blocking, or hanging strips.

END OF SECTION
SECTION 07 21 00 THERMAL INSULATION

PART 1 – GENERAL

1.01 SUMMARY
   A. Section Includes:
      2. Glass-fiber blanket insulation.

1.02 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS
   A. Product test reports.
   B. Research/evaluation reports.

PART 2 – PRODUCTS

2.01 MINERAL–WOOL BLANKET INSULATION
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Roxul Inc.
      2. Thermafiber.
   B. Unfaced, Mineral–Wool Blanket Insulation: ASTM C 665, Type I; with maximum flame–spread and smoke–developed indexes of zero and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.02 GLASS–FIBER BLANKET INSULATION
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. CertainTeed Corporation.
      2. Johns Manville.
      4. Owens Corning.
2.03 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Corporation.
      b. BaySystems NorthAmerica, LLC.
      c. Dow Chemical Company (The).
      d. Gaco Western Inc.
      e. Henry Company.
      f. SWD Urethane Company.
   2. Minimum density of 2.0 lb/cu. ft. aged thermal resistivity of 6.7 deg F x h x sq. ft./Btu x in. at 75 deg F
   3. EPA-approved, zero ozone-depleting blowing agent
   4. Air Barrier Association of America (ABAA) Listed Material. Considered air impermeable in accordance with ASTM E2178
   5. Class II Vapor retarder. Less than 1 perm in accordance with ASTM E96
   6. GREENGUARD certification for VOC Emissions
   7. Mold resistant per ASTM C1338

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

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

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

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

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

3.02 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer’s written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
B. Glass–Fiber or Mineral–Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
   4. For metal–framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

C. Spray–Applied Insulation: Apply spray–applied insulation according to manufacturer’s written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Spray Polyurethane Insulation: Apply according to manufacturer’s written instructions.

END OF SECTION
SECTION 07 84 13

PENETRATION FIRESTOPPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Penetrations in fire--resistance--rated walls.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

B. Product test reports.

1.04 QUALITY ASSURANCE

A. Fire--Test--Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by UL.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.

PART 2 – PRODUCTS

2.01 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is 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. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire--Resistance--Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01--inch wg (2.49 Pa).
   1. F--Rating: Not less than the fire--resistance rating of constructions penetrated.

C. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration
firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Install penetration firestopping to comply with manufacturer’s written installation instructions and published drawings for products and applications indicated.

C. Install forming 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 and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

D. Install fill materials for firestopping 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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.02 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning — Penetration Firestopping — Do Not Disturb. Notify Building Management of Any Damage."
   2. Designation of applicable testing and inspecting agency.
   3. Date of installation.
   4. Manufacturer’s name.

3.03 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.04 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL’s “Fire Resistance Directory” under product Category XHEZ.
B. Firestopping with No Penetrating Items:

C. Firestopping for Metallic Pipes, Conduit, or Tubing:

D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:

E. Firestopping for Insulated Pipes:

F. Firestopping for Miscellaneous Electrical Penetrants:

G. Firestopping for Miscellaneous Mechanical Penetrants:

H. Firestopping for Groupings of Penetrants:

END OF SECTION
SECTION 07 92 00

JOINT SEALANTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Urethane joint sealants.
   3. Latex joint sealants.
   5. Acoustical joint sealants.

1.02 ACTION SUBMITTALS

A. Product Data: For each joint–sealant product indicated.

B. Samples: For each kind and color of joint sealant required.

1.03 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.05 WARRANTY

A. Special Manufacturer’s Warranty: Manufacturer’s standard form in which joint–sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MATERIALS, GENERAL

A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

B. Liquid–Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid–applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
C. Stain—Test—Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.02 SILICONE JOINT SEALANTS

   1. Type: Single component (S) or multicomponent (M).
   2. Grade: Nonsag (NS).
   3. Class: 50.
   4. Uses Related to Exposure: Nontraffic (NT).

   1. Type: Single component (S).
   2. Grade: Nonsag (NS).
   4. Uses Related to Exposure: Nontraffic (NT).

2.03 URETHANE JOINT SEALANTS

   1. Type: Multicomponent (M).
   2. Grade: Pourable (P).
   3. Class: 50.

   1. Type: Single component (S) or multicomponent (M).
   2. Grade: Nonsag (NS).
   3. Class: 50.
   4. Uses Related to Exposure: Nontraffic (NT).

   1. Type: Multicomponent (M).
   2. Grade: Nonsag (NS).
   3. Class: 50.

2.04 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

2.05 SOLVENT—RELEASE—CURING JOINT SEALANTS

A. Acrylic—Based Joint Sealant: ASTM C 1311.

B. Butyl—Rubber—Based Joint Sealant: ASTM C 1311.
2.06  ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer’s standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.07  JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond—Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.08  MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint—sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint—sealant—substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 – EXECUTION

3.01  PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint—sealant manufacturer’s written instructions.
   1. Remove laitance and form—release agents from concrete.
   2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint—sealant manufacturer or as indicated by preconstruction joint—sealant—substrate tests or prior experience. Apply primer to comply with joint—sealant manufacturer’s written instructions. Confine primers to areas of joint—sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.02  INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer’s written recommendations.

G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.03 JOINT–SEALANT SCHEDULE

A. Joint–Sealant Application: Exterior joints in horizontal traffic surfaces.
   2. Urethane Joint Sealant: UJS–1 multicomponent, pourable, traffic grade, Class 50.

   1. Joint Locations:
      b. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
      c. Other joints as indicated.

   1. Joint Locations:
      a. Joints in exterior insulation and finish systems.
      b. Joints between metal panels.
      c. Joints between different materials listed above.
      d. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
      e. Other joints as indicated.

D. Joint–Sealant Application: Interior joints in horizontal traffic surfaces.
   1. Joint Locations:
      b. Other joints as indicated.

E. Joint–Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
      d. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      e. Other joints as indicated.

   1. Joint Sealant Location:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      b. Tile control and expansion joints in bathrooms.
      c. Other joints as indicated.

   1. Joint Location:
      a. Acoustical joints where indicated.
      b. Other joints as indicated.

H. Joint–Sealant Application: Concealed bedding joints.
   1. Joint Location: Thresholds, and sills of storefront framing and windows.

END OF SECTION
SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 – GENERAL

1.01 SUMMARY
   A. Section includes hollow-metal work.

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

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
   C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.04 INFORMATIONAL SUBMITTALS
   A. Product test reports.

PART 2 – PRODUCTS

2.01 INTERIOR DOORS AND FRAMES
      1. Physical Performance: Level A according to SDI A250.4.
      2. Doors:
         a. Type: As indicated in the Door and Frame Schedule.
         b. Thickness: 1–3/4 inches (44.5 mm).
         c. Face: Uncoated, cold–rolled steel sheet, minimum thickness of 0.053 inch (1.3 mm).
         d. Edge Construction: Model 2, Seamless.
         e. Core: Polyisocyanurate.
      3. Frames:
         a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
         b. Construction: Full profile welded.

2.02 FRAME ANCHORS
   A. Jamb Anchors:
      1. Stud–Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
   1. Monolithic Concrete Slabs: Clip--type anchors, with two holes to receive fasteners.

2.03 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
C. Inserts, Bolts, and Fasteners: Hot--dip galvanized according to ASTM A 153/A 153M.
D. Power--Actuated Fasteners in Concrete: From corrosion--resistant materials.
E. Mineral--Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).

2.04 FABRICATION

A. Fabricate hollow--metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer’s plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
B. Hollow--Metal Doors:
   1. Exterior Doors: Provide weep--hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
C. Hollow--Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip--on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
   2. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Stud--Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
         1) Three anchors per jamb up to 60 inches (1524 mm) high.
D. Hardware Preparation: Factory prepare hollow--metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
   1. Reinforce doors and frames to receive nontemplated, mortised, and surface--mounted door hardware.
   2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow--metal work for hardware.

2.05 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer’s standard primer.
PART 3 – EXECUTION

3.01 INSTALLATION

A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM—HMMA 840 as required by standards specified.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. Where frames are fabricated in sections because of shipping or handling limitations, fieldsplice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      c. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
      a. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
   4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
      a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
   2. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
   3. At Bottom of Door: [5/8 inch (15.8 mm)] plus or minus 1/32 inch (0.8 mm).
   4. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

3.02 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

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

END OF SECTION
SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
1. Solid-core doors with Hardwood Laminate faces.
2. Factory fitting flush wood doors to frames and factory machining for hardware.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of door.
B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
   1. Dimensions and locations of blocking.
   2. Dimensions and locations of mortises and holes for hardware.
   3. Dimensions and locations of cutouts.
   4. Undercuts.
   5. Requirements for veneer matching.
   6. Doors to be factory finished and finish requirements.
   7. Fire-protection ratings for fire-rated doors.

PART 2 – PRODUCTS

2.01 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1–A, "Architectural Wood Flush Doors."

B. WDMA I.S.1–A Performance Grade: Extra heavy duty.

C. Structural–Composite–Lumber–Core Doors:
      a. Screw Withdrawal, Face: 700 lbf (3100 N).
      b. Screw Withdrawal, Edge: 400 lbf (1780 N).

2.02 DOORS FOR CLEAR FINISH

A. Interior Solid–Core Doors:
   1. Grade: Custom.
   2. Faces: Walnut Wood Veneer to match 3rd and 4th Floor Renovation
   3. Core: Structural composite lumber.

2.03 FABRICATION

A. Factory fit doors to suit frame–opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
B. Factory machine doors for hardware that is not surface applied.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Hardware: For installation, see Section 08 71 00 “Door Hardware.”

B. Installation Instructions: Install doors to comply with manufacturer’s written instructions and referenced quality standard, and as indicated.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

END OF SECTION
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Access doors and frames for walls and ceilings.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 – PRODUCTS

2.01 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

B. Flush Access Doors with Exposed Flanges:
   1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer’s standard—width exposed flange, proportional to door size.
   2. Locations: Wall.
   3. Stainless—Steel Sheet for Door: Nominal 0.062 inch (1.59 mm), 16 gage.
      a. Finish: No. 4.
   4. Hinges: Manufacturer’s standard.
   5. Hardware: Latch.

C. Flush Access Doors with Concealed Flanges:
   1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
   2. Locations: Wall and ceiling.
   3. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
   4. Frame Material: Same material and thickness as door.
   5. Hinges: Manufacturer’s standard.
   6. Hardware: Latch.

D. Latch: Cam latch operated by pinned—hex—head wrench.

2.02 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold—rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Stainless—Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines or blend into finish.
D. Frame Anchors: Same type as door face.

E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.03 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

F. Extruded Aluminum: After fabrication, apply manufacturer’s standard protective coating on aluminum that will come in contact with concrete.

2.04 FINISHES

A. Comply with NAAMM’s "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel and Metallic-Coated-Steel Finishes:
   1. Factory Prime: Apply manufacturer’s standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

E. Stainless-Steel Finishes:
   1. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
      a. Directional Satin Finish: No. 4.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer’s written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.
3.02 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION
SECTION 08 41 13

ALUMINUM–FRAMED ENTRANCES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Exterior storefront framing.
   2. Exterior manual–swing entrance doors.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, full–size details, and attachments to other work.
   1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: For each exposed finish required.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.03 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC–certified energy performance values from manufacturer.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect’s approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

C. Structural–Sealant Glazing: Comply with ASTM C 1401 for design and installation of storefront systems.

1.06 WARRANTY

A. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory–applied finishes within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.
PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.

B. Wind Loads: As indicated on Drawings.

C. Deflection of Framing Members: At design wind pressure, as follows:
   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
      a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

D. Structural: Test according to ASTM E 330 as follows:
   1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
   1. Fixed Framing and Glass Area:
      a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static–air–pressure differential of 6.24 lbf/sq. ft. (300 Pa).
   2. Entrance Doors:
      a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static–air– pressure differential of 1.57 lbf/sq. ft. (75 Pa).
      b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static–air– pressure differential of 1.57 lbf/sq. ft. (75 Pa).

F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static–air–pressure differential of 20 percent of positive wind–load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).

G. Energy Performance: Certify and label energy performance according to NFRC as follows:
   1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U–factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

I. Structural–Sealant Joints:
   1. Designed to carry gravity loads of glazing.
   2. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).

J. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural–sealant–glazed storefront system without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
   1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
   2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to–substrate bond strength exceeds sealant’s internal strength.

2.02 FRAMING

A. Basis–of–Design Product: Subject to compliance with requirements, provide T500–OPG600 Series by Arcadia, Inc. or approved comparable product.

B. Framing Members: Manufacturer’s extruded–or formed–aluminum framing members of thickness required and reinforced as required to support imposed loads.
   2. Glazing System: Retained mechanically with gaskets on two sides and structural sealant on two sides.

C. Backer Plates: Manufacturer’s standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer’s standard high–strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Materials:
   1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
      c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
      d. Structural Profiles: ASTM B 308/B 308M.

2.03 ENTRANCE DOOR SYSTEMS

A. Swinging Entrance Doors: Manufacturer’s standard glazed entrance doors for manual–swing operation.
   1. Basis–of–Design Product: Subject to compliance with requirements, provide 450T Series by Arcadia, Inc. or approved comparable product.
   2. Door Construction: 2– to 2–1/4–inch (50.8– to 57.2–mm) overall thickness, with minimum 0.125–inch– (3.2–mm–) thick, extruded–aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
      a. Thermal Construction: High–performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
   3. Door Design: As indicated.
      a. Provide nonremovable glazing stops on outside of door.
2.04 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
   1. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

C. Weather Stripping: Manufacturer’s standard replaceable components.

D. Weather Sweeps: Manufacturer’s standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.05 GLAZING

A. Glazing: Comply with Section 08 80 00 "Glazing."

B. Glazing Gaskets: Manufacturer’s standard sealed-corner pressure–glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural–sealant manufacturer for use in storefront system indicated.

D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural–sealant, weatherseal–sealant, and structural–sealant–glazed storefront manufacturers for this use.

2.06 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from interior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.07 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

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

PART 3 – EXECUTION

3.01 INSTALLATION

A. General:
1. Comply with manufacturer’s written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:
1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 08 80 00 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

END OF SECTION
SECTION 087100

DOOR HARDWARE

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 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum—Framed Entrances and Storefronts”.
4. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 – Accessible and Usable Buildings and Facilities.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards – A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies
1.3 SUBMITTALS

A. Product Data: Manufacturer’s product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's “Sequence and Format for the Hardware Schedule.”
   2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
   3. Content: Include the following information:
      a. Type, style, function, size, label, hand, and finish of each door hardware item.
      b. Manufacturer of each item.
      c. Fastenings and other pertinent information.
      d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      e. Explanation of abbreviations, symbols, and codes contained in schedule.
      f. Mounting locations for door hardware.
      g. Door and frame sizes and materials.
      h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:
   1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer–installed and field–installed wiring. Include the following:
      a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
      b. Complete (risers, point–to–point) access control system block wiring diagrams.
      c. Wiring instructions for each electronic component scheduled herein.
   2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
E. Informational Submittals:
   1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware 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.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project’s vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
   1. Electrified modifications or enhancements made to a source manufacturer’s product line by a secondary or third party source will not be accepted.
   2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. Pre–Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section “Project Meetings” with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
   1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors’ personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
   2. Inspect and discuss electrical roughing–in, power supply connections, and other preparatory work performed by other trades.
   3. Review sequence of operation narratives for each unique access controlled opening.
   4. Review and finalize construction schedule and verify availability of materials.
   5. Review the required inspecting, testing, commissioning, and demonstration procedures
G. At completion of installation, provide written documentation that components were applied to manufacturer’s instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock–up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the “Keying Conference”.

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre–wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in–field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
   1. Seven years for heavy duty cylindrical (bored) locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual overhead door closer bodies.
4. Five years for motorized electric latch retraction exit devices.
5. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. 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.

PART 2 – PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer’s Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers’ names are abbreviated in the Door Hardware Schedule.

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Permanent cylinders, cores, and keys to be installed by Owner.

D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
   a. Widths up to 3’0”: 4–1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
   a. Exterior Doors: Heavy weight, non–ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:
   a. Non–removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out–swinging lockable doors.

5. Manufacturers:
   b. Stanley Hardware (ST) – CB Series.

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1–600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non–handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut–outs.

1. Manufacturers:
   a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
   b. Stanley.

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through–door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:
   b. Stanley Hardware (ST) – C Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through–door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:
a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) – EL–CEPT Series.
b. Stanley Hardware (ST) EPT–12C Series.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

2. Manufacturers:
   b. Stanley Hardware (ST) – WH Series.

D. Provide mortar guard enclosure on steel frames installed at masonry openings for each electrical hinge specified.

2.4 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2–inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2–inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer’s designated fastener type as indicated in Hardware Sets.

5. Manufacturers:
   a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

1. Manufacturers:
a. Stanley Best (BE).
b. No Substitution.

C. Cylinders: Original manufacturer cylinders complying with the following:
   1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
   2. Rim Type: Cylinders with back plate, flat--type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored--Lock Type: Cylinders with tailpieces to suit locks.
   4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
   1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.

E. Keying System: Each type of lock and cylinders to be factory keyed.
   1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel--silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. Existing System: Field verify and key locks to match Owner's existing system.

F. Key Quantity: Provide the following minimum number of keys:
   2. Construction Control Keys (where required): Two (2).

G. Construction Keying: Provide construction master keyed cylinders.


I. Key Registration List (Bitting List):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
   1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
   2. Locks are to be non--handed and fully field reversible.
   3. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.
4. Manufacturers:
   a. Sargent Manufacturing (SA) – 10 Line.
   b. Stanley Best (BE) – 9K Series.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer’s standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer’s special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
   4. Dustproof Strikes: BHMA A156.16.

2.8 ELECTRIC STRIKES

A. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.
   1. Manufacturers:
      a. HES (HS) – 9400/9500/9600/9700/9800 Series.

B. Provide electric strikes with in–line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
   1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

6. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

7. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.

8. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.

   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

10. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

11. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.


13. Rail Sizing: Provide exit device rails factory sized for proper door width application.

14. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

   1. Manufacturers:
      a. Sargent Manufacturing (SA) – 80 Series.
b. Stanley Precision (PR) – Apex 2000 Series.

C. Extruded Aluminum Removable Mullions: ANSI/BHMA A156.3 anodized, removable mullions with malleable–iron top and bottom retainers. Mullions to be provided standard with stabilizers and imbedded weatherstrip.

1. Manufacturers:
   a. Sargent Manufacturing (SA) – 980/980A Series.
   b. Stanley Precision (PR).

D. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable–iron top and bottom retainers and a primed paint finish.

1. Provide keyed removable feature where specified in the Hardware Sets.
2. Provide stabilizers and mounting brackets as required.
3. Provide electrical quick connection wiring options as specified in the hardware sets.
4. Manufacturers:
   a. Sargent Manufacturing (SA) – 980S Series.
   b. Stanley Precision (PR) – 822 Series.

2.10 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non–handed with full sized covers including installation and adjusting information on inside of cover.
2. Standards: Closers to comply with UL–10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through–bolt and security type fasteners as specified in the hardware sets.
B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

   1. Manufacturers:
      a. LCN Closers (LC) – 4040 Series.
      b. Norton Door Controls (NO) – 7500 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
   3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
   4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
      a. Stainless Steel: 300 grade, 050-inch thick.
   5. Options and fasteners: Provide manufacturer’s designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
   6. Manufacturers:
      a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      b. Trimco (TC).

2.12 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

   1. Manufacturers:
      a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
b. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:
   a. Rixson Door Controls (RF).

2.13 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL–10C.


D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.14 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap—lock into a 1” diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:
a. Sargent Manufacturing (SA) – 3280 Series.
b. Securitron (SU) – DPS Series.

B. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi–voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.

1. Manufacturers:
   a. Securitron (SU) – AQL Series.

2.15 FABRICATION
A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.16 FINISHES
A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
B. 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.
C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 – EXECUTION

3.1 EXAMINATION
A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION
A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer’s written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer’s published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface–mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Section “Closeout Procedures” for project punch and reporting requirements including compliance with approved submittals and verification door hardware is properly installed, operating and adjusted.

B. Fire Door Assembly Inspection: Reference Division 01 Sections “Closeout Procedures” and “Cash Allowances” for stipulations requiring an initial fire door assembly inspection, including documentation reporting, upon completion of door hardware installation according to NFPA 80 Standard for Fire Doors and Other Opening Protectives, paragraph 5.2.4, requirements.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner’s maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate selection for the material and application.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK – McKinney
2. PE – Pemko
3. SA – SARGENT
4. BE – dormakaba Best
5. HS – HES
6. RO – Rockwood
7. RF – Rixson
8. NO – Norton
9. OT – Other
10. SU – Securitron
Hardware Sets

Set: 1.0

Doors: 101

2 Elec Continuous Hinge   HT CFM__SLF--HD1 EL--CEPT   PE
1 Key Removable Mullion   L980A                US28     SA
1 Elec Rim Exit Device, Dummy LD 43 55 56 8810 PTB US32D   SA
1 Elec Rim Exit Device, Storeroom LD 43 55 56 72 8804 PSB US32D   SA
2 Final Keyed Core       1CP7 (by NAU)       626      BE
1 Mullion Cylinder       72 980C1            US26D    SA
2 Surface Closer/Stop    CLP7500             689      NO
1 Threshold              171A                PE
1 Gasketing              By Aluminum Frame Mfg. OT
1 Mullion Gasketing      5110BL              PE
2 Sweep                  315CN               PE
2 Frame Wiring Harness   QC--C1500P           MK
2 Door Wiring Harness    QC--Cxxx            MK
1 Card Reader            By Security Integrator OT
2 Position Switch        DPS--M--BK           SU
1 Power Supply           AQL (R8E1 as required) SU

Set: 2.0

Doors: 205

4 Hinge, Full Mortise, Hvy Wt   T4A3786 NRP US26D   MK
1 Rim Exit Device, Storeroom   16 43 72 8804 PSB US32D   SA
2 Final Keyed Core            1CP7 (by NAU)   626      BE
1 Electric Strike             9600              630      HS
1 SMART Pac Bridge Rectifier  2005M3 (for electric strike) HS
1 Surface Closer/Hold         7500H              689      NO
1 Wall Stop                   406/409            US26D    RO
1 Gasketing                   By Aluminum Frame Mfg. OT
1 Frame Wiring Harness        QC--C1500P         MK
1 Card Reader                  By Security Integrator OT
1 Position Switch             DPS--M--BK           SU
1 Power Supply                 AQL (R8E1 as required) SU

Notes: Operation Description:
Door normally closed, latched, and locked.
Presenting valid credential or key override to unlock.
Door remains locked when power fails.
Free to egress at all times.
## Set: 3.0

**Doors:** 210, 231A

<table>
<thead>
<tr>
<th>Item Description</th>
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<th>Finish/Type</th>
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<tr>
<td>8 Hinge, Full Mortise, Hvy Wt</td>
<td>T4A3786 NRP</td>
<td>US26D MK</td>
</tr>
<tr>
<td>1 Key Removable Mullion</td>
<td>L980A</td>
<td>US28 SA</td>
</tr>
<tr>
<td>1 Rim Exit Device, Storeroom</td>
<td>16 43 72 8804 PSB</td>
<td>US32D SA</td>
</tr>
<tr>
<td>1 Rim Exit Device, Dummy</td>
<td>16 43 72 8810 PTB</td>
<td>US32D SA</td>
</tr>
<tr>
<td>5 Final Keyed Core</td>
<td>1CP7 (by NAU)</td>
<td>626 BE</td>
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<tr>
<td>1 Mullion Cylinder</td>
<td>72 980C1</td>
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<tr>
<td>2 Surface Closer/Stop</td>
<td>CLP7500</td>
<td>689 NO</td>
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<tr>
<td>1 Gasketing</td>
<td>By Aluminum Frame Mfg.</td>
<td>OT</td>
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<tr>
<td>1 Mullion Gasketing</td>
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## Set: 4.0

**Doors:** 224, 224B

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<td>US32D SA</td>
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<td>2 Final Keyed Core</td>
<td>1CP7 (by NAU)</td>
<td>626 BE</td>
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<tr>
<td>1 Surface Closer/Hold</td>
<td>7500H</td>
<td>689 NO</td>
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<tr>
<td>1 Wall Stop</td>
<td>406/409</td>
<td>US26D RO</td>
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<tr>
<td>1 Gasketing</td>
<td>By Aluminum Frame Mfg.</td>
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## Set: 5.0

**Doors:** 106A, 106B

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<tr>
<td>1 Rim Exit Device, Storeroom</td>
<td>16 43 72 8804 PSB</td>
<td>US32D SA</td>
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<tr>
<td>2 Final Keyed Core</td>
<td>1CP7 (by NAU)</td>
<td>626 BE</td>
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<td>1 Surface Closer/Stop/Hold</td>
<td>CLP7500R</td>
<td>689 NO</td>
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<tr>
<td>1 Gasketing</td>
<td>By Aluminum Frame Mfg.</td>
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## Set: 6.0

**Doors:** 221A, 226A

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<td>T4A3786 NRP</td>
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<tr>
<td>1 Storeroom/Closet Lock</td>
<td>28 72 10G04 LL</td>
<td>US26D SA</td>
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<tr>
<td>1 Final Keyed Core</td>
<td>1CP7 (by NAU)</td>
<td>626 BE</td>
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<tr>
<td>1 Surface Closer</td>
<td>7500</td>
<td>689 NO</td>
</tr>
<tr>
<td>1 Wall Stop</td>
<td>406/409</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1 Gasketing</td>
<td>By Aluminum Frame Mfg.</td>
<td>OT</td>
</tr>
<tr>
<td>Set: 7.0</td>
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<td>4 Hinge, Full Mortise, Hvy Wt</td>
<td>T4A3786 NRP US26D MK</td>
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<tr>
<td>1 Classroom Lock</td>
<td>28 72 10G37 LL US26D SA</td>
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<tr>
<td>1 Final Keyed Core</td>
<td>1CP7 (by NAU) 626 BE</td>
<td></td>
</tr>
<tr>
<td>1 Surface Closer/Hold</td>
<td>7500H 689 NO</td>
<td></td>
</tr>
<tr>
<td>1 Wall Stop</td>
<td>406/409 US26D RO</td>
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<tr>
<td>1 Gasketing</td>
<td>By Aluminum Frame Mfg. OT</td>
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<td>4 Hinge, Full Mortise, Hvy Wt</td>
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<td>2 Elec Hinge, Full Mortise, Hvy Wt</td>
<td>T4A3786 QC US26D MK</td>
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<td>2 Elec Alarm Rim Exit Device, Exit Only</td>
<td>AL 12 43 72 8810 EO US26D SA</td>
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<td>3 Final Keyed Core</td>
<td>1CP7 (by NAU) 626 BE</td>
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<tr>
<td>1 Mullion Cylinder</td>
<td>72 980C1 US26D SA</td>
</tr>
<tr>
<td>1 Surface Closer</td>
<td>7500 689 NO</td>
</tr>
<tr>
<td>1 Surface Closer/Stop</td>
<td>CLP7500 689 NO</td>
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<tr>
<td>1 Wall Stop</td>
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<td>2 Frame Wiring Harness</td>
<td>QC–C1500P MK</td>
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<td>2 Door Wiring Harness</td>
<td>QC–Cxxx MK</td>
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<tr>
<td>2 Card Reader</td>
<td>By Security Integrator OT</td>
</tr>
<tr>
<td>2 Position Switch</td>
<td>DPS–M–BK SU</td>
</tr>
<tr>
<td>1 Power Supply</td>
<td>AQL (R8E1 as required) SU</td>
</tr>
<tr>
<td>2 Custom Illumination Signs</td>
<td>TBD OT</td>
</tr>
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</table>

Notes: A hollow metal mullion that is removable must be installed and part of the hollow metal door and frame section. NAU does not allow vertical rod exit devices.

Operation Description:
Door normally closed, latched and locked.
Presenting valid credential to shunt alarm.
Unauthorized access will sound alarm.
Key to reset alarm.
Free to egress at all times.

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### DOOR HARDWARE

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<td>6 Hinge, Full Mortise, Hvy Wt</td>
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<tr>
<td>1 Fire Rated Key Rem Mullion</td>
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<td>2 Fire Rated Rim Exit Device, Classroom</td>
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<td>3 Final Keyed Core</td>
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<td>1 Mullion Cylinder</td>
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<tr>
<td>2 Surface Closer/Stop</td>
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<tr>
<td>2 Kick Plate</td>
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<tr>
<td>1 Gasketing</td>
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<td>1 Mullion Gasketing</td>
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<td>1 Final Keyed Core</td>
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<td>1 Surface Closer</td>
</tr>
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<td>1 Kick Plate</td>
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<tr>
<td>1 Wall Stop</td>
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<tr>
<td>3 Silencer</td>
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<td>1 Surface Closer/Stop</td>
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<tr>
<td>1 Kick Plate</td>
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<tr>
<td>3 Silencer</td>
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<td>Set: 13.0</td>
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<tr>
<td>1 Storeroom/Closet Lock</td>
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<tr>
<td>1 Final Keyed Core</td>
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<tr>
<td>1 Surface Closer</td>
</tr>
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<td>1 Kick Plate</td>
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<td>28 72 10G04 LL</td>
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<tr>
<td>1 Final Keyed Core</td>
<td>1CP7 (by NAU)</td>
</tr>
<tr>
<td>1 Surface Closer/Stop</td>
<td>CLP7500</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 12&quot; x 2&quot; LDW CSK BEV</td>
</tr>
<tr>
<td>1 Gasketing</td>
<td>S88D</td>
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<td>3 Hinge, Full Mortise, Hvy Wt</td>
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<tr>
<td>1 Entry/Office Lock</td>
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<tr>
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<td>1 Surface Closer/Hold</td>
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<td>1 Kick Plate</td>
<td>K1050 12&quot; x 2&quot; LDW CSK BEV</td>
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<td>1 Wall Stop</td>
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## Set: 17.0

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<td>4</td>
<td>T4A3786 NRP, US26D MK</td>
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<tr>
<td>Classroom Lock</td>
<td>1</td>
<td>28 72 10G37 LL, US26D SA</td>
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<tr>
<td>Final Keyed Core</td>
<td>1</td>
<td>1CP7 (by NAU), 626 BE</td>
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<tr>
<td>Surface Closer/Hold</td>
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<td>7500H, 689 NO</td>
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<td>Kick Plate</td>
<td>1</td>
<td>K1050 12&quot; x 2&quot; LDW CSK BEV, US32D RO</td>
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Doors: 221B, 226B

## Set: 18.0

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<tr>
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Doors: 104A, 104B, 105, 117, 121, 122

## Set: 19.0

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<tr>
<td>Surface Closer/Hold</td>
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<td>Kick Plate</td>
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<td>K1050 12&quot; x 2&quot; LDW CSK BEV, US32D RO</td>
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<tr>
<td>Gasketing</td>
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### Set: 20.0

Doors: 203

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<tr>
<td>1 Final Keyed Core</td>
<td>1CP7 (by NAU)</td>
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<tr>
<td>1 Surf Overhead Hold Open</td>
<td>9–326</td>
<td>689 RF</td>
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<td>1 Surface Closer</td>
<td>7500</td>
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<td>1 Gasketing</td>
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### Set: 21.0

Doors: 1002, 1007, 2000, 2001

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<td>1 Wall Stop</td>
<td>406/409</td>
<td>US26D RO</td>
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<td>1 Gasketing</td>
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### Set: 22.0


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<td>1 Final Keyed Mortise Cylinder</td>
<td>1E–74</td>
<td>626 BE</td>
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<tr>
<td>1 Balance of Hardware</td>
<td>By Door Mfg.</td>
<td>OT</td>
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END OF SECTION 087100
SECTION 08 80 00

GLAZING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Glazed curtain walls.
   2. Storefront framing.
   3. Glazed entrances.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
   1. Design Wind Pressures: As indicated on Drawings.
   2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
   3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.03 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

1.05 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: GANA’s “Glazing Manual.”

B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer’s name, type of glass, thickness, and safety glazing standard with which glass complies.
1.06 WARRANTY

A. Manufacturer’s Special Warranty for Coated-Glass Products: Manufacturer’s standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer’s written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer’s Special Warranty on Insulating Glass: Manufacturer’s standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer’s written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat–treated float glass, or Kind FT heat–treated float glass as needed to comply with “Performance Requirements” Article. Where heat–strengthened glass is indicated, provide Kind HS heat–treated float glass or Kind FT heat–treated float glass as needed to comply with “Performance Requirements” Article. Where fully tempered glass is indicated, provide Kind FT heat–treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer’s published test data, based on procedures indicated below:
   1. U-Factors: Center–of–glazing values, according to NFRC 100 and based on LBL’s WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
   2. Solar Heat–Gain Coefficient and Visible Transmittance: Center–of–glazing values, according to NFRC 200 and based on LBL’s WINDOW 5.2 computer program.
   3. Visible Reflectance: Center–of–glazing values, according to NFRC 300.

2.02 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality–Q3, Class I (clear) unless otherwise indicated.

B. Heat–Treated Float Glass: ASTM C 1048; Type I; Quality–Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

2.03 INSULATING GLASS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. PPG Industries, Inc.
   2. Viracron, Inc.
B. Insulating–Glass Units: Factory–assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Sealing System: Dual seal.
   2. Spacer: Aluminum with black, color anodic finish.

2.04 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.05 MONOLITHIC–GLASS TYPES

A. Glass Type GL–1: Clear fully tempered float glass.
   1. Thickness: 6.0 mm.
   2. Provide safety glazing labeling.

2.06 INSULATING–GLASS TYPES

A. Glass Type GL–2: Low–e–coated, clear insulating glass.
   1. Overall Unit Thickness: 1 inch (25 mm).
   2. Thickness of Each Glass Lite: 6.0 mm.
   3. Outdoor Lite: Fully tempered float glass.
   4. Interspace Content: Air.
   5. Indoor Lite: Fully tempered float glass.
   6. Low–E Coatings:
      a. Standard: Comparable to Solarban 60 by PPG Industries, Inc.; sputtered on second surface.
      b. Advanced: Comparable to Sungate 600 by PPG Industries, Inc.; pyrolytic on fourth surface.
   8. Winter Nighttime U–Factor: 0.23 maximum.
   9. Summer Daytime U–Factor: 0.21 maximum.
   10. Solar Heat Gain Coefficient: 0.35 maximum.
   11. Provide safety glazing labeling.

PART 3 – EXECUTION

3.01 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.02 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION
SECTION 09 0500

FLOOR PREPARATION

PART 1 – GENERAL

1.1 SUBMITTALS

A. Section Includes:
   2. Surface preparation of concrete floor to receive the following floor coverings.
      a. Luxury Vinyl Floor
      b. Carpet Tile
   3. Application of vapor protection coating on concrete floors.

1.2 SUBMITTALS

A. Provide Data: Submit complete printed data on all products; preparation and installation procedures.

B. Environmental Design Submittals:
   1. Submit product data for each product stating the VOC content.

C. Warranty: Submit three (3) fully executed originals of specified warranty.

1.3 QUALITY ASSURANCE

A. Installer: Regularly engaged in floor preparation procedures specified and acceptance to the product manufacturer.

B. Product Manufacturer: Provide all products produced by one manufacturer.

1.4 PRODUCT DELIVERY, STORAGE, HANDLING

A. Deliver products to the site in original unopened, undamaged containers bearing labels as to content, handling, storage, last use dates and application only when necessary for use.

B. Handle and store in exact accordance with manufacturer’s instructions.

1.5 SPECIAL WARRANTY

A. Special warranties are in addition to and not an abridgement of any warranty available by law.

B. Provide a special warranty stating the installed system will maintain the moisture vapor transmission rate below 3lbs/1,000 sq. ft./24 hours for a period of ten (10) years from date of Substantial Completion.

C. Include cost for removing and replacing finished floor systems, including materials and labor.
PART 2 – PRODUCTS

2.1 MANUFACTURERS/MATERIALS

A. Subject to compliance with requirements, provide one of the following:
   1. MAPEI:
      a. 2 Component, 100% solids, 1 Coat Epoxy Moisture Barrier – Planiseal EMB.
      b. Crack Treatment: Provide manufacturers standard crack filler for both moving and non–moving joints.
      c. Primer: Primer WE.
      d. Leveling compound – Ultra Plan 1 Plus.
   2. Koester:
      b. Crack Treatment: Provide manufacturers standard crack filler for both moving and non–moving joints.
      d. Leveling Compound: Level Set 300.
   3. Ardex:
      a. Epoxy Based Moisture Control Sealer – ARDEX Moisture Control –S–MC.
      b. Crack Treatment: Provide manufacturers standard crack filler for both moving and non–moving joints.
   4. Aqua Fin:
      a. 2 components, 100% solids, coat moisture vapor emission reduction control system SG2.
      b. Crack Treatment: Provide manufactures standard crack filler for both moving and non–moving joints.
      c. Primer: Not required.
      d. Leveling Compound: 3 parts sand mixed with 1 part SG2.

PART 3 – EXECUTION

3.1 INSPECTION/TESTING

A. Before testing the concrete substrate for moisture, verify that the concrete is in its final conditioned environment at 73°F (23°C) and 50% relative humidity.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   4. Moisture Testing: Perform tests as follows.
      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation on substrates with maximum moisture—vapor—emission rate in excess of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
      b. Perform relative humidity test using in situ probes, ASTM F 2170.

C. Verity Substrate is free of bon–inhibiting materials and is suitable concrete substrate by performing a Direct Tensile Bond Test (ASTM D4541) with a minimum 175 psi (1,21 MPa) as per ACI (American Concrete Institute) recommendations.
3.2 SURFACE PREPARATION

A. Thoroughly clean surface of any substance that could interfere with the bond includes dirt, paint, tar, asphalt, silicates, wax, oil, grease, latex compounds, sealers, curing compounds, form release agents, laitance, loose topping, foreign substances and adhesives residue.

B. Mechanically prepare cracks and control, construction, saw cuts and expansion joints with a diamond crack-chasing/concrete-cutting blade. Overcut the joint width to obtain a sound substrate. Use a dustless collection system to completely remove dust and contaminants.

C. Mechanically clean and prepare the concrete substrate by shotblasting, scarifying, sandblasting, aggressive diamond–cup grinding, aggressive terrazzo diamond–plug grinding or other engineer–approved methods to obtain ICRI (International Concrete Repair Institute) CSP (Concrete Surface Profile) #2 (diamond–cup ground) or #3 (shotblasted).

D. Vacuum the prepared cracks and joints again to remove all dust, steel shot and contaminants.

E. Concrete substrates and ambient room temperatures must be a minimum 60°F (16°C) with a maximum 86°F (30°C). Temperatures must be maintained within this range for a minimum of 24 hours after installation of the finish flooring system.

3.3 APPLICATION – MOISTURE REDUCTION BARRIER

A. Apply in strict accordance with manufacturer’s written instructions.

B. Use a short–nap (3/8” [10 mm]) roller. Start rolling material in a north/south direction, followed immediately in an east/west direction across the entire surface being treated up to and around perimeter of any restrained surfaces (such as walls and columns). Apply only one coat with sufficient material working it into the concrete substrate. Use a quality paintbrush for the hard–to–reach areas.

Note: Do not spray material onto the surface. Material must be worked into the pores of the prepared concrete substrate, cracks, and joints; coat the sidewalls and bottom of the cavity using a roller or brush.

C. Cover the concrete substrate completely without any voids or pinholes fill sawout joints and cracks. Install at a rate as directed by the product manufacture to achieve proper moisture levels.

D. Allow to thoroughly dry.

3.4 APPLICATION OF LEVELING COMPOUND

A. Immediately after mixing, apply in exact accordance with manufacturer’s instructions.

B. Apply using a flat edge steel trowel finishing to smooth level surface free of towel marks.

3.5 PROTECTION

A. Close area to traffic and ventilation until thoroughly dry.

END OF SECTION 09 0500
PART 1 – GENERAL

1.1 SUMMARY
A. This section includes drywall accessories or noise control components as shown on the architectural drawings.

1.2 SUBMITTALS
A. Manufacturer’s Literature and Data:
   1. Product Data: Submit manufacturer’s technical data and brochures for each type of specified component required, including detail drawings, and installation instructions.

B. Shop Drawings:
   1. Shop drawings shall show dimensions, sizes, thickness, alloys, tempers, finishes, joining, attachments, and relationship of adjoining work.

C. Samples:
   1. Samples shall include two, 12” samples of each type of partition closure and finish as specified and accessories.

1.3 QUALITY ASSURANCE
A. Manufacturer: Firm with manufacturing and delivery capacity required for the project, shall have successfully completed at least ten projects within the past five years, utilizing systems, materials and techniques as herein specified.

B. Fabricator must own and operate its own manufacturing facilities for all metal components. Systems consisting of components from a variety of manufacturers will not be considered or accepted.

C. Manufacturer/Fabricator must own and operate its own Painting and Finishing facility to assure single source responsibility and quality control.

1.4 DELIVERY, STORAGE & HANDLING
All materials shall be protected during fabrication, shipment, site storage and erection to prevent damage from other trades. Store accessories inside a well–ventilated area, away from uncured concrete and masonry, and protected from the weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

PART 2 – PRODUCTS

2.1 MANUFACTURER
B. The listed manufacturer shall not be construed as closing specifications to other prospective manufacturers, but rather as establishing a level of quality in a metal system. Other systems may be submitted for approval; as provided for in Division 00.

2.2 SYSTEMS DESCRIPTION

A. Extruded aluminum partition closures are pre-assembled and spring loaded to provide a tight fit for vertical junctures of partitions and window walls. They are finished to match mullions in an anodized finish. They are sound tested to a composite STC of 38 with acoustical batts for sound attenuation.

2.3 MATERIALS

A. Aluminum extrusions: 6063–T5 temper, tensile strength 31 KSI (ASTM B 221, ASTM B 221 M). Provide depths and lengths as noted on drawings.

B. Acoustical Batts for sound attenuation (as specified). Factory-supplied caulk must be installed in the field for acoustical performance purposes.

C. Accessories:
   1. Extruded Aluminum Wall End Caps – size per partition

D. General: Provide metals free from surface blemishes where exposed to view in finished unit. Surfaces that exhibit pitting, seam marks, roller marks, stains, and discolorations, or other imperfections on finished units are not acceptable. All metal shall be of the highest-grade commercial type.

2.4 FABRICATION

A. Provide extruded aluminum partition closures and wall end caps in specified lengths and size to fit specified openings.

2.5 FINISHES

A. All material shall be factory anodized in clear.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examination of Surfaces: Installer must examine conditions under which work is to be performed and must notify contractor in writing of unsatisfactory conditions.

B. Verify that field measurements and block–out dimensions are as shown on shop drawings.

3.2 CLEANING

A. Clean all surfaces following installation. If necessary use only a mild soap or detergent solution such as TSP–90 or Ivory.
SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.

2.02 FRAMING SYSTEMS

A. Steel Studs and Runners: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
   2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:
   1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
   2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
   3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.

C. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: 1-1/2 inches (38 mm).
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

2.03 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
B. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch– (13-mm–) wide flanges.
   1. Depth: 1–1/2 inches (38 mm).

C. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch– (13-mm–) wide flanges, 3/4 inch (19 mm) deep.
   2. Steel Studs and Runners: ASTM C 645.
      a. Minimum Base–Metal Thickness: 0.018 inch (0.45 mm).
      b. Depth: 2–1/2 inches (64 mm).
   3. Hat–Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
      a. Minimum Base–Metal Thickness: 0.018 inch (0.45 mm).

2.04 AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt or foam gasket.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non–load–bearing steel framing members. Frame both sides of joints independently.

3.02 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
   1. Slip–Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb unless otherwise indicated.
   b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.03 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   3. Do not attach hangers to steel roof deck.
   4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION
SECTION 09 29 00

GYPSUM BOARD

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Tile backing panels.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire–resistance–rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.02 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.

2.03 TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer’s standard edges.
   1. Core: 5/8 inch (15.9 mm), Type X. USG FIBEROCK AQUA TOUGH or MOLD TOUGH

2.04 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum–coated steel sheet or rolled zinc.

2.05 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.06 AUXILIARY MATERIALS
A. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

B. Sound Attenuation Blankets: Unfaced blankets as specified in Section 07 21 00 “Thermal Insulation.”

C. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

PART 3 – EXECUTION

3.01 APPLYING AND FINISHING PANELS

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch (6.4- to 12.7-mm) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer’s written instructions.
   1. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

E. Prefill open joints and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 4: Mechanical and utility spaces.
      a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
   4. Level 5: Exposed locations.
      a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

H. Texture Finish Application: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.

I. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non–drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

J. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION
SECTION 09 30 00

TILING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Tile.
   2. Vapor retarder.
   3. Metal edge strips.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: Each type and composition of tile and for each color and finish required.

PART 2 – PRODUCTS

2.01 TILE PRODUCTS

A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. Tile Type WT–1: Ceramic subway tile.
   1. Basis–of–Design Product: Subject to compliance with requirements, provide Sweet Sixteen by Kaiser Tile or approved comparable product.
   2. Face Size: 4 by 16 inches
   3. Thickness: 8.5 mm
   4. Wearing Surface: Ceramic Glaze
   5. Tile Color: Truffle Matte

C. Tile Type FT–1: Porcelain Floor Tile
   1. Basis–of–Design Product: Subject to compliance with requirements, provide Stories by Kaiser Tile or approved comparable product.
   2. Face Size: 12 by 24 inches
   3. Thickness: 9.5 mm
   4. Wearing Surface: Porcelain
   5. Tile Color: Adorn D6

2.02 SETTING MATERIALS

2.03 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

B. Grout Color: #185 New Taupe

2.04 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Schluter Systems Brushed Stainless Steel as noted on drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

3.02 PREPARATION

A. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

B. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.

C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.03 INSTALLATION

A. Comply with TCA’s "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
   a. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.
B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

F. Joint Widths: 1/8 inch

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
   2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

I. Metal Edge Strips: Install at locations indicated or where a tile edge would otherwise be exposed.

§ 04 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Metal Studs or Furring:
   1. Tile Installation W245: Thin-set mortar on gypsum board; TCA W245.
      b. Grout: Polymer–modified sanded grout.

B. Interior Wall Installations, Concrete, Masonry or plaster:
   1. Tile Installation W223: Thin-set mortar on CMU; TCA W223.
      b. Grout: Polymer–modified sanded grout.

END OF SECTION
SECTION 09 5113
ACoustical
Panel Ceilings

Part 1 – General

1.01 Summary

A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.02 Action Submittals

A. Product Data: For each type of product.

1.03 Closeout Submittals

A. Maintenance data.

Part 2 – Products

2.01 Performance Requirements

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
   2. Smoke-Developed Index: 50 or less.

2.02 Acoustical Panel Ceilings, General

A. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

B. Acoustical Panel Standard: Comply with ASTM E 1264.

C. Metal Suspension System Standard: Comply with ASTM C 635.

D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, “Direct Hung,” unless otherwise indicated. Comply with seismic design requirements.

2.03 Acoustical Panels Act-1

A. Basis—of—Design Product: Subject to compliance with requirements, provide Ultima Lay—in by Armstrong World Industries, Inc. or approved comparable product.

B. Classification:
   1. Type and Form: Type IV, mineral base with membrane—faced overlay; Form 2, water felted; with vinyl overlay on face.
C. Color: White.

D. LR: 0.90 minimum

E. NRC: 0.75 minimum, Type E–400 mounting according to ASTM E 795.

F. CAC: 35 minimum.

G. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension—system members.

H. Thickness: 3/4 inch (19 mm).

I. Modular Size: 24 by 24 inches (610 by 610 mm).

2.04 METAL SUSPENSION SYSTEM FOR ACT–1

A. Basis—of—Design Product: Subject to compliance with requirements, provide Prelude XL by Armstrong World Industries, Inc. or approved comparable product.

B. Narrow—Face, Capped, Double—Web, Steel Suspension System: Main and cross runners roll formed from cold—rolled steel sheet; prepainted, electrolytically zinc coated, or hot—dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16—inch—(15 mm—) wide metal caps on flanges.
   1. Structural Classification: Heavy—duty system.
   2. End Condition of Cross Runners: Override (stepped) or butt—edge type.
   3. Face Design: Flat, flush.

C. Roll—Formed, Sheet—Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer’s standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension—system runners.

2.05 ACOUSTICAL PANELS ACT–2

A. Basis—of—Design Product: Subject to compliance with requirements, provide Ultima Lay—in Fireguard by Armstrong World Industries, Inc. or approved comparable product.

B. Classification:
   1. Type and Form: Type IV, mineral base with membrane—faced overlay; Form 2, water felted; with vinyl overlay on face.
   3. Fire: Approved for use in UL G241

C. Color: White.

D. LR: 0.90 minimum

E. NRC: 0.60 minimum, Type E–400 mounting according to ASTM E 795.
F. CAC: 40 minimum.

G. Edge/Joint Detail: square lay-in sized to fit flange of exposed suspension–system members.

H. Thickness: 3/4 inch (19 mm).

I. Modular Size: 24 by 24 inches (610 by 610 mm).

2.06 METAL SUSPENSION SYSTEM FOR ACT–2

A. Basis--of--Design Product: Subject to compliance with requirements, provide Prelude Plus XL Fire Guard by Armstrong World Industries, Inc. or approved comparable product.

B. Narrow--Face, Capped, Double--Web, Steel Suspension System: Main and cross runners roll formed from cold--rolled steel sheet; prepainted, electrolytically zinc coated, or hot--dip galvanized according to ASTM A 653/A 653M, not less than G60 coating designation; with prefinished 15/16--inch-- (15--mm--) wide metal caps on flanges.
   1. Structural Classification: Heavy--duty system.
   2. End Condition of Cross Runners: Override (stepped) or butt--edge type.
   3. Face Design: Flat, flush.
   4. Cap Material: Aluminum
   6. Fire: Approved for use in UL G241

C. Roll--Formed, Sheet--Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer’s standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension--system runners.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer’s written instructions and CISCA’s "Ceiling Systems Handbook."

B. Install ceilings to comply with UL G241 where 1 hr fire rating noted.

C. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less--than--half--width panels at borders, and comply with layout shown on reflected ceiling plans.
   1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

END OF SECTION
SECTION 09 51 13
METAL PERIMETER POCKETS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes Metal Perimeter Pockets as shown on the drawings.

1.2 SUBMITTALS

A. Manufacturer’s Literature and Data:

1. Product Data: Submit manufacturer’s technical data and brochures for each type of specified component including detail drawings, and installation instructions.

2. Shop drawings shall show dimensions, sizes, thickness, alloys, tempers, finishes, joining, attachments, and relationship of adjoining work.

B. Samples:

1. Samples shall include two, 6” pieces of each type of metal perimeter pocket and finish as specified and accessories.

1.3 QUALITY ASSURANCE

A. Manufacturer: Firm with manufacturing and delivery capacity required for the project, shall have successfully completed at least ten projects within the past five years, utilizing systems, materials and techniques as herein specified.

B. Fabricator must own and operate its own manufacturing facilities for all metal components. “Stick Built” or “Kit of Parts Systems” consisting of components from a variety of manufacturers will not be considered or accepted.

C. Manufacturer/Fabricator must own and operate its own Painting and Finishing facility to assure single source responsibility and quality control.

1.4 DELIVERY, STORAGE & HANDLING

All materials shall be protected during fabrication, shipment, site storage and erection to prevent damage to the finished work from other trades. Store accessories inside a well-ventilated area, away from uncured concrete and masonry, and protected from the weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

PART 2 – PRODUCTS

2.1 MANUFACTURER


B. The listed manufacturer shall not be construed as closing specifications to other prospective manufacturers, but rather as establishing a level of quality in a metal system. Other systems may be submitted for approval; as provided for in Division 00

B. Accessories: Manufacturer’s standard alignment devices, splices, corners and end closures will all be furnished as a complete package with single source responsibility.

C. General: Provide metals free from surface blemishes where exposed to view in finished unit. Surfaces that exhibit pitting, seam marks, roller marks, stains, and discolorations, or other imperfections on finished units are not acceptable. All metal shall be of the highest – grade commercial type.

2.3 FABRICATION

A. Provide Metal Perimeter Pockets of design, profile and function as indicated. Select Metal Perimeter Pockets to suit width and depth in 10”0” lengths to reduce the number of end joints.

B. Include corners, end closures and alignment devices to provide tight joints.

C. Provide splices or optional factory applied splice plates to properly secure joints to prevent gaping and insure alignment. Exposed attachments are not acceptable. Gaps at joints are not acceptable when Metal Perimeter Pockets are abutted end to end.

D. Metal Perimeter Pockets are designed to be supported 4’–0” (maximum) on center.

2.5 FINISHES

A. Finish shall be chosen from the Manufacturer’s standard paint finish selection.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examination of Surfaces: Installer must examine conditions under which work is to be performed and must notify contractor in writing of unsatisfactory conditions.

B. Verify that field measurements and block–out dimensions are as shown on shop drawings.

3.2 INSTALLATION

A. General: Comply with manufacturer’s printed instructions, with governing regulations for Seismic Codes, and with the Ceiling & Interior Systems Construction Association standards applicable to work.

B. Install all system components in compliance with ASTM C636–92, with hangers supported only from building structural members.

3.3 CLEANING

A. Clean all surfaces following installation. If necessary use only a mild soap or detergent solution such as TSP–90 or Ivory.

B. Replace coves having scratches, abrasions, or other defects with unblemished coves.

C. Maintenance per manufacturer’s finished maintenance instructions.
SECTION 09 6513

RESILIENT BASE AND ACCESSORIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Resilient base.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

PART 2 – PRODUCTS

2.01 THERMOPLASTIC–RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
   3. Flexco.
   4. Johnsonite; A Tarkett Company.
   5. Nora Systems, Inc.
   6. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
   2. Style: straight at carpet, toe at LVT and Concrete

C. Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer’s standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed.

H. Colors: As selected by Architect from full range of industry colors.

2.02 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic–cement–based formulation provided or approved by resilient–product manufacturer for applications indicated.
B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
   1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 – EXECUTION

3.01 PREPARATION

A. Prepare substrates according to manufacturer’s written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

   4. Moisture Testing: Proceed with installation only after substrates pass one of the following tests according to manufacturer’s written recommendations:
      a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
      b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are the same temperature as the space where they are to be installed.

3.02 RESILIENT BASE INSTALLATION

A. Comply with manufacturer’s written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. Preformed Corners: Install preformed corners before installing straight pieces.
G. Job-Formed Corners:
   1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
      a. Miter corners to minimize open joints.

3.03 CLEANING AND PROTECTION

   A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

END OF SECTION
SECTION 09 65 16
RESILIENT SHEET FLOORING

PART 1 – GENERAL

1. SUBMITTALS
   a. Product Specification
   b. Specification for Adhesive
   c. Floor Layouts
   d. Samples
   e. Qualifications for Installer

2. CLOSEOUT SUBMITTALS
   a. Maintenance Instructions
   b. Warranty
      i. Shaw agrees to repair or replace defective material within the specified warranty period.
         Warranty does not cover the installation. Flooring must be maintained according to Shaw’s
         Maintenance Instructions. Warranty periods are:
         10–year Light Commercial 20 mil+ styles

3. QUALITY ASSURANCE
   a. Environmental: FloorScore® Certified
   b. Installer Qualifications: Installer who has been trained in the installation of resilient sheet flooring.
   c. Mockups: Install 100 sf of product at designated location for architect review and approval. Include
      transition to exterior wall.

4. MATERIAL STORAGE AND HANDLING
   a. Store rolls standing upright; do not lay rolls down for long periods.
   b. When more than one roll of a color is being installed, all material should be from the same batch and the
      rolls must be installed in consecutive order. If material from more than one batch is to be used, the job
      should be laid out so that different batch numbers are not installed side by side.
   c. Flooring material and adhesive must be acclimated to the installation area for a minimum of 48 hours prior
      to installation at a temperature between 65°F and 85°F.

5. SITE CONDITIONS
   a. The permanent HVAC system must be operational and set to a minimum of 65°F or a maximum of 85°F for
      a minimum of 7 days prior to, during and after installation.

6. TESTING REQUIREMENTS
   a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq.cm.

PART 2 – PRODUCTS

1. LUXURY VINYL PLANKS WITH REINFORCED BACKING
   a. Manufacturer: Shaw Contract
   b. Product: Pigment 0503V
   c. Wear—layer Thickness: 20 mil
   d. Dimensions: 7” & 48 “ x 2.5 mm
   e. Wear Surface: Exoguard
2. INSTALLATION MATERIALS
   a. Adhesives:
      - Shaw 4100 spreadable
      - Shaw 200 for low demand areas
   b. Moisture Control (if needed): MoistureShield and MoistureTek
   c. Primer: Shaw 9050
   d. Leveling and Patching Compounds: Use cementitious patching and leveling compounds that meet or exceed Shaw’s maximum moisture level and pH requirements. Use of gypsum-based patching and/or leveling compounds which contain Portland or high alumina cement and meet or exceed the compressive strength of 3,000 psi are acceptable. If you have high moisture issue, be sure to use a moisture-tolerant patch such as USG EXG (exterior grade).
   e. Tack Abatement Coating: Shaw 6200
   f. Barrier Coat Floor Encapsulation: Shaw 9000

PART 3 – EXECUTION

9. EXAMINATION
   a. Ensure that moisture tests have been conducted and that the results do not exceed 90% In–Situ relative humidity when tested according to ASTM F 2170.
   b. PH of concrete sub–floor surface is no greater than 10.
   c. The permanent HVAC system turned on and set to a minimum of 68°F (20°C) for a minimum of 72 hours prior to, during and after installation. After the installation, the temperature should not exceed 100°F.
   d. Flooring material and adhesive need to be acclimated to the installation area for a minimum of 48 hours prior to installation.
   e. Refer to adhesive label for proper roller or trowel requirements
   f. Material should always be visually inspected prior to installations. Any material installed with visual defects will not be considered a legitimate claim as it pertains to labor cost.
   g. Install all cuts and rolls in consecutive sequence.
   h. Ensure that all recommendations for sub–floor and job site conditions are met prior to beginning the installation. Once the installation has started, you have accepted these conditions.

10. PREPARATION OF SUBSTRATE
   a. All substrates to receive resilient flooring shall be dry, clean, smooth and structurally sound. They shall be free of dust, solvent, paint, wax, oil, grease, residual adhesive, adhesive removers, curing, sealing, hardening, or parting compounds, alkaline salts, excessive carbonation or laitance, mold, mildew and other foreign materials that might prevent adhesive bond.
   b. CONCRETE
      i. New or existing concrete subfloors must meet the guidelines of the latest edition of ACI 302 and ASTM F 710.
      ii. On or below–grade slabs must have an effective vapor retarder directly under the slab.
      iii. Wet curing 7 days is the preferred method for curing new concrete.
      iv. Remove curing compounds 28 days after placement, so concrete can begin drying.
      v. Concrete floors shall be flat within 3/16” in 10 ft. F–Number System: Overall values of FF 36/FL 20 may be appropriate for resilient floor coverings.
      vi. Internal relative humidity may not exceed 90% RH.
   c. RESILIENT FLOOR COVERING
      i. Must be single layered, non–cushion backed, fully adhered and smooth.
ii. Must show no signs of moisture or alkaline substances.
iii. Waxes, polishes, grease and grime must be removed.
iv. Cuts, cracks, gouges, dents and other irregularities in the existing floor covering must be repaired or replaced.
v. Note: The responsibility of determining if the existing flooring is suitable to be installed over rests solely with installer/flooring contractor on site. If there is any doubt as to suitability, the existing flooring should be removed or an acceptable underlayment installed over it. Installations over existing resilient flooring may be more susceptible to indentation.

d. OLD ADHESIVE RESIDUE
   i. If the adhesive residue is asphalt–based (cut–back) or any other type of adhesive is present, it must be dealt with in one of two ways:
   ii. It may be mechanically removed such as bead blasting or scarifying;
   iii. A self–leveling Portland based underlayment may be applied over it. Check with the underlayment manufacturer for suitability, application instructions and warranties.
   iv. Never use solvents or citrus adhesive removers to remove old adhesive residue. Solvent residue left in and on the sub–floor may affect the new adhesive and the new floor covering.

k. INSTALLATION:
   Install per the manufacturers’ printed instructions

11. MAINTENANCE
   a. Initial Maintenance
      i. Sweep, vacuum or dust mop to remove dirt and grit.
      ii. If needed, add neutral cleaner to cool water following the manufacturer’s instructions.
      iii. Scrub with a low–rpm machine or auto scrubber. Use a red pad or brush.
      iv. Never use brown or black pads (too aggressive and can damage the product)
      v. Remove the cleaning solution with a wet–dry vacuum or auto scrubber until the floor is dry.
      vi. Rinse the floor with clean water. Repeat the rinse process if necessary to remove all haze.

   b. Routine Maintenance
      i. Sweep, vacuum or dust mop to remove dirt and grit.
      ii. Add neutral pH cleaner to cool water following the manufacturer’s instructions.
      iii. As needed, scrub with a low–rpm machine or auto scrubber to retain appearance. Use a red (light scrubbing) pad and neutral cleaner following the manufacturer’s instructions.

END OF SECTION 096516
SECTION 09 68 13

TILE CARPETING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes modular, tufted carpet tile.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
   2. Type of subfloor.
   3. Type of installation.
   4. Pattern of installation.
   5. Pattern type, location, and direction.
   6. Pile direction.

C. Samples: For each exposed product and for each color and texture specified.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.04 QUALITY ASSURANCE

A. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.06 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.07 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, loss of tuft bind strength, loss of face fiber, and delamination.
   3. Warranty Period: 15 years from date of Substantial Completion.
PART 2 – PRODUCTS

2.01 CARPET TILE (CPT–1)

A. Products: Subject to compliance with requirements, provide the following:
   1. Accelerate 1813 ; J+J Flooring

B. Color: No. Gain 1594

C. Size: 24 by 24 inches in Quarter Turn Pattern.

2.02 CARPET TILE (CPT–2)

A. Products: Subject to compliance with requirements, provide the following:
   1. Zenith 7716 ; J+J Flooring

B. Color: No. Waveform 2554

C. Size: 12 by 48 inches in Ashlar Pattern.

2.03 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex–modified, hydraulic–cement–based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water–resistant, mildew–resistant, nonstaining, pressure–sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
   1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Finishing Accessories
   1. Tandus Centiva Metal Edge–Steel–LVT to Carpet
   2. Johnsonite Edge Guard –Charcoal for Carpet to Concrete

PART 3 – EXECUTION

3.01 INSTALLATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Preparation: Comply with CRI 104, Section 6.2, “Site Conditions; Floor Preparation,” and with carpet tile manufacturer’s written installation instructions for preparing substrates indicated to receive carpet tile installation.
E. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

F. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

G. Maintain dye lot integrity. Do not mix dye lots in same area.

H. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

I. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

J. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

K. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.

L. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

END OF SECTION
SECTION 09 91 23

INTERIOR PAINTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.
   1. Steel.
   2. Galvanized metal.
   3. Wood.

1.02 DEFINITIONS

A. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
B. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
B. Samples: For each type of paint system and in each color and gloss of topcoat.

PART 2 – PRODUCTS

2.01 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List." Basis--of--Design: Sherwin Williams

B. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Nonflat Paints and Coatings: 10 g/L.
   2. Primers, Sealers, and Undercoaters: 10 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

2.02 PRIMERS/SEALERS

A. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.
B. Primer, Latex, for Interior Wood: MPI #39.

2.03 METAL PRIMERS

A. Primer, Rust–Inhibitive, Water Based: MPI #107.

B. Primer, Galvanized, Water Based: MPI #134.

2.04 WATER–BASED PAINTS


B. Latex, Interior, Institutional Low Odor/VOC, Semi–Gloss (Gloss Level 5): MPI #147.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Wood: 15 percent.
   2. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Comply with manufacturer’s written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface–applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface–applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.03 APPLICATION

A. Apply paints according to manufacturer’s written instructions and to recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks,
roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.04 CLEANING AND PROTECTION
Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

A. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.05 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:
   1. Institutional Low–Odor/VOC Latex System:
      c. Topcoat: Latex, interior, institutional low odor/VOC, semi–gloss (Gloss Level 5), MPI #147.

B. Galvanized–Metal Substrates:
   1. Institutional Low–Odor/VOC Latex System:
      a. Prime Coat: Primer, galvanized, water based, MPI #134.
      c. Topcoat: Latex, interior, institutional low odor/VOC, semi–gloss (Gloss Level 5), MPI #147.

C. Wood Substrates: Including doors.
   1. Institutional Low–Odor/VOC Latex System:
      a. Prime Coat: Primer, latex, for interior wood, MPI #39.
      c. Topcoat: Latex, interior, institutional low odor/VOC, semi–gloss (Gloss Level 5), MPI #147.

D. Gypsum Board Substrates:
   1. Institutional Low–Odor/VOC Latex System:
      a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
      c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

END OF SECTION
SECTION 10 11 00
VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Magnetic Glass Markerboards.
   2. Markerboard Accessories.

1.2 ACTION SUBMITTALS

A. Product Data: Manufacturer’s data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Provide for each type of visual display board including section details indicating trim, face material, colors, core and backing materials, dimensions, joint locations and special anchor details.

C. Samples: Submit samples not less than 12 inch square to illustrate materials, finish, color, and configuration of each type of visual display board required.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years documented experience manufacturing similar products.

1.4 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURER


B. The listed manufacturer shall not be construed as closing specifications to other prospective manufacturers, but rather as establishing a level of quality in a visual display board. Other systems may be submitted for approval; as provided for in Division 00.

2.2 MAGNETIC GLASS MARKERBOARDS

A. Frameless VisuGlass Magnetic Glass Markerboards:
   1. Materials
      b. Backing: 24 gauge steel backer and aluminum (ASTM B 221, 6063 alloy with T5 temper) mounting framework with high bond adhesive used to securely attach steel to glass.
   2. Viewing Style:
      a. Horizontal Glass Markerboards
         1) Size as noted on drawings.
   3. Mounting Method:
a. Z-bar hangers concealed to the back of the board with no visible mounting hardware. Number of Z-clips will vary from 4–12 depending on width of markerboard.

B. Markerboard Accessories:
1. Mounted Aluminum Marker Caddy: 1 per each wall.
   a. Colors:
      1) Stainless Steel
2. Board Cleaner: 1 per each wall.
3. Dry-Erase Supplies: 1 set per each wall.

2.3 FABRICATION
A. Laminate facing sheet and backing sheet to core material under pressure, using manufacturer’s recommended adhesive.
B. Provide factory-assembled visual display boards, except where sizes demand partial field assembly.
C. Assemble units in one piece without joints, wherever possible. Where required dimensions exceed maximum panel size available, provide two or more pieces of equal length, as indicated on approved shop drawings. Assemble to verify fit at factory, then disassemble for delivery and final assembly at project site.

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify that substrates are properly prepared to receive visual display boards.
B. Do not begin installation until substrates have been properly prepared.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION
A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION
A. Install in accordance with manufacturer’s instructions.
B. Where visual display boards must be partly assembled at project site, use factory-supplied H-bar to maintain proper alignment.
C. Install visual display boards level and plumb, keeping perimeter trim aligned in accordance with manufacturer’s recommendations.

END OF SECTION
SECTION 10 21 00
TOILET PARTITIONS – HDPE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solid plastic toilet compartments including the following:
   1. Floor mounted overhead–braced toilet compartments.
   2. Privacy screens.

1.02 SUBMITTALS

A. Product Data: Manufacturer’s data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Provide layout drawings and installation details with location and type of hardware required.

C. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: A company regularly engaged in manufacture of products specified in this section, and whose products have been in satisfactory use under similar service conditions for not less than 5 years.

B. Installer Qualifications: A company regularly engaged in installation of products specified in this Section, with a minimum of 5 years experience.

C. Materials: Doors, panels and pilasters, constructed from high density polyethylene (HDPE) resins. Partitions to be fabricated from polymer resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self—lubricating surface that resists marks from pens, pencils, markers and other writing instruments. Cover all plastic components with a protective plastic masking.

D. Performance Requirements:
   1. Fire Resistance: Partition materials shall comply with the following requirements, when tested in accordance with ASTM E 84:
      a. Class B flame spread/smoke developed rating.
   2. Material Fire Ratings:
      a. International Code Council (ICC): Class B.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer’s unopened packaging until ready for installation.

1.05 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by
manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s absolute limits.

1.06 WARRANTY

A. Manufacturer guarantees its plastic against breakage, corrosion, and delamination under normal conditions for 25 years from the date of receipt by the customer. If materials are found to be defective during that period for reasons listed above, the materials will be replaced free of charge. Labor not included in warranty.

PART 2 PRODUCTS

2.01 MATERIAL

A. Plastic Panels: High density polyethylene (HDPE) suitable for exposed applications, waterproof, non-absorbent, and graffiti-resistant textured surface.
   1. Recycled Content; Post Industrial: 25 percent.
   2. Recycled Content; Post Industrial: 100 percent.
   3. Recycled Content; Post Consumer: 100 percent.

B. Zinc Aluminum Magnesium and Copper Alloy (Zamac): ASTM B 86.

C. Stainless Steel Castings: ASTM A167, Type 304.

D. Aluminum: ASTM 6463-T5 alloy.

2.02 SOLID PLASTIC TOILET COMPARTMENTS

A. Basis of Design: Hiny Hiders Toilet Partitions as manufactured by and supplied by Scranton Products.

B. Doors, Panels, and Pilasters: 1 inch (25 mm) thick with all edges rounded to a radius. Mount doors and dividing panels based on height of specified system.
   1. Door and Panel Height: 66 inches (1676 mm).
   3. Pilasters: 82 inches (2083 mm) high and fastened to floor.

C. Panel Color: Traditional Series.
   1. Black – Orange Peel.

D. Pilaster Shoes: 3 inches (76 mm) high type 304, 20 gauge stainless steel. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.

E. Pilaster Shoes: 3 inches (76 mm) high one–piece molded HDPE. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.
   1. Pilaster Plastic Shoe Color: Black.

F. Headrail: Heavy-duty extruded 6463–T5 alloy aluminum with anti–grip design. Finish to be clear anodized. Fastened to headrail brackets with stainless steel tamper resistant Torx head sex bolt, and fastened at the top of the pilaster with stainless steel tamper resistant Torx head screws.
   1. Headrail Brackets: 20 gauge stainless steel with satin finish. Secured to the wall with stainless steel tamper resistant Torx head screws.

G. Wall Brackets:
   1. Stainless Steel Brackets: Stainless steel type 304.
   2. Brackets are fastened to pilasters with stainless steel tamper resistant Torx head screws and fastened to the panels with stainless steel tamper resistant Torx head sex bolts.
3. Bracket Type: Continuous 54 inches (1372 mm) stainless steel.

H. Door Hardware:
1. Continuous Stainless Steel Spring Loaded Hinge:
   a. Hinges: 54 inches (1372 mm).
2. Door Strike/Keeper. Heavy-duty extruded aluminum 6436–T5 alloy with a bright dip anodized finish. Secured to pilasters with stainless steel tamper resistant Torx head sex bolts. Bumper shall be made of extruded black vinyl.
   a. Style: 3 inches (76 mm) stainless steel emergency access.
3. Stainless Steel Slide Bolt Latch and Housing: Heavy-duty stainless steel type 304. The latch and housing to have a bright finish. The slide bolt and button to have a black anodized finish. ADA Compliant
4. Doors supplied with one coat hook/bumper and door pull made of chrome plated Zamak.

2.03 SOLID PLASTIC PRIVACY SCREENS

A. Provide plastic privacy screens in urinal and entry toilet room applications as indicated or scheduled.

B. Panels, and pilasters, if required, 1 inch (25 mm) thick with edges rounded to a radius. Screens to be mounted at 14 inches (356 mm) above the finished floor. Color as selected by Architect from manufacturer's full line of current colors.
   1. Aluminum heat sink fastened to bottom edges.
   2. Recycled content: Minimum 25 percent.

C. Screen Type: Wall mounted.
   1. Urinal Screens: 18 inches (457 mm) wide by 42 inches (1067 mm) high.

D. Wall Brackets: Extruded PVC plastic. Fastened to the panel/pilaster with stainless steel tamper resistant torx head screws and fastened to wall with stainless steel tamper resistant torx head sex bolts.
   1. Length of Wall Brackets: 41 inches (1041 mm).
   2. Bracket Color: Black.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Examine areas to receive toilet partitions, screens, and shower compartments for correct height and spacing of anchorage/blocking and plumbing fixtures that affect installation of partitions. Report discrepancies to the architect.

3.03 INSTALLATION

A. Install in accordance with manufacturer’s instructions.
B. Install partitions rigid, straight, plumb, and level manner, with plastic laid out as shown on shop drawings.

C. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 3/8 inch (9.5 mm).

D. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.

E. Finished surfaces shall be cleaned after installation and be left free of imperfections.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 – GENERAL
1.01 SUMMARY
   A. Section Includes:
      1. Stainless Steel corner guards.

1.02 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

1.03 QUALITY ASSURANCE
   A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

PART 2 – PRODUCTS
2.01 MATERIALS
   A. Stainless Steel: Type 304, 16 gauge Stainless Steel
   B. Fasteners: Field Applied heavy duty construction adhesive

2.02 CORNER GUARDS, STAINLESS STEEL, SURFACE MOUNT
   A. Surface–Mounted, fabricated with 90– or 135–degree turn to match wall condition.
      1. Dimensions:
         a. 2” wing
         b. 48” high
      2. Corner: Rounded Edge
      3. Finish: Brushed with Clear Protective Coating

PART 3 – EXECUTION
3.01 INSTALLATION
   A. General: Install impact–resistant wall protection units level, plumb, and true to line without distortions.
      Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the
finished Work.
1. Install impact–resistant wall protection units in locations and at mounting heights indicated on Drawings and at all outside corners exposed to traffic.
2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
   a. Provide anchoring devices to withstand imposed loads.

END OF SECTION
SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 – GENERAL

1.01 SUMMARY
   A. Section Includes: Public–use washroom accessories.

1.02 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.

1.03 CLOSEOUT SUBMITTALS
   A. Maintenance data.

PART 2 – PRODUCTS

2.01 PUBLIC–USE WASHROOM ACCESSORIES
   A. Basis–of–Design Product: Subject to compliance with requirements, provide product indicated or approved comparable product.
   B. Waste Receptacle: (1 per restroom)
      2. Description: Removable waste receptacle.
      5. Material and Finish: Stainless steel, No. 4 finish (satin).
      7. Lockset: Tumbler type
   C. Grab Bar: (1 set of 3 bars per each ADA stall)
      1. Mounting: Flanges with concealed fasteners.
      2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
         a. Finish: Knurled, No. 4 finish (satin).
      3. Outside Diameter: 1–1/2 inches (38 mm).
   D. Sanitary–Napkin Disposal Unit: (1 per female stall)
      2. Mounting: Surface, partition mounted
      3. Door or Cover: Self–closing, disposal–opening cover.
      4. Receptacle: Removable, leak–proof
5. Material and Finish: Stainless steel, No. 4 finish (satin).

E. Changing Station: (1 per restroom)
   2. Mounting: Recessed Mounted
   3. Material: 16g 304 Brushed Stainless Steel with Polyethylene interior

F. Owner Provided Contractor Installed Accessories
   1. Toilet Seat Cover Dispensers (1 per WC)
   2. Towel Dispensers (2 per restroom)
   3. Soap Dispensers (1 per Lav)

2.02 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six insert number keys to Owner’s representative.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install accessories according to manufacturers’ written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

END OF SECTION
SECTION 10 44 13

FIRE PROTECTION CABINETS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes fire-protection cabinets for portable fire extinguishers.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.03 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 – PRODUCTS

2.01 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. JL Industries, Inc.; a division of the Activar Construction Products Group.
   b. Larsens Manufacturing Company.
   c. Nystrom, Inc.
   d. Potter Roemer LLC.

B. Cabinet Construction: Nonrated/Rated

C. Cabinet Material: Stainless-steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: 1–1/4– to 1–1/2–inch (32– to 38–mm) backbend depth.

E. Cabinet Trim Material: Same material and finish as door.

F. Door Material: Stainless-steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color: Clear transparent acrylic sheet.

I. Door Hardware: Manufacturer’s standard door—operating hardware of proper type for cabinet type, trim style, and door
material and style indicated.

J. Accessories:
1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
   a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
      1) Location: Applied to cabinet door.
      3) Lettering Color: Black.
      4) Orientation: Vertical.

K. Materials:
1. Stainless Steel: ASTM A 666, Type 304.
   a. Finish: No. 4 directional satin finish.
2. Transparent Acrylic Sheet: ASTM D 4802, Category A–1 (cell–cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.02 FABRICATION
A. Fire–Protection Cabinets: Provide manufacturer’s standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 – EXECUTION

3.01 INSTALLATION
A. Prepare recesses for semirecessed fire–protection cabinets as required by type and size of cabinet and trim style.
B. Install fire–protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
C. Fire–Protection Cabinets: Fasten cabinets to structure, square and plumb.
D. Identification: Apply vinyl lettering at locations indicated.
E. Adjust fire–protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION
SECTION 10 44 16

FIRE EXTINGUISHERS

PART 1 – GENERAL

1.01 SUMMARY
   A. Section includes portable, hand-carried fire extinguishers.

1.02 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.03 INFORMATIONAL SUBMITTALS
   A. Warranty: Sample of special warranty.

1.04 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

1.05 COORDINATION
   A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.06 WARRANTY
   A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
      1. Warranty Period: Six years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
   A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, “Portable Fire Extinguishers.”
   B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.02 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS
   A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
      1. Manufacturers: Subject to compliance with requirements, provide products by the following:
         a. Amerex Corporation.
      2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
   B. Multipurpose Dry—Chemical Type: UL-rated 3–A:40–B:C, 5–lb (2.3–kg) nominal capacity, with monoammonium
phosphate–based dry chemical in manufacturer’s standard enameled container.
PART 3 – EXECUTION

3.01 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION
SECTION 12 24 13

ROLLER WINDOW SHADES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes manually operated roller shades.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Samples: For each exposed product and for each color and texture specified.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mecho/5 Slimline by MechoSystems or approved comparable product.

2.02 ROLLER SHADES

A. Chain–and–Clutch Operating Mechanisms: With continuous–loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
   1. Bead Chains: Manufacturer’s standard.
      a. Loop Length: Full length of roller shade.
      b. Limit Stops: Provide upper and lower ball stops.
      c. Chain–Retainer Type: Clip, jamb mount.

B. Rollers: Corrosion–resistant steel or extruded–aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive–end assemblies and idle–end assemblies designed to facilitate removal of shadebands for service.
   2. Direction of Shadeband Roll: Regular, from back of roller.
C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

E. Shadebands:
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      a. Type: Enclosed in sealed pocket of shadeband material.

F. Installation Accessories:
   1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
      a. Shape: L-shaped.
      b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 4 inches (102 mm).
   2. Installation Accessories Color and Finish: As selected from manufacturer's full range.
   3. Metal Perimeter Pockets Reference 09 51 13

2.03 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
   1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
   1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
   2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 – EXECUTION

3.01 ROLLER-SHADE INSTALLATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
C. Install roller shades level, plumb, and aligned with adjacent units, according to manufacturer’s written instructions.

D. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

E. Clean roller-shade surfaces after installation, according to manufacturer’s written instructions.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Wood casework.
   2. Table frames.
   3. Work Surface.
   4. Accessory items as specified herein.

1.02 CASEWORK DESIGN

A. Door and Drawer Design:
   - FLUSH OVERLAY: Square edged flush overlay design with 1/8" reveals between door to door, door to
drawer, drawer to drawer; 1/16" vertical reveal between doors/drawers and cabinet ends.

B. Standard grain pattern:
   1. End panels – vertical.
   2. Shelving – the grain shall run the width (left to right) of the shelf.
   3. Bottoms and tops of all units – the grain shall run the width (left to right) of the unit.

C. Grain pattern on cabinet fronts:
   - VERTICAL MATCHED GRAIN: Continuous vertical grain match on door and drawer fronts of individual
     cabinets. (Available for flush overlay construction only.)

D. Cabinet end panels exposed to view after installation must have finished ends. All end panels not exposed
to view after installation will be as listed under “concealed” plywood.

E. Cabinets to be rigid, self-supporting design for use in assembly or as a single stand alone unit if furnished
   with exposed finished ends. Suspended units are without sub base.

F. Flush interiors: Surface mounted bottoms and offsets caused by front face frames, which interfere with
ease of cleaning, are not acceptable.

G. Joinery: 32mm doweled joinery system glued, clamped and screwed. Dowels are to be hardwood,
laterally fluted with chamfered ends and a minimum diameter of 8mm. Spacing of dowels to meet AWI
(Architectural Woodworking Institute) and WI (Woodwork Institute) standards.

1.03 SUBMITTALS

A. Structural performance requirements: Casework components shall withstand the following minimum loads
   without damage or permanent deformation to the component or to the casework operation:
1. Steel base unit load capacity: 500 lbs. per lineal foot.
2. Suspended units: 300 lbs.
3. Drawers in a cabinet: 150 lbs.
5. Hanging wall cases: 300 lbs.
6. Load capacity for shelves of base units, wall cases and tall cases: 40 lbs. per square foot, up to 200 lbs.

B. Shop Drawings: Provide large scale plans and elevations of casework, cross sections, rough in and anchor placements, tolerances and clearances. Indicate relationship of units to windows, doors, surrounding walls and other building components.

C. Product Data: Submit manufacturer’s catalog for reference. Include cabinet dimensions, configurations, construction details, joint details, attachment details, and rough in details as required.

D. Product Samples to be submitted for approval: (1 each)
   1. Worktop: 4” x 4” sample of each material.
   2. Finish: 3” x 5” sample of each available standard stain color with finish.
   3. Hardware: Pulls, locks and hinges.

1.04 QUALITY ASSURANCE

A. Single source: Casework to be manufactured and furnished by a single laboratory furniture company.

B. Manufacturer’s qualifications: Modern plant with proper tools, dies, fixtures and skilled production staff to produce high quality laboratory casework and fume hoods, and shall meet the following minimum requirements:
   1. Minimum of ten years experience in the manufacturing of wood laboratory casework and fume hoods.
   2. Ten installations of equal or larger size.
   3. Must be financially stable.
   4. Must be a member of AWI and be QCP certified.

2. Finish for Wood Laboratory Products

All Wood Laboratory Products shall utilize an environmentally friendly, laboratory grade, water–borne finish.

A. Chemically Resistance Finish: Only highly chemically resistant water–borne finish that passes the casework specifications listed in Section 2.11 for chemical and durability resistance will be acceptable. A letter from a third–party testing agency, verifying independent test results, shall be submitted to the Owner Representative/Architect for approval – prior to award of contract.

B. VOC Emissions: Water–borne finishes shall be sprayed and cured with a maximum of 2.0 lbs. per gallon VOC (Volatile Organic Compounds) emissions as measured by EPA Method 24.

1.05 PROJECT CONDITIONS

A. Do not deliver or install wood product until the following conditions are met:
   1. Windows and doors are installed and the building is secure and weather tight.
   2. Ceiling, overhead ductwork and lighting are installed.
3. All painting is completed and floor tile is installed.
4. Interior building temperature to be between 65 and 80 degree F, and ambient relative humidity maintained between 25% and 55% prior to delivery, and during and after installation. Frequent and/or excessive changes in temperature and/or humidity levels during casework installation, or once casework is installed, must be avoided to prevent damage to materials.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Design, materials, construction and finish of casework as specified represents the minimum acceptable standard of quality for wood laboratory casework. Specifications are based on product by Hamilton Laboratory Solutions.

B. Nationally recognized manufacturers proposing casework different from that specified will be considered

C. Warranty: Provide manufacturer’s one--year warranty against defects in materials and workmanship.

2.02 CASEWORK MATERIALS

A. Definition of cabinet components by surface visibility:

1. EXPOSED SURFACES

a. Surfaces visible when drawers and solid doors are closed.
b. Surfaces visible behind clear glass doors, including tops and bottoms of shelves.
c. Interior surfaces of open units, including tops and bottoms of shelves.
d. Bottoms of cabinets 42” or more above finished floor.
e. Tops of cabinets less than 78” above finished floor, or are visible from an upper floor or staircase after installation.
f. Front edges of cabinet body members visible though a gap greater than 1/8” with doors and drawers closed.
g. Surfaces visible when fixed appliances are installed.
h. All front edges of shelving.

2. SEMI–EXPOSED SURFACES

a. Surfaces visible when doors or drawers are open.
b. Bottoms of cabinets 30” – 42” above finished floor.

3. CONCEALED SURFACES

a. Surfaces not normally visible after installation.
b. Bottoms of cabinets less than 30” above finished floor.
c. Tops of cabinets over 78” above finished floor which are not visible from an upper level.
d. Stretchers, blocking, components concealed by drawers.

B. Hardwood:

1. Hardwood lumber, free of defects. All lumber kiln dried to uniform moisture content of 6%--8%.

a. Exposed material:
C. **Plywood:**

1. **Core:**
   - 7-ply minimum (3/4" thick) veneer core plywood with cross and face plies bonded with Type II water resistant glue.

2. **Particleboard Core:** Grade 1–M–2, 48lb. density.

3. **Face veneers:**
   a. **Exposed surfaces:**
      - Rift cut red oak veneer, grade A, selected for wheat color, on cabinet fronts; Grade A, for the rest of the cabinet. Book matched, running matched only.
   b. **Semi–exposed:** Same species as exposed, grade 1 for maple, grade B for oaks.
   c. **Concealed:** Same species as semi–exposed.

D. **Hardboard:** Wood fibers and natural resin binders formed under heat and pressure.

E. **Glass:**
   - Tempered safety glass (3mm on wall/upper cases and 6mm on tall cases).

F. **NAUF Glue:** Laminating; Type II water resistant; assembly; Type III water resistant.

G. **Edgebanding:** 3mm hardwood on all edges of doors and drawers; fronts of shelves, base, wall, upper and tall cases. Bottoms and tops of wall, upper and tall case end panels to be .5mm.

H. **Finish:** Exposed and semi–exposed surfaces to have a highly chemical resistant, HAP’s (Hazardous Air Pollutants) free water based finish with built in U.V. blocker and stain. A minimum of 10 stain color choices shall be available. Finish must have less than 2.0 lbs per gallon of VOC’s per EPA Method 24. Products with Aziridin and Iso–cyanate will not be allowed.

**2.03 CASEWORK FABRICATION**

A. **Base Units:**

1. **Cabinet ends:** 3/4" thick plywood (for both exposed and concealed ends) with 3mm hardwood banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and four rows of shelf support holes:
   - No levelers required. Wood shimming approved.

2. **Top rails:**
   - **Front and Back:**
     a. Horizontal front top rail: 1" x 3" exposed solid hardwood or edge banded 9–ply minimum veneer core plywood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
b. Vertical back top rail: 3/4" x 3–3/4" solid hardwood or 7–ply minimum veneer core plywood. Attach to cabinet ends with glued 8mm dowel joinery and screws.

- Full Top Frame:
  a. Horizontal front top rail: 1" x 3" exposed solid hardwood or edge banded 9–ply minimum veneer core plywood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
  b. Vertical back top rail: 3/4" x 3–3/4" solid hardwood or 7–ply minimum veneer core plywood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
  c. Top side rails: 3/4" x 1–1/2" solid hardwood between front horizontal and back vertical rails, glued and screwed in place.

3. Intermediate rails:
   a. Front horizontal intermediate rail: 3/4" x 1–1/2" exposed solid hardwood rail to be provided between doors and drawers. Secure to cabinet end panels with glued 8mm dowel joinery. (Front intermediate rails will always be furnished on Lipped Overlay cabinets and on locked and keyed differently cabinets.)
   b. Intermediate Rear Rail: 3/4" x 1–1/2" solid hardwood rail, secured to cabinet end panels with glued 8mm dowel joinery. (Front and rear intermediate rails will always be furnished if security panels are included on locked and keyed differently cabinets.)

4. Toe space rail: 3–3/4" x 3/4" hardwood or 7–ply minimum 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: 3/4" thick plywood, set flush and joined to cabinet end panels with glued 8mm dowels and metal fasteners. Front edge to be banded with 3mm hardwood banding. Suspended unit bottoms to be 1" thick.

6. Backs:

   a. Cupboard units: One–piece 3/16" thick hardboard, rabbeted into rear top rail for easy removal from inside of cabinet.
   b. Drawer units:
      – Open back on units
   c. Sink units: Half height, one–piece 3/16" thick hardboard, rabbeted into rear rail for easy removal from inside of cabinet.

7. Vertical dividers in combination cabinets: 1–1/2" thick 13–ply minimum veneer core plywood panel (frames not permitted) glued and screwed in place, top and bottom with 3mm hardwood banding on front edge.

8. Security panels:
   – 3/16" thick hardboard panel rabbeted into front and rear rails (automatically included) and end panels, between drawers and above doors on units with locks. (Select for cabinets with locks keyed differently.)

9. Shelves:
   – 1" thick, 9–ply minimum veneer core plywood; 3mm hardwood banded on front edge, adjustable on 32mm centers.
   Depth:
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. Sides shall be joined by:
      – Lock joint, glued and pinned.
   b. Bottom: Nominal 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:
      – White coated MDF board.
   c. Divider grooves:
      – None.

11. Door and removable drawer front construction:
   – 3-ply, 3/4” thick particleboard core 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 3/4” thick 7–ply minimum veneer core plywood or lumber as required, with same stain and finish.

13. Pullboards: 1” thick plywood with balanced laminated faces. Writing surface is Antique White in color. Front to be constructed the same as a drawer front with reveals and grain as specified for cabinet face exterior. Suspension to be 3/4 extension, open roller, 75 lb. dynamic load, with hold open feature and epoxy coated.

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 minimum veneer core plywood with 3mm hardwood banding on front edge.

3. Bottoms:
   a. Wall and upper case: 1” thick, 9–ply minimum veneer core plywood with 3mm hardwood banding on front edge.
   b. Tall case: 3/4” thick, 7–ply minimum veneer core plywood with 3mm hardwood banding on front edge. Bottom plywood kick rail 3–3/4” high joined to cabinet sides.

4. Exposed backs: 1/4” thick veneered MDF plywood with backs recessed 7/8” and set into top, bottom and ends, sealed with hot melt glue process around entire perimeter.

5. Semi–exposed backs:
   – 1/4” thick veneered MDF plywood with backs recessed 7/8” and set into top, bottom and ends, sealed with hot melt glue process around entire perimeter.

6. Shelves
   – 1” thick, 9–ply minimum veneer core plywood; 3mm hardwood banded on front edge, adjustable on 32mm centers.
7. Door construction:
   - 3-ply, 3/4" thick particleboard core with 3mm hardwood banding on all four edges.

8. Framed glass doors: Solid hardwood, 3/4" x 2-3/4" 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. For sliding doors: nylon roller suspension riding in overhead steel track with bottom retainer strip.

9. 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. Drawer suspension, except on files:
   - Full extension, self-closing, ball bearing roller, 100 lb. dynamic load, epoxy coated.

2. File drawer suspension: Full extension with overtravel, ball bearing roller, 150 lb. dynamic load, zinc plated. File drawers to have built in hanging system.

3. Drawer and hinged door pull:
   - 4" Wire:
     - Stainless steel.

4. All pulls are mounted horizontally on drawers and:
   - Vertically on doors

5. Hinges: Notch for proper fit:
   - 5 knuckle, institutional style, hospital tipped, provide two hinges for doors up to 48" high; three hinges for doors over 48" high.
     - Stainless steel.

6. Unit shelf supports:
   - Metal pin and socket.

7. Door catches:
   - Adjustable, spring actuated nylon roller.
   - Magnetic.

8. Tall cabinet door catches on two door units when locks are required: Heavy-duty spring bolts located at top and bottom of door without the lock. Bolts are attached to one another by means that will conform to ADA requirements.

9. Elbow catches: Spring type with strike.

10. Locks, where indicated on drawings:
    - shall accept the BEST 7pin SFIC cores and be Olympus 721DW or equal

11. Label holders (if shown on drawings): 1-3/8" x 2-5/8", pinned to drawer and door fronts.
    - None required on this project.
    - One on each door and drawer with a finish of:
      - Stainless steel.
    - One on each single door and one on each pair of doors, and one on each drawer with a finish of:
12. Number plates (if shown on drawings): Shall be anodized aluminum with black numbers. Start with number (1) in each room where required. To be field installed.

2.04 TABLE FRAME

A. Perimeter table frame rails: 3/4" x 4–5/16" hardwood or 7–ply minimum veneer core plywood with attached steel corner braces, grooved and screwed into both rails at each corner. (Bottom rail edges to be radiused.)

B. Reinforcing cross rails: 3/4" 7–ply minimum veneer core plywood, dowelled and glued and pinned into front and back rails, at intervals not more than 33" on center in tables without drawers.

C. Separate cross rails: 3/4" x 4–5/16" hardwood or 7–ply minimum veneer core plywood with attached steel brackets at both ends.

D. 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.

E. Leg rails (if required): 1–1/4" x 2–1/2" hardwood mortised into legs and secured with 3/8"–16 x 5" stove bolt.

F. Leg shoes: Black rubber or vinyl with provision for floor clip.

2.05 SOLID PHENOLIC RESIN COMPOSITE LABORATORY WORK SURFACE

A. Material: Trespa Top Lab Plus Solid Phenolic, Black matte sheen, 1” thick (25mm) with 1/8” (3.175 mm) machined beveled top edge with blended bevel corners. Works surface shall be flat.

B. Backsplash curb: Same material as top, 4” high, supplied loose, bonded to top with epoxy resin adhesive. Provide where tops abut wall surfaces, fume hoods and locations noted on drawings. Include end curb where top abuts end wall.

C. Chemical Resistance Test Procedure: Follow SEFA 8 standards for chemical resistant testing and evaluations.

2.06 UNDER COUNTER MOUNT EPOXY SINKS

A. Material: DURATOP® Epoxy Sinks: Integrally molded from modified thermosetting epoxy resin, and oven cured. Nominal wall thickness of 1/2” (12.5 mm) with all interior corners coved to 1–1/2” (38 mm) radius and bottoms pitched to the outlet opening.

B. Undercounter mounted sink shall be installed from underside of countertop. Join work surface and sink with a 2-part epoxy grout adhesive or with a lab grade silicone.

C. Provide sink supports, hanging systems or other rod supports required.

D. Sink Color: Black to match adjacent work surface of Trespa Top Lab Plus solid phenolic.
2.06 WOOD FINISH

A. Chemical Resistance Test Procedure: Follow SEFA 8 standards for chemical resistant testing and evaluations. In addition, finished panels shall also be tested vertically during exposure to the test chemicals. Chemical concentrations shall be adjusted by the weight 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 and blotted dry. After 24 hours, the test surface shall be scrubbed with a damp paper towel and dried with paper towels, then evaluated.

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, 3/4” 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.

3. Ratings:
   a. No effect – Indicates no effect in gloss or color.
   b. Excellent – Indicates slight change in gloss or color.
   c. Good – Indicates slight surface etching or discoloration.

4. Test results: (Minimum requirements in addition to no more that four, level 3 per SEFA standards)

<table>
<thead>
<tr>
<th>REAGENT</th>
<th>HORIZONTAL TEST RATING</th>
<th>VERTICAL TEST RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Amyl Acetate</td>
<td>No effect</td>
<td>No effect</td>
</tr>
<tr>
<td>2. Ethyl Acetate</td>
<td>No effect</td>
<td>No effect</td>
</tr>
<tr>
<td>3. Acetone</td>
<td>No effect</td>
<td>No effect</td>
</tr>
<tr>
<td>4. Acid Dichromate 5%</td>
<td>No effect</td>
<td>No effect</td>
</tr>
<tr>
<td>5. Butyl Alcohol</td>
<td>No effect</td>
<td>No effect</td>
</tr>
<tr>
<td>6. Ethyl Alcohol</td>
<td>Excellent</td>
<td>No effect</td>
</tr>
<tr>
<td>7. Methyl Alcohol</td>
<td>No effect</td>
<td>No effect</td>
</tr>
<tr>
<td>8. Ammonium Hydroxide 28%</td>
<td>Excellent</td>
<td>No effect</td>
</tr>
<tr>
<td>9. Benzene</td>
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<td>No effect</td>
</tr>
<tr>
<td>10. Carbon Tetrachloride</td>
<td>No effect</td>
<td>No effect</td>
</tr>
<tr>
<td>11. Chromic Acid 60%</td>
<td>Excellent</td>
<td>No effect</td>
</tr>
<tr>
<td>12. Chloroform</td>
<td>No effect</td>
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</tr>
<tr>
<td>13. Dimethyl Formamide</td>
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<td>No effect</td>
</tr>
<tr>
<td>14. Dioxane</td>
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<td>No effect</td>
</tr>
<tr>
<td>15. Ethyl Ether</td>
<td>No effect</td>
<td>No effect</td>
</tr>
<tr>
<td>16. Formaldehyde 37%</td>
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</tr>
<tr>
<td>17. Gasoline</td>
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<td>No effect</td>
</tr>
<tr>
<td>18. Hydrochloric Acid 37%</td>
<td>Excellent</td>
<td>No effect</td>
</tr>
<tr>
<td>19. Hydrofluoric Acid 48%</td>
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<td>20. Hydrogen Peroxide 30%</td>
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<tr>
<td>21. Methyl Ethyl Ketone</td>
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</tr>
<tr>
<td>22. Mono Chlorobenzene</td>
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<td>23. Naphtha, VM&amp;P</td>
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<td>No effect</td>
</tr>
<tr>
<td>No.</td>
<td>Substance</td>
<td>Effect</td>
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<tr>
<td>-----</td>
<td>-----------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>24</td>
<td>Nitric Acid 30%</td>
<td>No effect</td>
</tr>
<tr>
<td>25</td>
<td>Nitric Acid 70%</td>
<td>Good–stain</td>
</tr>
<tr>
<td>26</td>
<td>Phosphoric Acid 85%</td>
<td>No effect</td>
</tr>
<tr>
<td>27</td>
<td>Silver Nitrate, Saturated</td>
<td>No effect</td>
</tr>
<tr>
<td>28</td>
<td>Sodium Hydroxide 10%</td>
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</tr>
<tr>
<td>29</td>
<td>Sodium Hydroxide 20%</td>
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<td>30</td>
<td>Sodium Hydroxide 40%</td>
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<td>31</td>
<td>Sodium Hydroxide, Flake</td>
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<tr>
<td>32</td>
<td>Sodium Sulfide, Saturated</td>
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<tr>
<td>33</td>
<td>Sulfuric Acid 77%</td>
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<tr>
<td>34</td>
<td>Toluene</td>
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<tr>
<td>35</td>
<td>Trichlorethylene</td>
<td>No effect</td>
</tr>
<tr>
<td>36</td>
<td>Xylene</td>
<td>No effect</td>
</tr>
<tr>
<td>37</td>
<td>Zinc Chloride, Saturated</td>
<td>No effect</td>
</tr>
<tr>
<td>38</td>
<td>Acetic Acid</td>
<td>Excellent</td>
</tr>
<tr>
<td>39</td>
<td>Sulfuric Acid 77% and Nitric Acid 70%, equal parts</td>
<td>Good–stain</td>
</tr>
</tbody>
</table>

### PART 3 EXECUTION

#### 3.01 INSTALLATION

A. Casework installation:

1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.

2. Fasten continuous cabinets together with joints flush, tight and uniform, with alignment of adjacent units within 1/16" tolerance.

3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board. Blocking in wall by rough carpentry, Division 6.

4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8" between top units.

B. Work surface installation:

1. Where required due to field conditions, scribe or caulk to abutting surfaces.

2. Secure joints in the field, where practicable, in the same manner as in factory, with dowels, adhesive or fasteners recommended by manufacturer.

3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

C. Sink installation: Sinks shall be set in chemical–resistant sealing compound, secured and supported per manufacturer’s recommendations.

D. Accessory installation: Install accessories and fittings in accordance with manufacturer’s recommendations. Turn screws to seat flat; do not drive.

#### 3.02 ADJUSTING
A. Repair or remove and replace defective work, as directed by (Architect/Owner) upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.03 CLEANING

A. Broom clean finished casework, touch up as required.

B. Clean materials as recommended by manufacturer.

END OF SECTION
SECTION 12 36 61

SOLID SURFACE COUNTERTOPS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Solid Surface Countertops.

1.02 SUBMITTALS

A. Product Data: Submit complete printed data on all specified manufactured items.

B. Shop Drawings: Submit Shop Drawings for shop fabricated items, showing location of each item, dimensioned plans and elevations, large scale details, anchors and other components. Indicate compliance with specified Standards and other specified requirements for materials and workmanship.

C. Samples:

1. Submit samples, approximately 6” square full thickness corner sections of solid surface material having finish proposed for the project.

1.03 QUALITY ASSURANCE

A. Fabricator/Installer: A firm which has successfully produced work similar to the quality specified and in the quantity shown for a period of not less than 5 years.

1.04 DELIVERY, STORAGE AND HANDLING

A. Protect material during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Store materials and completed work only in a dry, ventilated place, protected from the weather.

1.05 PROJECT CONDITIONS

A. Environmental Requirements: Do not start Work until room or space is at normal use temperature and humidity.

B. Field Measurements: Where solid surface is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support by field measurements before on Shop Drawings.

1.06 COORDINATION

A. Coordinate and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that the solid surface can be supported and installed as indicated.

PART 2 – PRODUCTS

SOLID SURFACE COUNTERTOPS
2.01 MATERIALS

A. Solid Surface Material:
   1. Material: Caesarstone
   2. Color: 4033 Rugged Concrete
   3. Thickness: ⅜”
   4. Edge: 1/8 eased edge
   5. Apron: 1 1/2”

2.02 FABRICATION

A. Shop–fabricate to the greatest extent possible, disassemble only as necessary for delivery and installation.

B. Counter Construction:
   1. Counter Top Supports: Where counter top span exceeds 48”, provide mid span support as shown.

C. Solid surface material: Shape to dimensions and profiles shown. Provide smooth finish on all exposed surfaces, edges and ends.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Basic Requirements:
   1. Install over ¾” plywood sub–top

B. Shop Fabricated Items:
   1. Install plumb, level, true and straight with no distortions.
   2. Provide tops fabricated in largest sizes practical. Assemble in field with splines for alignment and drawn tight to hairline contact with tight–joint fasteners.

C. Attachment: Set units using Construction Adhesive recommended by the manufacturer.

3.02 CLEANING AND PROTECTION

A. Repair or remove and replace defective work upon completion of installation.

END OF SECTION
SECTION 13 42 75

INTEGRATED INTERIOR ASSEMBLIES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Delegated design of integrated interior assemblies.
   2. Structure.
   3. Finish panels.
   4. Doors and frames.
   5. Door hardware.
   6. Factory integrated components.

1.2 SUBMITTALS

A. Product Data: Provide manufacturers standard tech sheets as applicable to the project for the following: Structure, Doors and Frames, Door Hardware, and Accessories.

B. Shop Drawings: Submit shop drawings for review prior to commencing any fabrication of the integrated interior assemblies. Coordinate as required until scope is confirmed by all affected stakeholders. Include manufacturer provided plans, elevations, sections, schedules and applicable notes.
   1. Field verify dimensions and locations prior to development of shop drawings.

C. Delegated Design Submittals: Provide structural analysis data and calculations for installed products to demonstrate compliance with design loads, signed and sealed by licensed professional engineer registered in the jurisdiction of the project.
   1. Include engineering calculations for grid connections, bulkhead connections, and seismic conditions.

D. Samples:
   1. Manufacturers full range of finishes for selection

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section, of the quality and complexity required for this project for a minimum 10 years. Show production facilities capable of meeting contract requirements for single-source responsibilities and warranty.
   2. Wall Installer Qualifications: Company trained and certified by manufacturer and specializing in performing the work of this section.

B. Source Limitations: Obtain integrated interior assemblies from a single source.
1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver or install integrated interior assemblies until spaces are enclosed and weather-tight, wet work is complete and dry, work above ceilings is substantially complete, and HVAC system is operational and able to maintain ambient temperature and humidity conditions between 60 and 90 degrees Fahrenheit (15.5 and 32.2 Celsius) with Relative Humidity maintained between 25 and 55 percent.

B. Do not allow packaging to get wet or develop condensation.

C. Comply with the manufacturer’s requirements for a warrantable installation of the installed products to meet the Performance and Design Criteria.

D. Collect and return re-usable packaging “cookies” to manufacturer.

1.5 WARRANTY

A. Manufacturer Warranty: Provide 10 year warranty for failures in materials or workmanship as indicated by the manufacturer standard warranty; 1 year warranty for soft-close door mechanisms.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Specification is based on products listed below by DIRTT Environmental Solutions.

B. The listed manufacturer shall not be construed as closing the specifications to other prospective manufacturers, but rather as establishing a level of quality for the interior assembly. Other systems may be submitted for approval as provided in Division 00.

2.2 DESCRIPTION

A. Factory assembled, site installed, integrated interior assemblies, including Structure, Doors and Frames, Door Hardware, and Factory Integrated components.

2.3 PERFORMANCE AND DESIGN CRITERIA

A. Provide integrated interior assemblies that are factory sub-assembled and site installed to integrate with the base building structure, shell, mechanical, electrical and plumbing systems.

B. Walls shall utilize factory finish site installed panels that mechanically fasten to a factory finished and assembled aluminum structural frame module. Finish panels may be monolithic or segmented with the ability to span off-module, or across multiple frames in segments or monoliths, vertically and horizontally.

C. Assembly shall allow for independent configuration of structure, finishes and functions relative to each side of the wall.

D. Assembly shall be comprised of components which can be disassembled, relocated and field cut and substantially reused for future reconfigurations allowing for adaptability and retrofitting of the Structure, Doors and Frames, Door Hardware, and Site Integrated components.

E. Integrated interior assembly shall enable access of the internal cavity from either side without the addition of an access panel or need for repairing of finishes.

F. Structural Performance:
1. Capable of withstanding the effects of gravity loads, dead loads, and the following loads and stresses within limits and under conditions indicated:
   a. Transverse Load: Lateral deflection of the overall span when tested under a uniformly distributed load of 5 psf (0.24 kN/m²) in accordance with ASTM E72 where (L) equals wall height:
      1. Glass Walls: not more than L/175 or 3/4 inch (19 mm) whichever is more stringent.
   b. Mechanical Strength: Capable of withstanding static loads in accordance with ANSI/BIFMA X5.6.
   c. Seismic Performance: When required by Authority Having Jurisdiction, provide integrated interior assemblies capable of withstanding effects of seismic motions determined according to the Authority Having Jurisdiction.

G. Acoustic Attenuation:
   1. Sound Transmission Class (STC) rating of integrated interior assemblies shall be calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

H. Fire Resistance:
   1. Finish materials shall be tested in accordance with ASTM E84 and NFPA 286 as required by 2018 IBC 803.1.1.

I. Assembly UL Ratings:
   1. UL 723; Standard for Test for Surface Burning Characteristics of Building Materials

2.4 STRUCTURE

A. Glazed wall: Site assembled non–bearing structural frame module with glass infill.
   1. Extrusion Profile: Rectilinear
   2. Material: Aluminum extrusions, 6063–T6 aluminum alloy classified as noncombustible in accordance with ASTM E136 per 2018 IBC 703.5.1.
      a. Thickness: As required to meet performance requirements.
   3. Wall Thickness: Actual 4 inch (102mm).
   4. Top Track: Continuous, with intermittent breaks for structural components.
   5. Bracing: as required to meet structural performance requirements
      a. Provide frame bases with continuous adjustment mechanism for [1–1/2 inch (38mm)] height adjustment to accommodate floor slab variances.
   7. Vertical Element Spacing: As required to meet performance requirements within a minimum of 6 inches (152mm) and a maximum of 60 inches (1524mm).
      a. Vertical Element spacing may exceed 60 inches (1524mm) with manufacturer review and approval.
   9. Glazing Gasket Color: TBD.
B. Structure Exposed Finishes:
   1. Clear Anodized Aluminum: AAMA 611, AAM12C22A31, Class I
   2. Powder coat:
      a. Finish: Per Finish Schedule, if noted
   3. Wood Veneer: Natural wood laminated to structure.
      a. Species: Per Finish Schedule, if noted
      b. Grade: 3.
      c. Sheen: Satin
      d. Grain Direction: Vertical

2.5 FINISH PANELS
A. Glass Finish Panel:
   1. Glazing Material:
      a. Tempered glass (GLS-#): Architectural flat glass per ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type 1, Class 1 (transparent), Quality q3. Complies with CPSC-16 CFR Part 1201 Category II per IBC 2015.2406.2.
         1. Thickness: 3/8 inch (10mm).
         2. Finish: Per Finish Schedule.

2.6 DOORS AND FRAMES
A. Coordinate ADA, ANSI, Access Control and Fire Life Safety requirements with drawings and schedules prior to the development of shop drawings per Pre-Manufacture Submittal requirements.
B. Hardware Preparation and Reinforcement: Factory milled, reinforced, drilled and taped doors and frames by manufacturer to receive Integrated Hardware Components as scheduled.
   1. Factory milled doors and frames with hinge locations and sizes as determined by integrated interior assembly manufacturer; including factory installed steel backer plates.
   2. Access Control Components: Factory provided rough in for Site Integrated Components and integrated interior assembly manufacturer provided hardware.
C. Aluminum Framed Glass Doors:
   1. Operation: swing and/or sliding, per schedule.
   2. Door Thickness: 1–11/16 inch (43mm) thick.
   3. Door Size: As indicated on Door Schedule.
   4. Stile Width: 4 inch (102mm) as indicated by Door Type on Door Schedule.
   5. Top Rail Height: 4 inch (102mm) as indicated by Door Type on Door Schedule.
   6. Bottom Rail Height: 7–7/8 inch (200mm) as indicated by Door Type on Door Schedule.
   8. Finish:
      a. Clear Anodized Aluminum: AAMA 611, AAM12C22A31, Class I
b. Powder coat, if noted.
   1. Color: Per schedule.

c. Wood Veneer: Natural, if noted
   1. Species: Per schedule below.
   2. Grade: 3.
   3. Grain Direction: Vertical
   4. Sheen: Satin

9. Adjustability: Provide door skirt to accommodate varying floor levels.

D. Frameless Glass Doors:

1. Operation: [sliding] [center pivot] [off-center pivot].

2. Door Size: As indicated on Door Schedule.

3. Top Rail Height: [2–5/16 inch (59mm)] [2–3/8 inch (60mm)].

4. Bottom Rail Height: [2–5/16 inch (59mm)] [5 inch (127mm)].

5. Glazing:
   a. Pivot Operation: Tempered 1/2 inch (13mm) prepped to suit applicable hardware.
   b. Sliding Operation: Tempered 3/8 inch (10mm) prepped to suit applicable hardware.

6. Finish: Per hardware finishes and Finish Schedule below.

7. Adjustability: Provide door skirt to accommodate varying floor levels.

E. Solid Core Wood Doors, if noted on schedule:

1. Operation: [swing and/or sliding].

2. Door Thickness: 1–11/16 inch (43mm).

3. Door Size: As indicated on Door Schedule.

4. Door Panel: Factory finished high density fiberboard faces over particleboard core with solid wood edging.

5. Finish:
   a. Paint: Manufacturers standard Chroma Coat
      1. Grade 2
      2. Color: Per Finish Schedule
   b. Wood Veneer: Natural
      1. Species: Per Finish Schedule below.
      2. Grade: 3
      3. Grain Direction: Vertical
      4. Sheen: Satin
   c. Thermofoil: Manufacturers standard 3D laminate
      1. Grade: 2
      2. Color/Pattern: Per Finish Schedule.
6. Vision Lite: Sizes and configurations as indicated on drawings, if required. Provide secure glazing stops on secure side of door.

F. Door Frames:
   1. Architectural grade structural aluminum factory finished and integrated with wall structure.
   2. Door frames capable of reconfiguration without part replacement or damage to wall components.
   3. Frames are shipped knocked down and assembled on site.
   4. Jambs shipped over length by 2 inches (50 mm) in height, for field cutting to suit opening height for proper alignment with adjacent frames.
   5. Extrusion Profile: Rectilinear
   6. Configuration: As required by door operation or function.
   7. Size: As required for doors sizes indicated on Door Schedule.
   8. Standard Frame Depth: 4 inches (102mm)
      a. Wrap Around frame: 4–3/4 inches (121 mm)
   9. Finish:
      a. Clear Anodized Aluminum: AAMA 611, AAM12C22A31, Class I
      b. Powder coat, if noted.
         1. Color: Per Finish Schedule, if noted.
      c. Wood Veneer: Natural
         1. Species: Per schedule.
         2. Grade: 3.
         3. Grain Direction: Vertical
         4. Sheen: Satin

2.7 DOOR HARDWARE

A. Site Integrated Components: Provide in accordance with Division 08 Openings and Division 28 Electronic Safety and Security.

B. All Hardware indicated in this section to be provided by the manufacturer or the manufacturers distribution partner and installed on site unless indicated otherwise.

C. General Door Hardware: UNLESS NOTED IN SCHEDULE, provide the following:
   1. Hinges: Stanley 4–1/2 x 4 inch (114mm x 102mm) Butt Hinge F179. Four hinges per door; no exceptions.
   2. Cylindrical Series Hardware:
      a. Schlage “AL” Series Cylindrical Hardware: [AL50PD Lockset] [AL10S Passage Set] [AL170 Dummy Trim].
      b. Schlage “S” Series Cylindrical Hardware: [S51PD Lockset] [S10D Passage Set] [S170 Dummy Trim].
      c. Falcon “B” Series Cylindrical Hardware: [B511 Lockset] [B101 Passage Set] [B12 Dummy Trim].
   3. Lever Style: [Jupiter] [Neptune] [Saturn] [Quantum] [Dane]
4. Circular Bar Pull: 1 inch (25mm) diameter x [12 inches (305mm)] [30 inches (762mm)] [72 inches (1829mm)] in height
   a. Features:
      1. Locking Bar Pull: Height determined by Door Height
5. Concealed Overhead Closers: [CRL Jackson Adjustable Spring Power 90º Hold Open 20106M20]
6. Electromagnetic Lock: [Schlage M420] [Schlage 320M]
7. Floor Stops: Dome.
   a. Type: [Jamb] [Header] [Drop Seal].
   b. Color: [Black] [Charcoal] [Silver].
9. Aluminum Framed Glass Door Gasket Color: [Black] [Charcoal] [Silver].

D. Sliding Door Hardware: Site installed manufacturer’s standard sliding door track, track cover and door roller assembly with alignment pin on floor. Anti–rack and Anti–lift hardware included in track assembly.
   1. Floor Track: None; Trackless
   2. Positive Latch: Manufacturer’s standard non–keyed, spring loaded, latch and strike that can secure sliding door panels to adjacent panels or jambs. Strike shall mount flush to surface of framing. Latch shall engage by closing action of door.
   3. Operation:
      a. Soft close mechanism for door weights of 165 pounds (75 kg) or less.
      b. Pneumatic slow down mechanism for door weight of 165 to 200 pounds (75 to 90 kg).

E. Hardware Finishes: BHMA Standard finishes provided as follows unless indicated otherwise:
   1. 626 – Satin Chrome: lever sets, flush bolt, dead bolt, metal roller catch, bolt, strike plate, dome floor stop and peg floor stop.
   2. 628 – Satin Aluminum: electromagnetic locks,
   3. 630 – Satin Stainless Steel: pulls.

F. Keying: Provide in accordance with Section 08 71 ## [door hardware section]
required movement without 2 inch (51mm) wall angles and all other acoustical ceiling components per section 09 51 00 Acoustical Ceilings.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.
   1. Floor Levelness:
      a. Contiguous wall lengths less than 40 feet: Base building sub-floor shall be level within 3/8 inch over 10 feet.
      b. Contiguous wall lengths greater than 40 feet: Base building sub-floor shall not exceed a maximum total floor flatness deviation greater than 1-1/2 inches.
   2. Vertical leading edge of assembly structure to base building: Where partitions attach to adjacent walls, the finish face shall be plum within 1/2 inch over 10 feet.
   3. Top of assembly structure to base building: Where partitions attach to bulkhead or soffit, the finish face shall be level within 1/2 inch over 10 feet.
   4. Lay in Ceilings: Where partitions attach to lay-in ceiling grid, the grid shall be level within 1/4 inch over 10 feet.

B. Verify products have been stored, and will be installed, in accordance with project's Construction Indoor Air Quality Management Plan, if required.

C. Verify field or hold—to control dimensions before fabrication of integrated interior assemblies. Coordinate fabrication schedule with construction schedule and progress to avoid delay in the work.

D. Examine all adjoining work including work by others.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with manufacturer’s instructions.

B. Locations to receive integrated interior assemblies shall be inspected for compliance with manufacturers requirements.

C. Survey floor to determine the nature of floor level and determine where special conditions exist beyond manufacturer’s standard leveling capabilities of 1-1/2 inch (38mm) total variation in floor level.

D. Field conditions and pre—existing installations by others which may adversely affect installation or exceed the manufacturers limitations shall be corrected before installing walls.

3.3 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present and pre-installation meeting.
B. All building services shall be installed and connected to the base building systems by licensed subtrades. All building services shall be inspected by authorized trade representatives and Authority Having Jurisdiction in the presence of a manufacturer representative. Coordinate with all affected parties as required.

C. Doors and frames
   1. Install sliding doors plumb, level, square, and in proper alignment.
   2. Install doors to close against walls without gaps
   3. Install doors to open and close smoothly.
   4. Anchor sliding doors securely to supports.

3.4 ADJUSTING
   A. Adjust and lubricate hardware for proper operation in accordance with manufacturer’s instructions.
   B. Doors and Frames
      1. Adjust for smooth and balanced door movement in accordance with manufacturer’s instructions.
      2. Adjust and lubricate hardware for proper operation.

3.5 CLEANING
   A. Upon completion of installation clean finishes in accordance with the manufacturer’s instructions. Avoid alkaline or abrasive agents. Avoid scratching or marring finishes.

3.6 PROTECTION
   A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.7 DEMONSTRATION
   A. Manufacturer’s representative will be responsible to provide general product training to the Owner or their outsourced operations team at time of installation as well as conduct a comprehensive training session(s) to convey the methodology, and assembly of the walls to sustain general operational maintenance by the Owner’s personnel with clearance over the facilities lifetime.
PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes fire-suppression piping and equipment for the following building systems:

1. Addition and Remodel: Wet-pipe, fire-suppression sprinklers, including piping, valves, specialties, and automatic sprinklers. Extend new coverage from the nearest fire sprinkler main.
2. Remodel area: add/relocate sprinkler heads and piping to provide adequate coverage for remodeled areas. Refer to architectural drawings for areas.
3. Unconditioned / Fire Sprinkled area: Spaces subject to “freeze conditions” are to be provided with a pre-action fire sprinkler system.
4. The Contractor is to field-verify existing system piping and head locations.
5. Perform a flow test, witnessed by the AHJ or Owner’s representative. Review with the Engineer and reduce by 10% before using the results in the hydraulic calculations.
6. Provide the revised fire sprinkler riser in the new building location.

B. Related Sections include the following:

1. Division 26 Section "Fire Alarm Systems" for alarm devices not in this Section.

1.03 DEFINITIONS

A. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

B. Authority having Jurisdiction: The building official, Engineer and the insurance underwriter, where applicable.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

A. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction. Obtain approval from the Engineer prior to submitting to other authorities having jurisdiction.

1. Design Sprinkler system with the 10% reduced flow test data performed by the Contractor – see above.
2. Include losses through water-service piping, valves, and backflow preventers.
3. Sprinkler Occupancy Hazard Classifications: As follows:
b. Patient Areas: Light Hazard.
d. Library Reading Rooms: Light Hazard.
e. Restaurant, Kitchen, and Bakery Service Areas: Ordinary Hazard, Group 1.
f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
g. Building Service Areas: Ordinary Hazard, Group 1.
h. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
i. General Storage Areas: Ordinary Hazard, Group 2.

4. Minimum Density for Automatic–Sprinkler Piping Design: As follows:
   a. Light–Hazard Occupancy: 0.10 gpm over 1500–sq. ft. area.
   b. Ordinary–Hazard, Group 1 Occupancy: 0.15 gpm over 1500– sq. ft. area.
   c. Ordinary–Hazard, Group 2 Occupancy: 0.20 gpm over 1500– sq. ft. area.
   d. Special Occupancy Hazard: As determined by authorities having jurisdiction.

5. Maximum Protection Area per Sprinkler: As follows:
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Shellspace/Future tenant finish: 100 sq.ft.
   g. Other Areas: According to NFPA 13

B. Components and Installation: Capable of producing piping systems with 175–psig minimum working–pressure rating, unless otherwise indicated.

1.05 SYSTEM DESCRIPTIONS

A. Wet–pipe fire protection riser and fire suppression sprinklers.
B. Pre–action fire protection system for areas subject to freezing conditions.

1.06 SUBMITTALS

A. Product Data:
   1. Pipe and fitting materials and methods of joining for standpipe piping.
   2. Pipe and fitting materials and methods of joining for sprinkler piping.
   3. Pipe hangers and supports.
   4. Piping seismic restraints.
   5. Valves, including specialty valves, accessories, and devices.
   6. Alarm devices. Include electrical data.
   7. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by engineer and other authorities having jurisdiction. Include hydraulic calculations, unless noted otherwise. Drawings are to be approved by the Engineer prior to submitting to other authorities having jurisdiction.

C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor’s Material and Test Certificate for Aboveground Piping" and "Contractor’s Material and Test Certificate for Underground Piping."

D. Maintenance Data: For each type of standpipe and sprinkler specialty to include in maintenance manuals specified in Division 1.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction. The Engineer requires evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor who cannot show such experience, may be found not suitable to perform the work. Fire protection contractors are to be pre-approved by owner prior to submitting a construction bid.

Contractors shall submit documentation to the engineer prior to bidding. Allowance of shall be by addendum.

B. Engineering Responsibility: Preparation of working plans using AutoCad compatible drawing program, calculations, and field test reports by a qualified professional engineer or Engineering Technician NICET Level III.

C. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and that comply with other requirements indicated.

D. Standpipe and Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:

1. NFPA 13–07, "Installation of Sprinkler Systems."

G. International Conference of Building Code Officials codes and standards complying with the following:


1.08 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. Sprinkler Cabinets: A supply of spare sprinklers shall be supplied and located in a cabinet where the temperature does not exceed 100°F. These sprinklers shall correspond to the types and temperature ratings to the sprinklers installed on the project. Special sprinkler head wrenches shall be included to correspond to the types of heads provided.

B. The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:

1. For systems with over 1000 sprinklers, not less than 24 sprinklers.
2. Locate spare head box, wrench and sprinklers near system riser serving each building.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Specialty Valves and Devices:
   a. Tyco Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Star Sprinkler Corp.
   d. Viking Corp.

2. Sprinkler, Drain and Alarm Test Fittings:
   a. Tyco Corp
   b. Fire–End and Croker Corp.
   c. Victaulic Co. of America.

3. Sprinklers:
   a. Tyco Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.
   d. Victaulic Co of America.

4. Keyed Couplings for Steel Ductile, Iron, and Copper Tubing Piping:
   a. Tyco Corp.
   b. Victaulic Co. of America.
   c. Gruvlok.
   d. Star
   e. Ward Couplox

5. Press–Seal Fittings for Steel Piping: (not allowed)
6. Mechanically Formed Tee Outlets: Only Victaulic 920 Series mechanical tees or Engineer–approved equal are allowed.
2.02 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 PIPES AND TUBES

A. Ductile-Iron Pipe: AWWA C151, mechanical–joint type; with cement–mortar lining and seal coat according to AWWA C104. Include gland, rubber gasket, and bolts and nuts according to AWWA C111.


C. Thinwall, Threadable Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10. NPS 2” and smaller. (Dyna–Thread 40 allowed)

2.04 PIPE AND TUBE FITTINGS


C. Steel, Threaded Couplings: ASTM A 865.

D. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.

E. Steel Flanges and Flanged Fittings: ASME B16.5.

F. Steel, Grooved–End Fittings: UL–listed, ASTM A 47, malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.05 JOINING MATERIALS

A. Refer to Division 23 Section for pipe–flange gasket materials and welding filler metals.

B. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel–pipe dimensions. Include ASTM A 536, ductile–iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry–pipe service for couplings for dry piping.

C. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.06 SPECIALTY VALVES

A. Ball Drip Valves: UL 1726, automatic drain valve, NPS 3/4, ball check device with threaded ends.
2.07 SPRINKLERS

A. Sprinkler types, features, and options include the following:

1. Extended–coverage sprinklers.
2. Pendent sprinklers.
5. Recessed sprinklers, including escutcheon.
7. Sidewall, dry–type sprinklers.
8. Upright sprinklers.
9. Concealed sprinklers, where indicated.

B. Sprinkler Finishes: Chrome–plated, bronze, and painted.

C. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, and recessed–type sprinklers are specified with sprinklers.

1. Ceiling Mounting: white painted, one piece, flat.
2. Ceiling Mounting: white painted, two piece, with 1–inch vertical adjustment.

D. Sprinkler Guards: Wire–cage type, including fastening device for attaching to sprinkler.

2.08 SPECIALTY SPRINKLER FITTINGS

A. Specialty Fittings: UL listed; made of steel, ductile iron, or other materials compatible with piping.


C. Locking–Lug Fittings: (not allowed).

D. Mechanical–T Fittings: Only Victaulic 920 Series mechanical tees or Engineer–approved equal are allowed.

E. Mechanical–Cross Fittings: (not allowed).

F. Drop–Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.

G. Sprinkler, Drain and Alarm Test Fittings: UL–listed, cast– or ductile–iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.

2.09 PRESSURE GAGES

A. Pressure Gages: UL 393, 3–1/2– to 4–1/2–inch– diameter dial with dial range of 0 to 250 psig.

PART 3 – EXECUTION
3.01 PREPARATION

A. Engineer’s Water Analysis. Provided flow information is calculated and preliminary in nature. Obtain actual flow information after modifications to underground infrastructure piping are completed.

3.02 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 COORDINATION

A. All work of this contractor will be coordinated with other trades to insure minimal changes to the sprinkler system from the designs. Careful coordination of mechanical and electrical ducts, pipe and conduit shall be required.

B. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing waste, rainwater, and soil lines; supply, return, and exhaust ductwork, water piping, fire protection piping; and pneumatic control piping.

C. All piping shall be run concealed where possible. All lines will be run as high as possible so as to not interfere with future changes to ceiling heights or other mechanical equipment. This contractor will be responsible for all sleeves, core drills, and sealing of penetrations in walls, floors, and structural members to facilitate the installation of the system, however, no holes in structural members will be allowed unless approved by the structural engineer.

3.04 PIPING APPLICATIONS

A. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system’s pressure rating may be used in aboveground applications, unless otherwise indicated.

B. Wet–Pipe Sprinklers: Use the following:

1. NPS 2 and Smaller: Schedule 40 and Dynathread 40, threadable steel pipe with threaded ends; cast– or malleable–iron threaded fittings; and threaded joints.

3.05 JOINT CONSTRUCTION

A. Refer to Division 23 for basic piping joint construction.
B. Steel—Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll—grooved ends and Schedule 30 or thinner steel pipe with roll—grooved ends; steel, grooved—end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer’s written instructions. Use gaskets listed for dry—pipe service for dry piping, preaction, FDC & roof standpipes.

C. Press—Seal—Fitting Joints: (not allowed).

D. Locking—Lug—Fitting, Twist—Locked Joints: (not allowed).

E. Dissimilar—Piping—Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric fittings if both piping materials are metal. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for dielectric fittings.

3.06 PIPING INSTALLATION

A. Refer to Division 23 for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2–1/2 and larger connections.

F. Install "Inspector’s Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building. Pipe bell drips to express drains when available.

I. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.

1. No powder driven studs allowed.
2. Wrap—around braces are to be provided at end of branch lines.
3. MRI area—install with Non—metallic hangers.

J. Earthquake Protection: Install piping according to Factory Mutual 2–8 requirements, to protect from earthquake damage. Seismic Bracing shall be designed to withstand vertical forces and movement.
K. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.

3.07 SPECIALTY SPRINKLER FITTING INSTALLATION

A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.08 SPRINKLER APPLICATIONS

A. General: Sprinkler heads shall be of the latest design closed spray type for 155EF unless specified otherwise or required by code. All sprinklers shall be UL listed as quick response. Heads shall be a minimum orifice size of 1/2". Temperature rating of heads in elevator shafts & boiler plant shall be 286EF. Extra Large Orifice (ELO) heads shall not be used. Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7'-0" height above the floor or where damage from room occupant use may occur.
2. Rooms with Suspended Ceilings: Recessed sprinklers, typical.
3. Rooms with Suspended Ceilings: Concealed sprinklers, where indicated.
5. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
6. Provide freeze-proof type automatic sprinkler heads serving walk in freezers, unconditioned spaces, areas subject to freezing and in other areas requiring their use.
7. Heads located within the air streams of unit heaters or other heat-emitting equipment shall be selected for proper temperature rating.
8. Sprinkler Finishes: Use sprinklers with the following finishes:
   a. Upright, Pendent, and Sidewall Sprinklers: Chrome-plated in finished spaces exposed to view; rough bronze in mechanical spaces (typical) not exposed to view.
   b. Concealed Sprinklers: Rough brass, with white cover plate.
   c. Recessed Sprinklers: Bright white, with bright white escutcheon.

3.09 SPRINKLER INSTALLATION

A. Every effort shall be required to insure that the heads form a symmetrical pattern in the ceiling with the ceiling grid, lights, diffusers and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads should be symmetrical and all piping run parallel or perpendicular to building lines.

1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions. Provide a 6" center line clearance as a minimum dimension allowed.
2. Sprinkler heads in patient rooms shall be located inside area of patient bed curtain tracks.
3. Locate sprinkler on narrow center line of suspended ceiling tile in Corridors and Lobby/Waiting areas.

B. Where layout of sprinkler heads is shown on reflected ceiling plans the locations shall be followed unless approval is obtained from the Architect or such locations shown do not meet the requirements of NFPA–13. In either case, approval of the Architect shall be obtained in writing before sprinkler head locations are changed. If the installation of additional heads are needed to conform to NFPA 13 requirements in areas where heads are shown on reflected ceiling plans, they shall be included in the contract price.
C. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

D. Future finish and tenant finish, Shell spaces shall be piped to accommodate future. Install sprinklers with 1" x ½" bushings, and space heads at a max. spacing of 100 sq. ft. per head. Occupancy shall be Ordinary-Hazard Group 1 Design.

E. Concealed type sprinkler shall be installed in the following areas:
   1. All areas served by the Pre-Action system.

3.10 CONNECTIONS

A. Connect water-supply piping and standpipes and sprinklers where indicated.

B. Install ball drip valves at each check valve for fire department connection & Roof top standpipes. Drain to floor drain, express drain or outside building.

C. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

D. Electrical Connections: Power wiring is specified in Division 26.

E. Connect alarm devices to fire alarm.

3.11 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14.

B. Interconnected standpipe feed mains & Tunnel System Piping shall be labeled “FIRE WATER” every 10 feet. (Vertical Standpipe in stairwells are not required to be labeled).

C. Floor control assembly risers shall have signs attached that identifies smoke zone areas protected by sprinkler system. Coordinate zones identification with Alarm system.

3.12 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping according to NFPA 13, “System Acceptance” Chapter.

B. Flush, test, and inspect standpipes according to NFPA 14, “Tests and Inspection” Chapter.

C. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

D. Report test results promptly and in writing to Architect and authorities having jurisdiction.

E. Whether the underground serving the sprinkler system is done by this contractor or another, this contractor will be responsible to assure and have in his possession a certificate that the underground has been flushed and
tested by the contractor who installed it in accordance with NFPA–24 prior to connection of the underground piping to the overhead sprinkler system.

3.13 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers having paint other than factory finish.

3.14 PROTECTION

A. Protect sprinklers from damage until Substantial Completion.

3.15 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete and that “Material Test Certificates” are complete.

C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

E. Verify that potable–water supplies have correct types of backflow preventers, where indicated.

F. Drain dry–pipe sprinkler piping.

G. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.

H. Fill wet–pipe sprinkler piping with water.

I. Fill standpipes with water.

J. Verify antifreeze solution mixtures and fill system with solution.

K. Verify that hose connections are correct type and size.

L. Energize circuits to electrical equipment and devices.

M. Coordinate with fire alarm tests. Operate as required.

N. Verify air compressors and their accessories are installed and operate correctly.

3.16 DEMONSTRATION & TESTS
A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi in excess of the normal pressure when the normal pressure is above 150 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.

C. The local jurisdiction having authority and the State Fire Marshal’s office (where required) shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of underground, hydrostatic testing, or flow testing that may be required.

D. This contractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Contractor Test Certificates for the overhead and underground work are completed and delivered to the owner’s insurance underwriter to assure proper insurance credit.

E. All tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

3.17 WARRANTY, AS–BUILT DRAWINGS & MANUALS

A. This contractor shall warranty the sprinkler system and all its components for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this contractor.

B. Provide Operation and Maintenance Manuals with copies of warranty, all contractors Test Certificates, and corrected Hard copy—as—builts included. A minimum 3 sets to be provided in red 3–ring binders.

C. Electronic copy of AutoCad as—builts drawings shall also be provided on CD, with each O&M Manual.

END OF SECTION 211000
SECTION 220500

COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   7. Grout.
   8. Equipment installation requirements common to equipment sections.
   10. Link Seal

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspace.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases and accessible tunnels.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene–propylene–diene terpolymer rubber.
   2. NBR: Acrylonitrile–butadiene rubber.
1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code—Steel."

B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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 to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe–Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8–inch maximum thickness unless thickness or specific material is indicated.
   a. Full–Face Type: For flat–face, Class 125, cast–iron and cast–bronze flanges.
   b. Narrow–Face Type: For raised–face, Class 250, cast–iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full–face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe–Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.


F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper–phosphorus alloys for general–duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion–resistant metal band on each end.

1. Manufacturers:
   b. Fernco, Inc.
   d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder–joint, plain, or weld–neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory–fabricated, union assembly, for 250–psig minimum working pressure at 180 deg F.
1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150– or 300–psig minimum working pressure as required to suit system pressures.

1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.

E. Dielectric–Flange Kits: Companion–flange assembly for field assembly. Include flanges, full–face– or ring–type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150– or 300–psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized–steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300–psig minimum working pressure at 225 deg F.

1. Manufacturers:
   a. Calpico, Inc.
   b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300–psig minimum working pressure at 225 deg F.

1. Manufacturers:
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Victaulic Co. of America.
2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized--Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile--iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast--iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PE: Reusable, PE, tapered--cup shaped, and smooth--outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One--Piece, Deep--Pattern Type: Deep--drawn, box--shaped brass with polished chrome--plated finish.

C. One--Piece, Floor--Plate Type: Cast--iron floor plate.

D. Split--Casting, Floor--Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic--cement grout.
2. Design Mix: 5000–psi, 28–day compressive strength.

2.10 LINK SEAL

A. Link–Seal® Modular Seal Pressure Plates

1. Link–Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:

   a. Izod Impact – Notched = 2.05ft–lb/in. per ASTM D–256
   Flexural Strength @ Yield = 30,750 psi per ASTM D–790
   Flexural Modulus = 1,124,000 psi per ASTM D–790
   Elongation Break = 11.07% per ASTM D–638
   Specific Gravity = 1.38 per ASTM D–792

2. Models LS200–275–300–315 shall incorporate the most current Link–Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315–325–340–400–410–425–475–500–525–575–600 shall incorporate an integral recess known as a “Hex Nut Interlock” designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer’s name molded into it.

3. For fire and Hi-Temp service, pressure plates shall be steel with 2–part Zinc Dichromate Coating.

4. Link–Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link–Seal® modular seal technical data. Bolts, flange hex nuts shall be: 316 Stainless Steel per ASTM F593–95, with a 85,000 psi average tensile strength.

PART 3 – EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
3.2 PIPING SYSTEMS – COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. 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 Coordination Drawings.

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 to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. 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 type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

   2. Existing Piping: Use the following:
      a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
      f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
      g. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. 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 above finished floor level. Refer to Division 07 Section “Sheet Metal Flashing and Trim” for flashing.

   1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
S. 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 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing–in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing–in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water–flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA’s “Copper Tube Handbook,” using lead–free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook,” “Pipe and Tube” Chapter, using copper–phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. 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.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 “Quality Assurance” Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2–1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
3.5 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections “Interior Painting” and “Exterior Painting.”

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 220500
SECTION 220517
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 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
1. Sleeves.
2. Sleeve–seal systems.

1.3 ACTION 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, Schedule 40, with plain ends and welded steel collar; zinc coated.
C. Galvanized–Steel–Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
E. Galvanized–Steel–Sheet Sleeves: 0.0239–inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE–SEAL SYSTEMS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Link–Seal
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. 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.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion–resistant coating, of length required to secure pressure plates to sealing elements.

2.3 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.

1. Sleeves are not required for core–drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, 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 above finished floor level.

3. 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 07 Section "Joint Sealants."

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 07 Section "Penetration Firestopping."

3.2 SLEEVE–SEAL–SYSTEM INSTALLATION

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.

3.3 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.
   b. Piping NPS 6 and Larger: Cast–iron wall sleeves.

2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6: Cast–iron wall sleeves with sleeve–seal system.
      1) Select sleeve size to allow for 1–inch annular clear space between piping and sleeve for installing sleeve–seal system.
   b. Piping NPS 6 and Larger: Cast–iron wall sleeves with sleeve–seal system.
      1) Select sleeve size to allow for 1–inch annular clear space between piping and sleeve for installing sleeve–seal system.

3. Concrete Slabs–on–Grade:
   a. Piping Smaller Than NPS 6: Cast–iron wall sleeves with sleeve–seal system.
      1) Select sleeve size to allow for 1–inch annular clear space between piping and sleeve for installing sleeve–seal system.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve–seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve–seal system.

4. Concrete Slabs above Grade:


5. Interior Partitions:


END OF SECTION 220517
SECTION 220518

ESCUTCHEONS 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Escutcheons.

1.3 ACTION 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 finish and setscrew fastener.
C. One–Piece, Stamped–Steel Type: With chrome–plated finish and spring–clip fasteners.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
B. Install escutcheons with ID to 2 inch (50mm), tube, and insulation of insulated piping and with OD that completely covers opening.
   1. Escutcheons for Piping:
a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished, chrome-plated finish.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with chrome-plated finish.
d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping Larger than 2 inch (50mm) at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish. Retain one of first two subparagraphs below.
f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping Larger than 2 inch (50mm) at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish. Retain one of first two subparagraphs below.
h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
i. Bare Piping Larger than 2 inch (50mm) in Unfinished Service Spaces: One-piece, stamped-steel type with polished, chrome-plated finish. Retain one of first two subparagraphs below.
j. Bare Piping 2 inch and Smaller in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
k. Bare Piping in Equipment Rooms Larger than 2 inch: One-piece, stamped-steel type with chrome- or cadmium-plated finish.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518
SECTION 220523
GENERAL–DUTY VALVES 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze angle valves.
   2. Bronze ball valves.
   4. Bronze swing check valves.
   5. Bronze globe valves.

B. Related Sections:
   1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
   2. Division 22 Section “Identification for Plumbing Piping and Equipment” for valve tags and schedules.
   3. Division 33 water distribution piping Sections for general–duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile–butadiene, Buna–N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.
G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.
1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.

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 angle 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.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Gear Actuator: For quarter–turn valves NPS 8 and larger.
   2. Handwheel: For valves other than quarter–turn types.
   3. Handlever: For quarter–turn valves NPS 6 and smaller except plug valves.
   4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug–valve head.
E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve–End Connections:
   1. Solder Joint: With sockets according to ASME B16.18.
   2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP–45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hammond Valve.
      b. Milwaukee Valve Company.
   2. Description:
      b. CWP Rating: 200 psig.
      d. Ends: Threaded.
      e. Stem and Disc: Bronze.
      f. Packing: Asbestos free.
      g. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

A. Two–Piece, Full–Port, Bronze Ball Valves with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Hammond Valve.
      e. Lance Valves; a division of Advanced Thermal Systems, Inc.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Red–White Valve Corporation.
      i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Lance Valves; a division of Advanced Thermal Systems, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. DynaQuip Controls.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Red-White Valve Corporation.

2. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
j. Port: Full.

D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

2. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

2.4 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:
   b. CWP Rating: 200 psig.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Red–White Valve Corporation.
   i. Zy–Tech Global Industries, Inc.

2. Description:
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.6 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Hammond Valve.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red–White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

b. CWP Rating: 200 psig.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. 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.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.
3.3 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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.
3. Throttling Service Globe, angle, ball or butterfly valves.
4. Pump—Discharge Check Valves:
   a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2–1/2 and Larger for Domestic Water: swing check valves with lever and weight.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder–joint valve–end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2–1/2 to NPS 4: Flanged ends except where threaded valve–end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder–joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 or Class 150, bronze disc.
3. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless–steel trim.
4. Bronze Swing Check Valves: Class 125 or Class 150, bronze disc.
5. Bronze Globe Valves: Class 125 or Class 150, bronze disc.

B. Pipe NPS 2–1/2 and Larger:

1. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless–steel trim.

END OF SECTION 220523
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:
   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.

B. Related Sections include the following:
   1. Division 21 Section "Water-Based Fire–Suppression Systems" for pipe hangers for fire–suppression piping.

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.

C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.

   1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

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.
4. Pipe positioning systems.
5. Mechanical Anchors: ICC-ES Evaluation Reports validating ‘Cracked Concrete’ testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code—Steel."
AWS D1.4, "Structural Welding Code—Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code—Steel."
2. AWS D1.2, "Structural Welding Code—Aluminum."
3. AWS D1.4, "Structural Welding Code—Reinforcing Steel."
4. 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. Anvil International.
2. AAA Technology & Specialties Co., Inc.
5. Carpenter & Paterson, Inc.
6. Empire Industries, Inc.
7. ERICO/Michigan Hanger Co.
8. FNW/Ferguson Enterprises
10. Grinnell Corp.
11. GS Metals Corp.
13. PHD Manufacturing, Inc.
14. PHS Industries, Inc.
15. Piping Technology & Products, Inc.
16. Tolco Inc.
17. Simpson Strong–Tie Co.

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:

1. Anvil International.
2. B–Line Systems, Inc.; a division of Cooper Industries.
3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
4. FNW/Ferguson Enterprises
5. GS Metals Corp.
6. Hilti, Inc.
8. Thomas & Betts Corporation.
9. Tolco Inc.
10. 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 Cold Piping: Water–repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.


E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. 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. MKT Fastening, LLC.
      c. Powers Fasteners.
      d. Simpson Strong–Tie Co.

B. Mechanical–Expansion Anchors and Concrete Screws: 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. For anchors resisting seismic loads and/or supporting life–safety systems including fire sprinkler systems, Anchors shall have been tested for ‘Cracked Concrete’ per A.C. 193 per a valid ICC–ES Evaluation Report. Manufacturers with these anchors have been designated below with: "*"

   1. Manufacturers:
2.7 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.

B. Manufacturers:

2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop–or field–fabricated equipment support made from structural–steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.


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. 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.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel–Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe–Ring with or without Turnbuckle–Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2–Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U–Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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.

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.
2. Carbon–or Alloy–Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

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 or Simpson Blue Banger Concrete insert with UL & FM approvals): 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.

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. 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.

L. Comply with MSS SP–69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA–102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. 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. Comply with SEI/ASCE 7 and with requirements for seismic–restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. 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.

C. 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.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. 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. Powder actuated fasteners shall not be used for seismic bracing attachments.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for ‘Cracked Concrete’ per A.C. 193 and shall have a valid ICC–ES Evaluation Report.

G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

I. 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. 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.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

N. 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 B31.9 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.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   5. Pipes NPS 8 and Larger: Include wood inserts.
   6. Insert Material: Length at least as long as protective shield.
   7. Thermal–Hanger Shields: Install with insulation same thickness as piping insulation.
3.3 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.

3.4 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.

3.5 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. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing–repair paint to comply with ASTM A 780.

END OF SECTION 220529
SECTION 220553
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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Pipe labels.
   2. Stencils.
   3. Valve tags.
   4. Warning tags.
   5. Ceiling grid

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 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.

2.2 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
   1. Stencil Material: Fiberboard or metal.
   2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.3 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 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.

2.4 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 by 5–1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

2.5 CEILING GRID

A. Provide valve identification for all plumbing gas valves located above the ceiling on the ceiling grid below the valve.

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. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer’s option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.

C. 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 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:

2. Sanitary Waste and Storm Drainage Piping:

3.4 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 hose connections; and similar roughing–in connections of end–use fixtures and units. 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:
   b. Hot Water: 1–1/2 inches, round.

2. Valve–Tag Color:

3. Letter Color:

3.5 WARNING–TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553
SECTION 220719
PLUMBING PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Domestic recirculating hot-water piping.
   4. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 DEFINITIONS:

A. Refer to Section 220500 “Common Work Results for Plumbing”.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water–vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at pipe expansion joints for each type of insulation.
   3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   4. Detail removable insulation at piping specialties, equipment connections, and access panels.
   5. Detail application of field-applied jackets.
   6. Detail application at linkages of control devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.7 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.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings establish and maintain clearance requirements for installation of insulation and field–applied jackets and finishes and for space required for maintenance.

1.9 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS


B. Insulation for below–ambient service requires a vapor–barrier.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. 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.
E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Mineral–Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553:
   1. Type II and ASTM C 1290, Factory–applied jacket requirements are specified in "Factory–Applied Jackets" Article.

   2. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; SOFTR All–Service Duct Wrap.

H. Mineral–Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fibrex Insulations Inc.; Coreplus 1200.
      b. Johns Manville; Micro–Lok.
      c. Knauf Insulation; 1000–Degree Pipe Insulation.
      d. Manson Insulation Inc.; Alley–K.
      e. Owens Corning; Fiberglas Pipe Insulation.

   2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A,

I. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 INSULATING CEMENTS


   1. Products: Subject to compliance with requirements, provide the following:


   1. Products: Subject to compliance with requirements, provide the following:
      a. Ramco Insulation, Inc.; Ramcote 1200 and Quik–Cote.
2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral–Fiber Adhesive: Comply with MIL–A–3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges – Marathon Industries; 225.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL–A–3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges – Marathon Industries; 225.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL–PRF–19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor–Barrier Mastic: Water based; suitable for indoor use on below–ambient services.
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Flagstaff, AZ  
100% CD  
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1. **Products:** Subject to compliance with requirements, provide one of the following:
   b. Vimasco Corporation; 749.

2. **Water-Vapor Permeance:** ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. **Service Temperature Range:** Minus 20 to plus 180 deg F.
4. **Solids Content:** ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. **Color:** White.

#### C. Vapor–Barrier Mastic: Solvent based; suitable for indoor use on below–ambient services.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges – Marathon Industries; 501.

2. **Water-Vapor Permeance:** ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. **Service Temperature Range:** 0 to 180 deg F.
4. **Solids Content:** ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. **Color:** White.

#### D. Vapor–Barrier Mastic: Solvent based; suitable for outdoor use on below–ambient services.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges – Marathon Industries; 570.

2. **Water-Vapor Permeance:** ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. **Service Temperature Range:** Minus 50 to plus 220 deg F.
4. **Solids Content:** ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. **Color:** White.

#### E. Breather Mastic: Water based; suitable for indoor and outdoor use on above–ambient services.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   e. Vimasco Corporation; WC–1/WC–5.

2. **Water-Vapor Permeance:** ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. **Service Temperature Range:** Minus 20 to plus 180 deg F.
4. **Solids Content:** 60 percent by volume and 66 percent by weight.
5. **Color:** White.

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2.5 SEALANTS

A. **ASJ Flashing Sealants**, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire– and water–resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 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–SSL: ASJ with self–sealing, pressure–sensitive, acrylic–based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD–APPLIED JACKETS

A. Field–applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.


C. PVC Jacket: High–impact–resistant, UV–resistant PVC complying with ASTM D 1784, Class 16354–C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field–applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color–code jackets based on system.
   a. White.
4. Factory–fabricated fitting covers to match jacket if available; otherwise, field fabricate.
2.8 TAPES


1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor–retarder tape matching field–applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum–Foil Tape: Vapor–retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

B. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   
a. Engineered Brass Company.
b. Insul–Tect Products Co.; a subsidiary of MVG Molded Products.
c. McGuire Manufacturing.
d. Plumberex.
e. Truebro; a brand of IPS Corporation.
f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

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.

C. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   
a. Truebro; a brand of IPS Corporation.
b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. 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. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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. 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:
      a. **2 inches** o.c.
      b. For below–ambient services, apply vapor–barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor–barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. 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.

P. For above—ambient services, do not install insulation to the following:

2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire—Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire—rated walls and partitions.

   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire—resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire—rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

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 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.

6. 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, 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. 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. 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 INSTALLATION OF MINERAL–FIBER INSULATION

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. Instead, 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.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. 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 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.
3.8 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. Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

C. 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.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
   1. NPS 1–1/2 and Smaller: Insulation shall be one of the following:
      a. Mineral–Fiber, Preformed Pipe Insulation, Type I:
         1) 1 inch thick
   2. NPS 2 and Larger: Insulation shall be one of the following:
      a. Mineral–Fiber, Preformed Pipe Insulation:
         1) 1–1/2 inches thick.

B. Domestic Hot and Recirculated Hot Water:
   1. NPS 1–1/2 and Smaller: Insulation shall be one of the following:
      a. Mineral–Fiber, Preformed Pipe Insulation, Type I:
         1) 1 inch thick.
   2. NPS 2 and Larger: Insulation shall be one of the following:
      a. Mineral–Fiber, Preformed Pipe Insulation, Type I:
         1) 1–1/2 inches thick.

C. Storm water and Overflow:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral–Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Blanket Insulation. Type I: 1 inch thick.

c. Drain Manufacturer’s Pre-formed bowl Insulation: 1 inch thick.

3.10 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, Concealed:

1. None.

D. Piping, Exposed:

1. PVC:

   a. White: 30 mils thick
SECTION 221116

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
   2. Encasement for piping.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.
   B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: 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 water service according to requirements indicated:
   1. Notify Construction Manager or owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Construction Manager's written permission.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

C. All piping shall be American made and tested; no import pipe will be permitted.

D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.

E. All piping installed in or passing through a plenum must be plenum rated, fire wrapped, or installed in a metal conduit.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.


E. Bronze Flanges: ASME B16.24, Class 150, with solder–joint ends.

F. Copper Unions:
   1. MSS SP–123.
   4. Solder–joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe–Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full–face or ring type unless otherwise indicated.

B. Metal, Pipe–Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.


D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper–phosphorus alloys for general–duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting—Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve—Type Transition Coupling: AWWA C219.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cascade Waterworks Manufacturing.
      b. Dresser, Inc.; Piping Specialties Products.
      c. Ford Meter Box Company, Inc. (The).
      d. JCM Industries.
      e. Romac Industries, Inc.
      f. Smith–Blair, Inc.; a Sensus company.
      g. Viking Johnson.

2.5 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 Nipples and Waterways:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elster Perfection Corporation.
      b. Grinnell Mechanical Products; Tyco Fire Products LP.
      c. Matco−Norca.
      d. Clearflow/Perfection Corp.
      e. Precision Plumbing Products, Inc.
      f. Victaulic Company.

   2. Standard: IAPMO PS 66 or ASTM F−1545−97.
   3. Electroplated steel nipple or waterway complying with ASTM F 1545 or ANSI/NSF−61 Compliant.
   4. Pressure Rating and Temperature: 300 psig at 225 deg F.
   5. End Connections: Male threaded or grooved.
   6. Lining: Inert and noncorrosive, propylene or LTHS.

PART 3 – EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. 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.

B. Polypropylene pipe in or passing through plenums must be fire wrapped or installed in a metal conduit.

C. Install copper tubing under building slab according to CDA’s “Copper Tube Handbook.”

D. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Division 22 Section "Domestic Water Piping Specialties."

H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
   1. Piping will be drained seasonally for freeze protection.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. 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.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.2 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 pipes, tubes, and fittings before assembly.
C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water–flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Joints for Dissimilar–Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1–1/2 and Smaller: Fitting–type coupling.
2. Fittings for NPS 2 and Larger: Sleeve–type coupling.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples/waterways.

C. Dielectric Fittings for NPS 2–1/2 to NPS 4: Use dielectric nipples/waterways.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric nipples/waterways

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   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. Support vertical piping and tubing at base and at each floor.
C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. 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.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4–inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. 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.
7. NPS 6: 12 feet with 3/4–inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8–inch rod.

G. Install supports for vertical steel piping every 15 feet.

H. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1–1/4 and larger.

I. Support piping and tubing not listed in this article according to MSS SP–69 and manufacturer’s written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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 water–service piping with shutoff valve; extend and connect to the following:

1. Plumbing Fixtures: Cold– and hot–water–supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
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.
3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day 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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. 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 a separate report for each test, complete with diagram of portion of piping tested.
   c. 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.
   d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
   f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. 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. Adjust balancing valves in hot–water–circulation return piping to provide adequate flow.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures 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. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non–potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water–sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
3.11 PIPING SCHEDULE

A. Some piping types and sizes mentioned in this section may not be used on this project.

B. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

C. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.

E. Under—building—slab, domestic water piping, NPS 2 and smaller shall be the following:
   1. Hard or soft copper tube, ASTM B 88, Type K; wrought—copper, solder—joint fittings; and brazed joints.

F. Aboveground domestic water piping, NPS 2 and smaller shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast—copper, solder—joint fittings; and soldered joints.

G. Aboveground domestic water piping, NPS 2–1/2 to NPS 4, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast—copper, solder—joint fittings; and soldered joints.
   2. Joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball for piping NPS 3 and smaller. Use butterfly or ball, with flanged ends for piping NPS 4 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2–1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116
SECTION 221119
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 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes the following domestic water piping specialties:
      1. Vacuum breakers.
      2. Balancing valves.
      3. Strainers.
      4. Drain valves.
      5. Water hammer arresters.
   
   B. Related Sections include the following:
      1. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.

1.3 PERFORMANCE REQUIREMENTS
   A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.
   
   B. Shop Drawings: Diagram power, signal, and control wiring.
   
   C. Field quality—control test reports.
   
   D. Operation and Maintenance Data: For domestic water piping specialties 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. NSF Compliance:
2. Comply with NSF 61, "Drinking Water System Components – Health Effects; Sections 1 through 9."

PART 2 – PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe–Applied, Atmospheric–Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Co.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. FEBCO; SPX Valves & Controls.
   e. Rain Bird Corporation.
   f. Toro Company (The); Irrigation Div.
   g. Watts Industries, Inc.; Water Products Div.
   h. Zurn Plumbing Products Group; Wilkins Div.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose–Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrowhead Brass Products, Inc.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. MIFAB, Inc.
   e. Prier Products, Inc.
   g. Woodford Manufacturing Company.
   h. Zurn Plumbing Products Group; Light Commercial Operation.
   i. Zurn Plumbing Products Group; Wilkins Div.

5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Toro Company (The); Irrigation Div.
g. Zurn Plumbing Products Group; Wilkins Div.

3. Operation: Continuous—pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.2 BALANCING VALVES

A. Copper—Alloy Calibrated Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Flo Fab Inc.
      c. ITT Industries; Bell & Gossett Div.
      d. NIBCO INC.
      e. TAC Americas.
      f. Taco, Inc.
      g. Victaulic
      h. Watts Industries, Inc.; Water Products Div.
   2. Type: Ball or Y—pattern globe valve with two readout ports and memory setting indicator.
   3. Body: bronze,
   4. Size: Same as connected piping, but not larger than NPS 2.
   5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast—Iron Calibrated Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Flo Fab Inc.
      c. ITT Industries; Bell & Gossett Div.
      d. NIBCO INC.
      e. TAC Americas.
   2. Type: Adjustable with Y—pattern globe valve, two readout ports, and memory—setting indicator.
   3. Size: Same as connected piping, but not smaller than NPS 2–1/2.
   4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
2.3 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: 0.020 inch.
   b. Strainers NPS 2–1/2 to NPS 4: 0.045 inch.
   c. Strainers NPS 5 and Larger: 0.10 inch.

2.4 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.

2.5 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. PPP Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI–WH 201, Sizes A through F.
PART 3 – EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section “Common Work Results for Plumbing” for piping joining materials, joint construction, and basic installation requirements.

B. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install Y-pattern strainers for water on supply side of each control valve, water pressure—reducing valve, solenoid valve, and pump.

E. Install water hammer arresters in water piping according to PDI–WH 201.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each 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 ADJUSTING

A. Set field—adjustable pressure set points of water pressure—reducing valves.

B. Set field—adjustable flow set points of balancing valves.

C. Set field—adjustable temperature set points of temperature—actuated water mixing valves.

END OF SECTION 221119
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:


1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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 Sanitary Waste Service: Do not interrupt 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 no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: All cast-iron waste, vent and sewer pipe and fittings shall conform to the requirements of CISPI Standard 301 and ASTM A 888. All products shall be marked with the collective trademark of the Cast Soil Pipe Institute and shall be listed by NSF International or receive prior approval of the engineer. All cast-iron pipe and fittings shall be American made and tested. Non-compliant import cast-iron products will not be permitted. Any non-compliant cast-iron product installed by the contractor on this project will be replaced at the contractor’s expense and shall include all repairs, patching, painting and other incidental work required to return the project to its pre-remediation state.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AB&I Foundry
   b. Charlotte Pipe
   c. Tyler Pipe

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ANACO.
   b. Ideal
   c. Mission Rubber Company; a division of MCP Industries, Inc.
   d. Tyler Pipe.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Husky SD 4000.
   b. Clamp–All Corp Hi–TORQ 125.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

D. Solvent Cement: ASTM D 2564.
   1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 – EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section “Earth Moving.”

3.2 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 coordination drawings.

B. Install piping in concealed locations 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.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.
J. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. 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 two 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.

L. 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.

M. 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.**
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.

N. 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."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground **PVC** piping according to ASTM D 2321.

Q. Install engineered soil and waste drainage and vent piping systems as follows:


R. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity–flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force–main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity–flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
3. Install cleanout fitting with closure plug inside the building in sanitary force–main piping.

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section “Sleeves and Sleeve Seals for Plumbing Piping.”

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section “Sleeves and Sleeve Seals for Plumbing Piping.”
V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Plastic, Nonpressure--Piping, Solvent--Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe--handling practice of cleaners, primers, and solvent cements.
   2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic--restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

   1. Install carbon--steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless--steel pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon--steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless--steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Install individual, straight, horizontal piping runs:
      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.
   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling or valve and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double--rod hangers, with 3/8--inch minimum rods.

F. 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.
   4. NPS 6 and NPS 8: 60 inches with 3/4--inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8--inch rod.
   6. Spacing for 10--foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
G. Install supports for vertical cast-iron soil piping every 15 feet.
H. Support piping and tubing not listed above according to MSS SP–69 and manufacturer’s written instructions.

3.5 CONNECTIONS
A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
C. 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.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Comply with requirements for **cleanouts and drains** specified in Division 22 Section "Sanitary Waste Piping Specialties."
   6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2–1/2 and larger.
D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
E. Make fixture and equipment connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2–1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION
A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

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 CLEANING AND PROTECTION

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.

3.9 PIPING SCHEDULE

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. Hubless, cast–iron soil pipe and fittings CISPI hubless–piping couplings; and coupled joints.

C. Aboveground, soil and waste piping NPS 4 and larger shall be any of the following:

1. Hubless, cast–iron soil pipe and fittings heavy–duty hubless–piping couplings; and coupled joints.

D. Aboveground, vent piping NPS 3 and smaller shall be any of the following:

1. Hubless, cast–iron soil pipe and fittings CISPI hubless–piping couplings; and coupled joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Aboveground, vent piping NPS 4 and larger shall be any of the following:
   1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

F. Underground, soil, waste, and vent piping NPS 3 and smaller shall be any of the following:
   1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

G. Underground, soil and waste piping NPS 4 and larger shall be any of the following:
   1. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316
SECTION 221319
SANITARY WASTE PIPING SPECIALTIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Through-penetration firestop assemblies.

1.3 DEFINITIONS

A. FOG: Fats, oils, and greases.
B. FRP: Fiberglass–reinforced plastic.
C. HDPE: High–density polyethylene plastic.
D. PE: Polyethylene plastic.
E. PP: Polypropylene plastic.
F. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
   1. Cleanouts.
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.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 – PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast–iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Oatey.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast–iron drainage pipe fitting and riser to cleanout.
15. Size: Same as connected branch.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 THROUGH—PENETRATION FIRESTOP ASSEMBLIES

A. Through—Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ProSet Systems Inc.

4. Size: Same as connected soil, waste, or vent stack.
5. 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.
7. Special Coating: Corrosion resistant on interior of fittings.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep—Seal Traps:

1. Description: Cast—iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap—seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2: 4—inch—minimum water seal.
   b. NPS 2—1/2 and Larger: 5—inch—minimum water seal.

B. Air—Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" 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.
   4. Locate at base of each vertical soil and waste stack.

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.
   1. drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   2. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install wood—blocking reinforcement for wall—mounting—type specialties.

F. 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 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low—Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Manufacturer’s Field Service: Engage a factory–authorized service representative to inspect field–assembled grease removal devices and their installation, including piping and electrical connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 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.

3.5 DEMONSTRATION

A. Engage a factory–authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain grease removal devices. Refer to Division 01 Section “Demonstration and Training.”

END OF SECTION 221319
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

   1. Faucets for lavatories bathtub/showers showers and sinks.
   2. Flushometers.
   3. Toilet seats.
   4. Protective shielding guards.
   5. Fixture supports.
   7. Urinals.
   8. Lavatories.
  10. Service sinks.

B. Related Sections include the following:

   1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
   2. Division 22 Section "Emergency Plumbing Fixtures."

1.3 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

D. 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, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

E. FRP: Fiberglass–reinforced plastic.

F. PMMA: Polymethyl methacrylate (acrylic) plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow–control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. 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.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


E. NSF Standard: Comply with NSF 61, "Drinking Water System Components—Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast–Iron Fixtures: ASME A112.19.1M.
2. Porcelain–Enameled, Formed–Steel Fixtures: ASME A112.19.4M.
6. Vitreous–China Fixtures: ASME A112.19.2M.
8. Whirlpool Bathtub Fittings: ASME A112.19.8M.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose–Thread Outlet: ASME A112.18.3M.
5. Hose–Connection Vacuum Breakers: ASSE 1011.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

2. Brass and Copper Supplies: ASME A112.18.1.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
3. Floor Drains: ASME A112.6.3.
6. Off–Floor Fixture Supports: ASME A112.6.1M.

1.6 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.
2. Faucet Cartridges and O–Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged–top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.
PART 2 – PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Delta.

2.2 SINK FAUCETS

A. Sink Faucets:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Delta.

2.3 FLUSHOMETERS

A. Flushometers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Zurn Plumbing Products Group; Commercial Brass Operation.

2.4 TOILET SEATS

A. Toilet Seats:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Centoco Manufacturing Corp.
      c. Church Seats.
      d. Olsonite Corp.
      e. Sperzel.
   2. Description: Toilet seat for water-closet-type fixture.
      a. Material: Molded, solid plastic with antimicrobial agent.
      b. Configuration: Open front without cover.
      c. Size: Elongated.
      d. Hinge Type: CK, check.
      e. Class: Heavy-duty commercial.
2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
   a. Engineered Brass Co.
   b. Insul–Tect Products Co.; a Subsidiary of MVG Molded Products.
   c. McGuire Manufacturing Co., Inc.
   d. Plumberex Specialty Products Inc.
   e. TCI Products.
   f. TRUEBRO, Inc.
   g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

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. Product shall also meet the ASTM E 84 25/450 smoke and flame rating.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. TRUEBRO, Inc.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot– and cold–water supplies and trap and drain piping. Comply with ADA requirements.

2.6 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.

B. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall–mounting, urinal–type fixture. Include steel uprights with feet.

C. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall–mounting, lavatory–type fixture. Include steel uprights with feet.
2.7 WATER CLOSETS

A. Water Closets:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard Companies, Inc.
      b. Crane Plumbing, L.L.C./Fiat Products.
      c. Eljer.
      d. Kohler Co.

2.8 URINALS

A. Urinals:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard Companies, Inc.
      b. Briggs Plumbing Products, Inc.
      c. Crane Plumbing, L.L.C./Fiat Products.
      d. Eljer.
      e. Kohler Co.

2.9 LAVATORIES

A. Lavatories:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard Companies, Inc.
      b. Briggs Plumbing Products, Inc.
      c. Crane Plumbing, L.L.C./Fiat Products.
      d. Eljer.
      e. Kohler Co.

2.10 COMMERCIAL SINKS

A. Commercial Sinks:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay Manufacturing Co.
      b. Just Manufacturing Company.

2.11 SERVICE SINKS

A. Service Sinks:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
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 off–floor supports, affixed to building substrate, for wall–mounting fixtures.

1. Use carrier supports with waste fitting and seal for back–outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair–type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back–outlet, wall–mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor–mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall–mounting fixtures with tubular waste piping attached to supports.

F. Install counter–mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing–in drawings.

H. 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.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General–Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
L. Install toilet seats on water closets.

M. 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.

N. Install water--supply flow--control fittings with specified flow rates in fixture supplies at stop valves.

O. 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.

P. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

Q. 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 22 Section "Common Work Results for Plumbing."

R. Seal joints between fixtures and walls, floors, and countertops using sanitary--type, one--part, mildew--resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

U. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 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. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low--Voltage Electrical Power Conductors and Cables."

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 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor–operated mechanisms.

3.6 CLEANING

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.

3.7 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.

3.8 PLUMBING FIXTURE SCHEDULE (See Drawings)

SS–1 Service Sink (Floor Mounted, Square): Kohler, 28 x 28–inch, enameled cast iron floor–mounted model, K9146–3" drain with strainer, No. K8940 removable vinyl–coated rim guard; Chicago 897 faucet with vacuum breaker, screw–driver stops in shanks, 5 foot rubber hose and 853 wall hook.

END OF SECTION 224000
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following emergency plumbing fixtures:

1. Emergency showers.
2. Eyewash equipment.
3. Combination units.

B. Related Sections include the following:

1. Division 22 Section “Domestic Water Piping Specialties” for backflow preventers.
2. Division 22 Section “Sanitary Waste Piping Specialties” for floor drains.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable–water supply.


D. Tepid: Moderately warm.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: Submit certificates of performance testing specified in “Source Quality Control” Article.

D. Field quality–control test reports.

E. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.
1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."


D. NSF Standard: Comply with NSF 61, "Drinking Water System Components—Health Effects," for fixture materials that will be in contact with potable water.

PART 2 – PRODUCTS

2.1 COMBINATION UNITS

A. Combination Units, ES–1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian model G–1902 free standing emergency shower / eye wash with stay open ball valves stainless steel shower head and eye wash bowl, Thermostatic mixing valve and in–line dual check valves on hot and cold water supplies or a comparable product by one of the following:

   b. Chicago Faucets.
   c. Encon Safety Products.
   d. Guardian Equipment Co.
   e. Haws Corporation.
   f. Lab Safety Supply Inc.
   g. Murdock, Inc.
   h. Sellstrom Manufacturing Co.
   i. Speakman Company.
   j. WaterSaver Faucet Co.
   k. Western Emergency Equipment.

2.2 WATER–TEMPERING EQUIPMENT

A. Water–Tempering Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Bradley Corporation.
   c. Encon Safety Products.
   d. Haws Corporation.
   e. Lawler Manufacturing Co., Inc.
   f. Leonard Valve Company.
   g. Powers, a Watts Industries Co.
2. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.

   a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure. Provide flow rate required to equipment being served.

2.3 SOURCE QUALITY CONTROL

A. Certify performance of plumbed emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section “General-Duty Valves for Plumbing Piping.”

   1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.

   2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section “Common Work Results for Plumbing.”

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters and Gages for Plumbing Piping."
G. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

H. Install equipment nameplates or equipment markers on fixtures and equipment signs on water–tempering equipment. Identification materials are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect cold–water–supply piping to plumbed emergency plumbing fixtures not having water–tempering equipment.

C. Connect hot– and cold–water–supply piping to hot– and cold–water–tempering equipment. Connect output from water–tempering equipment to emergency plumbing fixtures.

3.4 FIELD QUALITY CONTROL

A. Mechanical–Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

B. Electrical–Component Testing: After electrical circuitry has been energized, test for compliance with requirements.

1. Test and adjust controls and safeties.

C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

D. Report test results in writing.

3.5 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500
PART 1 – GENERAL

1.1 GENERAL CONDITIONS

A. The General Conditions of the Contract, with the amendments, supplements, forms, and requirements in Division 1, and herewith made a part of this Division.

B. All sections of Division 21, 22, & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.

C. Mechanical equipment that is pre–purchased if any will be assigned to the Mechanical Contractor. By assignment to the Mechanical Contractor, the Mechanical Contractor shall accept and installed the equipment and provide all warranties and guarantees as if the Mechanical Contractor had purchased the equipment.

D. Construction Indoor–Air Quality Management
   1. Comply with SMACNA’s “SMACNA IAQ Guideline for Occupied Buildings under Construction.”
      a. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section “Temporary Facilities and Controls,” install filter media having a MERV 8 according to ASHRAE 52.2 at each return–air inlet for the air–handling system used during construction.
      b. Replace all air filters immediately prior to occupancy.

1.2 SCOPE OF WORK

A. The project described herein is the Northern Arizona University Science Annex Renovation / Levels–1 & 2. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.

1.3 CODES & ORDINANCES

A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.

B. Applicable codes:
   1. International Building code– 2012 Edition

1.4 INDUSTRY STANDARDS

A. All work shall comply with the following standards.
   1. Associated Air Balance council (AABC)
   2. Air Conditioning and Refrigeration Institute (ARI)
   3. Air Diffusion council (ADC)
   4. Air Movement and Control Association (AMCA)
   5. American Gas Association (AGA)
   6. American National Standards Institute (ANSI)
   7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
   8. American Society of Mechanical Engineers (ASME)
   10. American Water Works Association (AWWA)
   11. Cooling Tower Institute (CTI)
   12. ETL Testing Laboratories (ETL)
   13. Institute of Electrical and Electronic Engineers (IEEE)
   14. Hydronics Institute (HI)
   15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
   17. National Electrical Code (NEC)
   18. National Electrical Manufacturers Association (NEMA)
   19. National Electrical Safety code (NESC)
   21. Sheet Metal and Air Conditioning Contractor’s National Association (SMACNA)
   22. Underwriters Laboratories (UL)
   23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)
   24. Heat Exchanger Institute (HEI)
   25. Hydraulic Institute (HI)
   26. Thermal Insulation Manufacturer’s Association (TIMA)
   27. Scientific Apparatus Makers Association (SAMA)

B. Compliance Verification:
   1. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
   2. Form U–1, the manufacturer’s data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
   3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

1.5 UTILITIES & FEES

A. All fees for permits required by this work will be paid by this division. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.
1.6 SUBMITTALS AND SHOP DRAWINGS

A. General: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect manufacturer’s data on products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the engineer’s office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review. If the re-submittal is returned a 2nd time for correction the Contractor will provide the specific equipment that is specified on the drawings and/or the specifications. Written approval of the Owner’s Representative shall be obtained before installing any such equipment or materials for the project.

B. Review by the Owner’s Representative is for general conformance of the submitted equipment to the project specification. In no way does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. Regardless of any items overlooked by the submittal review, the requirements of the contract drawings and specifications must be followed and are not waived or superseded in any way by the review.

C. By description, catalog number, and manufacturer’s names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.

D. If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer’s current, recognized, hourly rates.

E. Submittal Format: At the contractor’s discretion, project submittals may be in either of the formats described in the following paragraphs, but mixing the two formats is not acceptable.

1. Hardcopy Submittal Format: Six (6) copies of the descriptive literature covering products and materials to be used in the installation of mechanical systems for this project will be provided for review. The submittals shall be prepared in an orderly manner, contained in a 3-ring loose-leaf binder with index and identification tab for each item or group of items and for each specification section. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.
   a. Submitted literature shall bear the Contractor’s stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.
   b. Submitted literature shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.
   c. Submitted literature shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.

2. Electronic Submittal Format: Identify and incorporate information in each electronic submittal file as follows:
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a. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.

b. Submitted electronic file shall bear the Contractor’s stamp, indicating that he has checked all equipment being submitted, that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.

c. Submitted electronic file shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.

d. Submitted electronic file shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.

e. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

f. Name file with submittal number or other unique identifier, including revision identifier.

g. Electronic file shall be completely electronically searchable or it will be rejected.

h. Provide means for insertion to permanently record Contractor’s review and approval markings and action taken by:

1) Architect.

i. Transmittal Form for Electronic Submittals:

1) Use one of the following options acceptable to the Owner;

   a) Software–generated form from electronic project management software.
   b) Electronic form.

2) The Electronic Submittal shall contain the following information:

   a) Project name.
   b) Date.
   c) Name and address of Architect.
   d) Name of Construction Manager.
   e) Name of Contractor.
   f) Name of firm or entity that prepared submittal.
   g) Names of subcontractor, manufacturer, and supplier.
   h) Category and type of submittal.
   i) Submittal purpose and description.
   j) Specification Section number and title.
   k) Specification paragraph number or drawing designation and generic name for each of multiple items.
   l) Drawing number and detail references, as appropriate.
   m) Location(s) where product is to be installed, as appropriate.
   n) Related physical samples submitted directly.
   o) Indication of full or partial submittal.
   p) Transmittal number[, numbered consecutively].
   q) Submittal and transmittal distribution record.
   r) Other necessary identification.
   s) Remarks.

j. Metadata: Include the following information as keywords in the electronic submittal file metadata:

1) Project name.
2) Number and title of appropriate Specification Section.
3) Manufacturer name.
4) Product name.

1.7 DRAWINGS AND MEASUREMENTS

A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.

B. It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect’s office before work is started.

C. This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.

D. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.

E. The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.

F. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch = 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.

G. Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

1.8 CONTRACTOR’S USE OF BUILDING EQUIPMENT

A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

MECHANICAL REQUIREMENTS 230100 – 5
1.9 EXISTING CONDITIONS

A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for any extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.

B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.

C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.

1.10 EQUIPMENT CAPACITIES

A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.

B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers’ standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.

1.12 COOPERATION WITH OTHER TRades

A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.

B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.

C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.

D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110–16 and 384–4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.
1.13 RESPONSIBILITY OF CONTRACTOR

A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner’s Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.

B. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.

B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

1.15 UNFIT OR DAMAGED WORK

A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

1.16 WORKMANSHIP

A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner’s representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

1.17 SAFETY REGULATION

A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well.
Installation of any and all wiring done under Division 21, 22 and 23 shall be in accordance with the requirements of Division 26, Electrical.

B. All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.

C. Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.

D. The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.

B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.

C. The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.

D. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.

E. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.

F. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor’s expense.

B. All open duct and pipe openings shall be adequately covered at all times.

1.21 INSTALLATION CHECK

A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust
if necessary, and approve the equipment installation. In each case, the equipment supplier’s representative shall be present when the equipment is placed in operation. The equipment supplier’s representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.

B. Each equipment supplier’s representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.

C. All costs for this work shall be included in the prices quoted by equipment suppliers.

1.22 EQUIPMENT LUBRICATION

A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.

B. Necessary time shall be spent with the Owner’s Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.

C. Detergent oil as used for automotive purposes shall not be used for this work.

1.23 CUTTING AND PATCHING

A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.

B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

1.24 EXCAVATION AND BACKFILLING

A. All necessary excavations and backfilling for the Mechanical phase of this project shall be provided as work of this Division. Trenches for all underground pipelines shall be excavated to the required depths. The bottom of trenches shall be compacted hard and graded to obtain required fall. Backfill shall be placed in horizontal layers, not exceeding 12 inches in thickness, and properly moistened. Each layer shall be compacted, by suitable equipment, to a density of not less than 95 percent as determined by ASTM D–1557. After pipelines have been tested, inspected, and approved, the trench shall be backfilled with selected material. Excess earth shall be hauled from the job site. Fill materials approved by the Architect shall be provided as work of this Division.

B. No trenches shall be cut near or under any footings without consultation first with the Architect’s office. Any trenches or excavations more than 30 inches deep shall be tapered, shored, covered, or otherwise made absolutely safe so that no vehicle or persons can be injured by falling into such excavations, or in any way be harmed by cave-ins, shifting earth, rolling rocks, or by drowning. This protection shall be extended to all persons approaching excavation related to this work whether or not such persons are authorized to be in the vicinity of the construction.
1.25 ACCESS

A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910

B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.

C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.

D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.

1.26 CONCRETE BASES AND INSERTS

A. Bases: The concrete bases shall be provided and installed as work by this division. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 3, Concrete.

B. All floor–mounted mechanical equipment shall be set on 6–inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1–inch beveled edge all around.

C. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division

D. Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe–supporting system.

1.27 CLEANING AND PAINTING

A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.

B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 9, Painting.
C. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

D. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

1.28 CONTRACT COMPLETION

A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.

C. Instructions To Owner’s Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner’s representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.

D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.

E. The guarantee so assumed by the Contractor and as work of this Section is as follows:
   1. That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.
   2. That the circulation of water shall be complete and even.
   3. That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.
   4. That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.
   5. That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.
   6. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect’s Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100–percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect’s Certificate of Substantial Completion.
7. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.
8. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct--taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.29 CURBS
   A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by Division 22 and 23.

1.30 TEST RUN
   A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

1.31 EQUIPMENT STARTUP AND CHECKOUT:
   A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.
   B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

1.32 DEMOLITION
   A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   B. Proceed with demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   C. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   D. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   E. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame--cutting operations. Maintain portable fire--suppression devices during flame--cutting operations.
   F. Maintain adequate ventilation when using cutting torches.
   G. Remove decayed, vermin--infested, or otherwise dangerous or unsuitable materials and promptly dispose of off--site.
   H. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
I. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

J. Dispose of demolished items and materials promptly.

K. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

L. Existing Facilities: Comply with building manager’s requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

M. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

N. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

O. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

P. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

END OF SECTION 23 0100
SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
7. Grout.
8. Equipment installation requirements common to equipment sections.
10. Concrete bases.
11. Supports and anchorages.
12. Link–Seal

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases, and accessible tunnels.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene–propylene–diene terpolymer rubber.
   2. NBR: Acrylonitrile–butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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 to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured—in—place concrete and other structural components as they are constructed.
C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe–Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos–free, 1/8–inch maximum thickness unless thickness or specific material is indicated.
      a. Full–Face Type: For flat–face, Class 125, cast–iron and cast–bronze flanges.
      b. Narrow–Face Type: For raised–face, Class 250, cast–iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full–face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.


E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper–phosphorus alloys for general–duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. Plastic–to–Metal Transition Fittings: CPVC and PVC one–piece fitting with manufacturer’s Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent–cement–joint end.
1. Manufacturers:
   a. Eslon Thermoplastics.

2.5 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld–neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Unions: Factory–fabricated, union assembly, for 250–psig minimum working pressure at 180 deg F.

E. Dielectric Flanges: Factory–fabricated, companion–flange assembly, for 150– or 300–psig minimum working pressure as required to suit system pressures.

F. Dielectric–Flange Insulation Kits: Field–assembled, companion–flange assembly, full–face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Provide separate companion flanges and steel bolts and nuts for 150– or 300–psig minimum working pressure as required to suit system pressures.

G. Dielectric Couplings: Galvanized–steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300–psig minimum working pressure at 225 deg F.

H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300–psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized–Steel Sheet: **0.0239–inch** minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile–iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast–iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.


2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.


C. One–Piece, Cast–Brass Type: With set screw.


D. One–Piece, Stamped–Steel Type: With set screw or spring clips and chrome–plated finish.

E. Split–Plate, Stamped–Steel Type: With concealed hinge, set screw or spring clips, and chrome–plated finish.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, non–shrink and nonmetallic, dry hydraulic–cement grout.

2. Design Mix: 5000-psi, 28–day compressive strength.

2.10 LINK–SEAL MODULAR SEAL PRESSURE PLATES

A. Link–Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
   1. Izod Impact – Notched = 2.05ft–lb/in. per ASTM D–256
   2. Flexural Strength @ Yield = 30,750 psi per ASTM D–790
   3. Flexural Modulus = 1,124,000 psi per ASTM D–790
   4. Elongation Break = 11.07% per ASTM D–638
   5. Specific Gravity = 1.38 per ASTM D–792

B. Models LS200–275–300–315 shall incorporate the most current Link–Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315–325–340–360–400–410–425–475–500–525–575–600 shall incorporate an integral recess known as a “Hex Nut Interlock” designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer’s name molded into it.

C. For fire service, pressure plates shall be steel with 2–part Zinc Dichromate Coating.

D. Link–Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link–Seal® modular seal technical data. Bolts, flange hex nuts shall be:
   1. 316 Stainless Steel per ASTM F593–95, with a 85,000 psi average tensile strength.

PART 3 – EXECUTION

3.1 PIPING SYSTEMS – COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. 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 Coordination Drawings.

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 to permit valve servicing.

G. Install piping at indicated slopes.
H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. 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 type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
      g. 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.

M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. PVC Steel Pipe Sleeves: For pipes smaller than NPS 6.
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
      c. 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 above finished floor level. Refer to Division 07 Section “Sheet Metal Flashing and Trim” for flashing.
         1) Seal space outside of sleeve fittings with grout.
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
O. Aboveground, Exterior—Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast—iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior—Wall Pipe Penetrations: Install cast—iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. 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 07 Section "Penetration Firestopping" for materials.

R. Verify final equipment locations for roughing—in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing—in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water—flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA’s "Copper Tube Handbook," using lead—free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. 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.
G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 “Quality Assurance” Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2–1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections “Interior Painting” and “Exterior Painting.”

B. Damage and Touchup: Repair marred and damaged factory–painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer’s written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor–bolt manufacturer’s written instructions.

7. Use 3000–psi, 28–day compressive–strength concrete and reinforcement as specified in Division 03 Section “Miscellaneous Cast–in–Place Concrete.”

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section “Metal Fabrications” for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 LINK SEAL

A. Provide Link Seal at all piping penetrations from the outside.

END OF SECTION 230500
SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 – GENERAL

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

1.2 SUMMARY
   A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer’s factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION
   A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
      1. Motor controllers.
      2. Torque, speed, and horsepower requirements of the load.
      3. Ratings and characteristics of supply circuit and required control sequence.
      4. Ambient and environmental conditions of installation location.

PART 2 – PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS
   A. Comply with requirements in this Section except when the requirements in equipment schedules, other specification sections, drawing notes or in other contract documents are more stringent.

   B. Comply with NEMA MG 1 unless otherwise indicated.

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.

   C. Motors 3/4 HP and larger: Polyphase.
D. Motors smaller than 3/4 HP: Single phase.

E. All motors shall have ASTM Grade 5 hardware that is Yellow Zinc–dichromate plated.

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. Rotor: Random–wound, squirrel cage.

E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating.

G. Insulation: Class F.

H. 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.

I. 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.
   5. Shaft Grounding Ring: Microfiber type.
      a. Provide grounded discharge path for VFD induced voltage in the shaft to prevent arching in the motor bearings.

2.5 Electronically Commutated Motor (ECM)

   1. Motor enclosures: Open type
   2. Motor to be a DC electronic commutation type motor (ECM).
      a. AC induction type motors are not acceptable.
3. Permanently lubricated motor with heavy duty ball bearing
4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
5. Speed controllable to 20% of full speed (80% turndown).
   a. Potentiometer dial mounted at the motor speed controller
   b. 0–10 VDC signal.
6. 85% efficient at all speeds minimum.
7. Motors smaller than 2.0 hp.

2.6 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. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

C. Motors 1/20 HP and Smaller: Shaded–pole type.

D. 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, unless otherwise indicated.

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 230513
SECTION 230514
VARIABLE FREQUENCY MOTOR DRIVES

PART 1 – GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install variable frequency drive (VFD) system with motors as described in Contract Documents.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers

1. IEEE 519–1992,

1.3 QUALITY ASSURANCE

A. Requirements: Drive shall meet requirements of IEEE 519 as measured at VFD system terminals.

B. Certifications: Completed unit including motor shall be UL or ETL listed and carry appropriate label.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store unit in area free of dirt, vibration, and moisture.

B. Do not allow unit to be exposed to excessive heat or cold.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. General:

1. Provide VFD and motor one coordinated package, warrantied by VFD supplier.

2. Variable Frequency Drive (VFD) System shall be solid state AC to DC converter sinesoidal pulse—width modulation (PWM) type.

3. Unit shall operate on:

    a. Input Voltage Greater than 3 H.P. than 460/3/60 less than 3 H.P> than 230/1/60.
    b. Input frequency 60 Hz, plus or minus 5 percent.

4. All components of system shall be contained in single enclosure as integrated package.

5. Control power for operator devices and customer connections shall be 120 volts. Control power transformer shall be ‘Machine Tool’ type and have primary and secondary fusing.
6. Variable Frequency Drive shall be rated for continuous current equal to 105 percent of motor FLA.
7. Rated overload current shall be 120 percent for one minute.
8. Unit shall be adjustable accel / decel time setting from one second to 120 seconds.
9. Unit shall maintain 95 percent or better displacement power factor over entire speed range.

B. Enclosure:
   1. NEMA 1 force ventilated enclosure with louver covered exhaust ports, hinged doors, and painted with high-grade enamel.
   2. Door mounted operator devices shall be industrial, oil tight.
   3. Wall mounted or freestanding as shown on Drawings.

C. Variable Frequency Drive Inverter:
   1. Altitude compensated and sized for elevation at which unit will be installed.
   2. Capable of operating in ambient temperature of 14 deg F to 122 deg F and humidity of 0 percent to 90 percent non-condensing.
   3. Mounted on removable panel along with other components so panel can be removed from enclosure for maintenance or part replacement.
   4. Output frequency clamp on drive for setting minimum or maximum output frequency.
   5. Supply with door interlock input disconnect motor circuit protector. Door mounted handle shall be able to lock in OFF position.

D. Controls And Safety Equipment:
   1. Provide, as minimum, following door mounted operator controls:
      a. HAND / OFF / AUTO Switch.
      b. Local / Remote Selector.
      c. Frequency Setting Speed Selector.
      d. Frequency Indication Meter calibrated in percent speed.
      e. Power on Light.
      f. VFD / Bypass Switch.
      g. VFD Fault Light.
      h. External Fault Light (safeties interlock).
      i. Digital Keypad Programmable Parameter Unit (75 hp and less).
   2. Provide minimum of following protective features with alarm display indication:
      a. Over-current shut-off.
      b. Regenerative over voltage.
      c. Electronic Thermal Protector.
      d. Heatsink Overheat.
      e. Instantaneous Power Failure.
      f. Output Ground Fault (Actual phase to phase or phase to ground without damage).
   3. Provide following termination points on terminal strip for field connections:
      a. Safeties Interlock.
      b. Remote Start / Stop Contact.
      c. Remote VFD Fault Contact.
      d. Remote VFD / Bypass Enable Contact.
      e. Remote Electronic Signal Input.
4. Auto Restart shall be initiated by means of automatic time delayed restart after recovering form under voltage or loss of power. Inverter shall not automatically restart after over–current, over–voltage, over–temperature, or other damaging conditions, but shall require manual restart.

   a. Supply inverter with bypass contactor arrangement for transfer to feeder line to operate at constant speed.
   b. Contactors shall be electrically and mechanically interlocked and supplied with adjustable motor overload relay.

5. Provide VFD isolation switch to allow maintenance on VFD while operating in bypass mode. Pre–wired in same enclosure including contactors, input disconnect MCP, motor overload, VFD / Bypass selector switch, and Bypass On light.

6. Provide elapsed time meter.

7. Frequency Jump: Supply drive with capability of being field retrofitted with frequency jump control to avoid operating at point of resonance with natural frequency of machine.

8. Provide VFD unit with computer signal control option through future addition of RS 232 data card.

9. Fault Diagnostics: Drive system shall have non–volatile fault retention so VFDs fault history is available from memory even after power loss.

E. Approved Products:

   1. Yaskawa Electric America, Inc.
   2. Rockwell Automation, Inc; Allen–Bradley Brand (ABB).
   3. Toshiba International Corp E3.
   4. Mitsubishi A/F 500 Series.

2.2 SOURCE QUALITY CONTROL

A. Before shipping, test each unit and supply certified test report with each unit. Standard test shall include following:

   1. Visual inspection consisting of checking unit enclosure, wiring, connections, fasteners, covers, and locking mechanism.
   2. High Pot Test:

      a. Apply two times rated voltage plus 1000 volts AC for 60 seconds in accordance with UL 508 on all peripheral drive system power components (circuit breakers, contactors, motor overloads, line reactors, disconnect switches, etc) as complete package.
      b. Include copy of test results in operations manuals.

   3. Test devices and lights on control panel devices.
   4. Test optional equipment specified with VFD system.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

A. Testing:

   1. VFD supplier shall provide three full spectrum harmonic analyses of VFD voltage and current waveforms for each VFD system.
2. Harmonic report shall demonstrate operating harmonic waveforms with VFD's at 100 percent load, 50 percent load, and with motors operating across line.

3. Conduct harmonic tests at start–up and perform in presence of Architect:

   a. Harmonic current distortion measured at VFD input terminals shall not exceed 40 percent of fundamental current drawn by VFD.
   b. Voltage distortion at this point shall not exceed 3 percent of fundamental.
   c. VFD supplier shall provide harmonic control devices to meet above requirements as integral part of ETL or UL listed VFD system.
   d. Compliance with above limits is strictly responsibility of VFD supplier. Adjustments required to bring system to within specified limits shall be performed at no additional cost to Owner.
   e. Harmonic tests shall be published and included in Operation and Maintenance Manual.
   f. Harmonic distortion compliance shall be approved before final acceptance by Owner.

B. Manufacturer’s Field Services:

1. Provide field start–up service by authorized factory service representative consisting of system check–out, start–up, and system run.
2. Provide certificate of completion and authorized factory service including operator training and start–up.
SECTION 230517
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 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Sleeves.
   2. Stack-sleeve fittings.
   3. Sleeve-seal systems.
   4. Sleeve-seal fittings.
   5. Grout.

1.3 ACTION 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, Schedule 40, with plain ends and welded steel collar; zinc coated.
C. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Zurn Industries, LLC.

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, provide products by one of 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: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. HOLDRITE.

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.

2.5 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.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, 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 above finished floor level.
   3. 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 Section 079200 "Joint Sealants."

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 Section 078413 "Penetration Firestopping."

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 Section 076200 "Sheet Metal Flashing and Trim."
   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 Section 078413 "Penetration Firestopping."
3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

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

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.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves.
      c.
   2. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   4. Concrete Slabs above Grade:
      b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
   5. Interior Partitions:

END OF SECTION 23 0517
SECTION 230518
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 01
      Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Escutcheons.

1.3 ACTION 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 or 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.

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 insulated 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 with polished, chrome-plated finish.
b. Chrome-Plated Piping: **One-piece, cast-brass** type with polished, chrome-plated finish.
c. Insulated Piping: **One-piece, stamped-steel type with chrome-plated finish**. Retain one of first two subparagraphs below.
d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: **One-piece, cast-brass** type with polished, chrome-plated finish.
e. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish**.
f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: **One-piece, cast-brass** type with polished, chrome-plated finish.
g. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish**.
h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: **One-piece, cast-brass** type with polished, chrome-plated finish.
i. Bare Piping Larger than 2 inch in Unfinished Service Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish**.
.j. Bare Piping 2 inch and Smaller in Equipment Rooms: **One-piece, cast-brass** type with polished, chrome-plated finish.
k. Bare Piping Larger than 2 inch in Equipment Rooms: **One-piece, stamped-steel type with chrome- or cadmium-plated 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 polished, chrome-plated finish and concealed or exposed-rivet hinge.
   c. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   d. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed or exposed-rivet hinge.
   e. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   f. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed or exposed-rivet hinge.
   g. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated or rough-brass finish.
   h. Bare Piping Larger than 2 inch in Unfinished Service Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed or exposed-rivet hinge.
   i. Bare Piping 2 inch and Smaller in Equipment Rooms: Split-casting brass type with polished, chrome-plated or rough-brass finish.
   j. Bare Piping Larger than 2 inch in Equipment Rooms: Split-plate, stamped-steel type with chrome- or cadmium-plated finish and concealed or exposed-rivet hinge.

3.2 FIELD QUALITY CONTROL

   A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518
SECTION 230523

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
4. Bronze swing check valves.
5. Iron swing check valves.
8. Lubricated plug valves.

B. Related Sections:

1. Section 230553 “Identification for HVAC Piping and Equipment” for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile–butadiene, Buna–N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.
1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated. Body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.

B. Maintenance data for valves to be included in the operation and maintenance data specified in Division 1. Include detailed manufacturer’s instructions on adjusting, servicing, disassembling, and repairing.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve as listed in SUMMARY from a single source and from a single manufacturer.

B. Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.
   4. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

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, and weld ends.
   3. Set angle, 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.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   2. Handwheel: For valves other than quarter-turn types.
   3. Handlever: For quarter-turn valves NPS 6 and smaller[ except plug valves].

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve–End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
      a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg. For, globe, and check valves: below 421 deg. F for ball valves.
   3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP–45.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. APCO Willamette Valve and Primer Corp.
   2. Babbitt Steam Specialty Company.
   3. Bray Controls.
   4. Center Line.
   5. Cla-Val Company.
   6. Conbraco Industries Inc.
   7. Crane Co.; Crane Valve Group.
   8. Fisher Valve by Emerson.
   9. Flo Fab Inc.
   13. Jamesbury; a subsidiary of Metso Automation.
   14. Jomar International LTD.
   15. Keystone Valve USA, Inc.
   16. Kitz Corp.
   17. Metraflex Company.
   18. Milwaukee Valve Company.
   20. NIBCO Inc.
   23. Stockham Valves and Fittings, Inc.
2.4 BRONZE BALL VALVES

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

2.5 IRON, SINGLE–FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single–Flange (Lug) Butterfly Valves:

1. Description:
   a. Standard: MSS SP–67, Type I.
   b. CWP Rating: 150 psig.
   c. Body Design: Lug type; suitable for bidirectional dead–end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One– or two–piece stainless steel.
   g. Disc: Nylon 11 coated ductile iron.

B. 175 CWP, Iron, Single–Flange (Lug) Butterfly Valves:

1. Description:
   a. Standard: MSS SP–67, Type I.
   b. CWP Rating: 175 psig.
   c. Body Design: Lug type; suitable for bidirectional dead–end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One– or two–piece stainless steel.
   g. Disc: Nylon 11 coated ductile iron.

C. 200 CWP, Iron, Single–Flange Butterfly Valves with EPDM Seat and Nylon 11 coated ductile Iron Disc:
1. Description:
   a. Standard: MSS SP–67, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Lug type; suitable for bidirectional dead–end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One– or two–piece stainless steel.
   g. Disc: Nylon 11 coated ductile iron.

D. 250 CWP, Iron, Single–Flange Butterfly Valves with EPDM Seat and Nylon 11 coated ductile Iron Disc:

1. Description:
   a. Standard: MSS SP–67, Type I.
   b. CWP Rating: 250 psig.
   c. Body Design: Lug type; suitable for bidirectional dead–end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One– or two–piece stainless steel.
   g. Disc: Nylon 11 coated ductile iron.

2.6 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valve:

1. Description:
   b. CWP Rating: 200 psig.
   e. Ends: Threaded.
   f. Disc: Bronze, Type 1.

2.7 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Description:
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded.
   f. Disc: Bronze.
2.8  IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Description:
   a. Standard: MSS SP–71, Type I.
   b. NPS 2–1/2 to NPS 12, CWP Rating: 200 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.

2.9  BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Description:
   b. CWP Rating: 300 psig.
   d. Ends: Threaded.
   e. Stem: Bronze.
   f. Disc: PTFE or TFE.
   g. Packing: Teflon impregnated, asbestos free.
   h. Handwheel: Malleable iron.

2.10 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Description:
   a. Standard: MSS SP–85, Type I.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Stem: Brass alloy. OS &Y.
   f. Disc: Renewable bronze seat.
   g. Trim: Bronze.
   h. Packing and Gasket: Teflon impregnated, asbestos free.
   i. Handwheel: Cast iron

2.11 LUBRICATED PLUG VALVES

A. Class 125, Regular–Gland, Lubricated Plug Valves with Threaded Ends:

1. Description:
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PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do no proceed with installation until 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 INSTALLATION

A. Install valves as indicated, according to manufacturer’s written instructions.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in position to allow full stem movement.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.
4. Install all check valves a minimum of five pipe diameters downstream of pump discharge or elbow to avoid flow turbulence. In extreme cases add flow straighteners as required to correct the turbulence.
3.3 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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. **Shutoff Service**: Ball or butterfly valves.
3. **Throttling Service except Steam**: Globe valves.
5. Pump–Discharge Check Valves:
   a. **NPS 2 and Smaller**: Bronze swing check valves with bronze disc.
   b. **NPS 2–1/2 and Larger**: Iron swing check valves with lever and weight or with spring or iron, metal–seat check valves.
6. Drain Service (except Steam): Two–Piece, Full Port Bronze Ball Valves with Bronze Trim. To be installed with NPS ¾ hose thread outlet and hose cap with chain.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder–joint valve–end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2–1/2 to NPS 4: Flanged ends except where threaded valve–end option is indicated in valve schedules below.
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 ends except where threaded valve–end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 CHILLED–WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. **Bronze Valves**: May be provided with solder–joint ends instead of threaded ends.
3. Ball Valves:
   a. **Piece**: Two
   b. **Port**: Full.
   c. **Material/Trim**: Bronze with:
   1) Bronze trim.
4. Bronze Swing Check Valves:
   a. **Class 150**
   b. Bronze disc.
6. Bronze Globe Valves:
   a. **Class 125**
b. **Bronze disc.**

### 3.6 HEATING–WATER VALVE SCHEDULE

#### A. Pipe NPS 2 and Smaller:

1. **Bronze Valves**: May be provided with solder–joint ends instead of threaded ends.
2. Ball Valves:
   a. **Piece**: Two
   b. **Port**: Full.
   c. **Material/Trim**: Bronze with:
      1) **Bronze trim**.
3. Bronze Swing Check Valves:
   a. **Class 150**
   b. **Bronze disc**.
4. Bronze Globe Valves:
   a. **Class 125**
   b. **Bronze disc**.

#### B. Pipe NPS 2–1/2 and Larger:

1. **Iron Valves, NPS 2–1/2 to NPS 4**: May be provided with threaded ends instead of flanged ends.
2. Iron, Single–Flange Butterfly Valves, NPS 2–1/2 to NPS 12:
   a. **200 CWP**.
   b. **Seat**: EPDM.
   c. **Disc**: Ductile–iron.
3. **Iron Swing Check Valves**: Class 125, metal seats.
4. **Iron Globe Valves**: Class 125.
5. **Lubricated Plug Valves**: Class 125, regular gland, flanged.

### 3.7 LOW–PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

#### A. Pipe NPS 2 and Smaller:

1. Ball Valves:
   a. **Piece**: Two
   b. **Port**: Full.
   c. **Material/Trim**: Bronze with:
      1) **Bronze trim**.
2. Bronze Swing Check Valves:
   a. **Class 150**

#### B. Pipe NPS 2–1/2 and Larger:

1. **Iron Valves, NPS 2–1/2 to NPS 4**: May be provided with threaded ends instead of flanged ends.
2. Iron, Single–Flange Butterfly Valves, NPS 2–1/2 to NPS 12:
   a. **200 CWP**.
   b. **Seat**: EPDM.
   c. **Disc**: Ductile–iron.
3. **Iron Swing Check Valves**: Class 125, metal seats.
4. **Iron Globe Valves**: Class 125.
b. Bronze disc.
4. Bronze Globe Valves:
   a. Class 125
   b. Bronze disc.

B. Pipe NPS 2–1/2 and Larger:
1. Iron Valves, NPS 2–1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal seats.

3.8 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)
A. Pipe NPS 2 and Smaller:
1. Ball Valves:
   a. Piece: Two
   b. Port: Full.
   c. Material/Trim: Bronze with:
      1) Bronze trim.
2. Bronze Swing Check Valves:
   a. Class 150
   b. Bronze disc.
4. Bronze Globe Valves:
   a. Class 125
   b. Bronze disc.

B. Pipe Sizes NPS 2–1/2 and Larger:
1. Iron Valves, NPS 2–1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal seats.

3.9 STEAM-CONDENSATE VALVE SCHEDULE
A. Pipe NPS 2 and Smaller:
1. Ball Valves:
   a. Piece: Two
   b. Port: Full.
   c. Material/Trim: Bronze with:
      1) Bronze trim.
2. Bronze Swing Check Valves:
   a. Class 150
   b. Bronze disc.
4. Bronze Globe Valves:
   a. Class 125
   b. Bronze disc.

B. Pipe NPS 2–1/2 and Larger:
1. Iron Valves, NPS 2–1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal seats.
4. Lubricated Plug Valves: Class 125, regular gland, flanged.

END OF SECTION 230523
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.

B. Related Sections:
   1. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

   1. Trapeze pipe hangers.
2. Metal framing systems.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel 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.

PART 2 – PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon–Steel Pipe Hangers and Supports:

1. Description: MSS SP–58, Types 1 through 58, factory–fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP–69, Type 59, shop– or field–fabricated pipe–support assembly made from structural carbon–steel shapes with MSS SP–58 carbon–steel hanger rods, nuts, saddles, and U–bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International.
   b. Cooper B–Line, Inc.; a division of Cooper Industries.
   c. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   d. FNW/Ferguson Enterprises
   e. GS Metals Corp.
   f. Hilti, Inc.insert manufacturer’s name.
   h. Thomas & Betts Corporation.
   i. Tolco Inc.
   j. Unistrut; an Atkore International company.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Metallic Coating:
   a. Electroplated zinc.

B. Non–MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International; a subsidiary of Mueller Water Products, Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.
   d. FNW/Ferguson Enterprises
   e. Haydon Corporation.
   f. NIBCO INC.
   g. PHD Manufacturing, Inc.
   h. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Coating:
   a. Zinc.

2.4 THERMAL–HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
3. ERICO International Corporation.
5. PHS Industries, Inc.
6. Pipe Shields Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation–Insert Material for Cold Piping:
1. Water–repellent treated, ASTM C 533, Type I calcium silicate with 100–psig minimum compressive strength.

C. Insulation–Insert Material for Hot Piping:
1. Water-repellent treated, ASTM C 533, Type I calcium silicate with 100–psig minimum compressive strength.

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.

2.5 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.

B. Mechanical–Expansion Anchors: Insert–wedge–type, steel anchors, for use in hardened portland cement concrete; with pull–out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, carbon–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 INSTALLATION

A. Comply with SEI/ASCE 7 and with requirements for seismic–restraint devices in Section 230548 “Vibration and Seismic Controls for HVAC.”

B. Metal 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 the building structure.

C. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36, carbon–steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field–assembled metal framing systems.

E. Thermal–Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
F. 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.

G. Install hangers and supports complete with necessary attachments, 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 that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

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 allowed by 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. Pipes NPS 8 and Larger: Include wood or reinforced calcium–silicate–insulation inserts of length at least as long as protective shield.

6. Thermal–Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

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/D1.1M 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 so contours of welded surfaces match adjacent contours.

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.

3.4 PAINTING

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing–repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are 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 carbon–steel pipe hangers and supports and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal–hanger shield inserts for insulated piping and tubing.

H. 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 up to 1050 deg F, pipes NPS 4 to NPS 24, 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 36, 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.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two–Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U–Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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 or carbon–steel plate.
15. 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 or carbon–steel plate, and with U–bolt to retain pipe.
16. 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.
17. Single–Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2–1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. 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.
20. 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.
21. 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.
I. 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 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. 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.

K. 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.

L. 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.

M. 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 allow 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 allow 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 allow 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.

N. Comply with MSS SP–69 for trapeze pipe–hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA–103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder–actuated fasteners instead of building attachments where required in concrete construction.

END OF SECTION 230529
SECTION 230550
OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. All pertinent sections of Division 21, 22, & 23 Mechanical General Requirements, are part of the work of this Section. Division 1 is part of this and all other sections of these specifications.

1. Testing and Balancing is specified in section 230594.
2. Training and Instructions to Owner’s Representative is specified in section 230100.

1.2 SCOPE OF WORK

A. Submission of Operating and Maintenance Manuals complete with Balancing reports. (Coordinate with Division 1).
B. Coordination of work required for system commissioning.
C. Provide a hard copy and an electronic copy on CD of the O and M manual fully searchable in PDF format.

1.3 SUBMITTALS

A. Submit product data in accordance with Division 1 and Section 230100. Submit the following:

2. Hard copy and an electronic copy on CD of the O and M manual fully searchable in PDF format. Both the hard copy and the electronic copy are to be fully indexed. The electronic copy shall also have a linked index.

PART 2 – PRODUCTS

2.1 O & M MANUALS

A. The operating and maintenance manuals shall be as follows:

1. Binders shall be red buckram with easy-view metal for size 8-1/2 x 11-inch sheets, with capacity expandable from 2 inches to 3-1/2 inches as required for the project. Construction shall be rivet-through with library corners. No. 12 backbone and lining shall be the same material as the cover. The front cover and backbone shall be foil-stamped in white as follows: (coordinate with Division 01)
OPERATION AND MAINTENANCE OF HVAC SYSTEM 230550 – 2

PART 3 – EXECUTION

3.1 OPERATING AND MAINTENANCE MANUALS:

A. Work under this section shall be performed in concert with the contractor performing the system testing and balancing. Six (6) copies of the manuals shall be furnished to the Architect for distribution to the owner.

B. The “Start–Up and Operation” section is one of the most important in the manual. Information in this section shall be complete and accurately written and shall be verified with the actual equipment on the job, such as switches, starters, relays, automatic controls, etc. A step–by–step start–up procedure shall be described.

C. The manuals shall include air and water–balancing reports, system commissioning procedures, start–up tests and reports, equipment and system performance test reports, warranties, and certificates of training given to the owner’s representatives.

An index sheet typed on AICO Gold–Line indexes shall be provided in the front of the binder. The manual shall be include the following:

SYSTEM DESCRIPTIONS

START–UP PROCEDURE AND OPERATION OF SYSTEM

MAINTENANCE AND LUBRICATION TABLE

OPERATION AND MAINTENANCE BULLETINS

AUTOMATIC TEMPERATURE CONTROL DESCRIPTION OF OPERATION, INTERLOCK AND CONTROL DIAGRAMS, AND CONTROL PANELS.

AIR AND WATER SYSTEM BALANCING REPORTS

EQUIPMENT WARRANTIES AND TRAINING CERTIFICATES

SYSTEM COMMISSIONING REPORTS

EQUIPMENT START–UP CERTIFICATES

END OF SECTION 230550
SECTION 230553
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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Danger, Warning and Caution signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Danger tags.
8. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. 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. Metal Labels for Equipment:

1. Material and Minimum Thickness, predrilled or stamped holes for attachment hardware:
   a. Brass, 0.032–inch.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2–1/2 by 3/4 inch.
3. 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.
4. Fasteners: Stainless-steel;
   a. Rivets or self-tapping screws
5. Adhesive: Contact–type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled holes for attachment hardware, 1/16 inch thick.
2. Letter Color:
   a. Black.
3. Background Color:
   a. White.
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;
   a. Rivets or self–tapping screws
8. Adhesive: Contact–type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment’s Drawing designation 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.

D. 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 DANGER, WARNING AND CAUTION SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; 1/16 inch thick.

B. Danger signs, colors:

1. Letter Color:
a. White.

2. Background Color:
   a. Red.

C. Warning signs, colors:
   1. Letter Color:
      a. Black.
   2. Background Color:
      a. Orange.

D. Caution signs, colors:
   1. Letter Color:
      a. Black.
   2. Background Color:
      a. Yellow.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2–1/2 by 3/4 inch.

G. 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. Fasteners: Stainless—steel;
   1. Rivets or self—tapping screws
   2. Rivets.

I. Adhesive: Contact—type permanent adhesive, compatible with label and with substrate.

J. 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.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; 1/16 inch thick.
B. Letter Color:
   1. White.

C. Background Color:
   1. Black.

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 names 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;
   1. 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 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of \(1-1/4\) inches for ducts; and minimum letter height of \(3/4\) inch for access panel and door labels, equipment labels, and similar operational instructions.

   1. Stencil Material:
      a. Aluminum.
   2. Stencil Paint:
      a. Exterior, gloss, alkyd enamel black unless otherwise indicated.
      b. Paint may be in pressurized spray--can form.
   3. Identification Paint:
      a. Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 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, predrilled or stamped holes for attachment hardware, minimum thickness:
      a. Brass, 0.032--inch
   2. Fasteners: Brass;
      a. Wire--link or beaded chain; or S--hook

B. Valve Schedules:
1. For each piping system, on 8–1/2–by–11–inch bond paper, tabulate:
   a. Valve number.
   b. Piping system.
   c. System abbreviation (as shown on valve tag).
   d. Location of valve (room or space).
   e. Normal–operating position (open, closed, or modulating).
   f. Variations for identification.
   g. Mark valves for emergency shutoff and similar special uses.

2. Valve–tag schedule:
   a. Shall be included in operation and maintenance data.

2.7 DANGER TAGS

A. Danger Tags: Preprinted or partially preprinted, accident–prevention tags, of plasticized card stock with matte finish suitable for writing.

   1. Size:
      a. 3 by 5–1/4 inches minimum

   2. Fasteners:
      a. Brass grommet and wire.

   3. Nomenclature: Large–size primary caption such as "DANGER," and "DO NOT OPERATE."


2.8 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident–prevention tags, of plasticized card stock with matte finish suitable for writing.

   1. Size:
      a. 3 by 5–1/4 inches minimum

   2. Fasteners:
      a. Brass grommet and wire.

   3. Nomenclature: Large–size primary caption such as "WARNING" and "DO NOT OPERATE."


2.9 CAUTION TAGS

A. Caution Tags: Preprinted or partially preprinted, accident–prevention tags, of plasticized card stock with matte finish suitable for writing.

   1. Size:
      a. 3 by 5–1/4 inches minimum

   2. Fasteners:
      a. Brass grommet and wire.

   3. Nomenclature: Large–size primary caption such as "CAUTION," and "DO NOT OPERATE."

2.10 CEILING GRID

A. Provide red lettering on the ceiling tile grid of the locations of all fire dampers, smoke dampers and fire/smoke dampers. Size of lettering and verbiage is to conform to IBC and NFPA standards.

B. Provide valve identification for all HVAC valves located above the ceiling on the ceiling grid below the valve.

C. Provide equipment identification for all fan coil units located above the ceiling on the ceiling grid below the unit.

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. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Stenciled Pipe Label Option:
   1. Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option.
   2. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.

C. 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 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

D. Pipe Label Color Schedule: (Coordinate with Owners Standards)
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. **Yellow**: For hot-air supply ducts.
3. **Green**: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. **ASME A13.1 Colors and Designs**: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of **50 feet** in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION (See Drawing Schedules.)

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 hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553
SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
   a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:
   a. Variable-flow hydronic systems.

3. Various HVAC Equipment.
   a. Air Handlers.
   b. Fan Coil Units.
   c. Radiant Ceiling heating panels.
   d. Motors.
   e. Heat Transfer Coils.

1.3 DEFINITIONS


C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within the following number of days of the Contractor’s Notice to Proceed, submit documentation that the TAB contractor and this Project’s TAB team members meet the qualifications specified in "Quality Assurance" Article;
   1. 30 days.
B. Certified TAB reports.

C. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB and shall be the same as the TAB Contractor.
   2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician and shall be the same as the TAB Contractor.

B. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by:
   1. Architect.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on the following distribution systems have been satisfactorily completed:
   1. Air.
   2. Water.
   3. Air and water.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:
1. Owner approved T & B Contractor.

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.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow—control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

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:
   1. Ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in:
      a. Section 233113 "Metal Ducts"
   2. Verify ceiling plenums and underfloor air plenums used for supply, return or relief air are properly separated from adjacent areas.
   3. Verify that penetrations in plenum walls are sealed and fire—stopped if required.

F. Examine equipment performance data including fan and pump curves.
   1. 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.
   2. Calculate system—effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems – Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality—control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable—air—volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three—way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat—transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.
O. Examine operating safety interlocks and controls on HVAC equipment.

P. 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 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 this section and:
   1. AABC's "National Standards for Total System Balance"

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper–control positions, valve position indicators, fan–speed–control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch–pound (IP).

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. Determine the best locations in main and branch ducts for accurate duct–airflow measurements.
D. Check airflow patterns from the outdoor–air louvers and dampers and the return– and exhaust–air dampers through the supply–fan discharge and mixing dampers.

E. Locate start–stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air–handling–unit components.

K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT–VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Where sufficient space in ducts is unavailable for Pitot–tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single–inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double–inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air–handling unit, rooftop unit, and other air–handling and –treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat–recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system–effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from one of the following entities for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for adjustment of fans, belts, and pulley sizes to achieve indicated air–handling–unit performance:
   a. Architect.

7. Do not make fan–speed adjustments that result in motor overload. Consult equipment manufacturers about fan–speed safety factors. Modulate dampers and measure fan–motor amperage to ensure that
no overload will occur. Measure amperage in full–cooling, full–heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot–tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct–reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch–circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems’ “as–built” piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water–station pressure gage for adequate pressure for highest vent.
4. Check flow–control valves for specified sequence of operation, and set at indicated flow.
5. Set differential–pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive–displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump–motor load. If motor is overloaded, throttle main flow–balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.
3.8 PROCEDURES FOR CONSTANT–FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive–displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer’s pump curve at zero flow and verify that the pump has the intended impeller size.

   a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from the following entity and comply with requirements in Section 232123 "Hydronic Pumps."

      1) Architect.

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer’s head–capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

   a. Monitor motor performance during procedures and do not operate motors in overload conditions.


4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure–independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

   1. System components that have Cv rating or an accurately cataloged flow–pressure–drop relationship may be used as a flow–indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems’ pressures and temperatures including outdoor–air temperature.

I. Measure the differential–pressure–control–valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.
3.9 PROCEDURES FOR VARIABLE–FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two– and three–way control valves by setting systems at maximum flow through heat–exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer’s name, model number, and serial number.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.

B. Motors Driven by Variable–Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.11 PROCEDURES FOR HEAT–TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry–bulb temperature of entering and leaving air.
   5. Wet–bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:
   1. Nameplate data.
   2. Airflow.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit–breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:
   1. Dry–bulb temperature of entering and leaving air.
   2. Airflow.
   3. Air pressure drop.
   4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:
   1. Dry–bulb temperature of entering and leaving air.
2. Wet–bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.12 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: **Plus or minus 10 percent**.
2. Air Outlets and Inlets: **Plus or minus 10 percent**.
3. Heating–Water Flow Rate: **Plus or minus 10 percent**.
4. Cooling–Water Flow Rate: **Plus or minus 10 percent**.

3.13 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: Prepare progress reports on the following interval 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;

1. Weekly.

3.14 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field–report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect’s name and address.
6. Engineer’s name and address.
7. Contractor’s name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer’s name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor—, return—, and exhaust—air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet— and dry—bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable—air—volume systems.
   g. Settings for supply—air, static—pressure controller.
   h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single—line diagram and include the following:

   1. Quantities of outdoor, supply, return, and exhaust airflows.
   2. Water and steam flow rates.
   3. Duct, outlet, and inlet sizes.
   4. Pipe and valve sizes and locations.
   5. Terminal units.

E. Air—Handling—Unit Test Reports: For air—handling units with coils, include the following:

   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer’s serial number.
      f. Unit arrangement and class.
      g. Discharge arrangement.
      h. Sheave make, size in inches, and bore.
      i. Center—to—center dimensions of sheave, and amount of adjustments in inches.
      j. Number, make, and size of belts.
      k. Number, type, and size of filters.
2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static—pressure differential in inches wg.
   f. Preheat—coil static—pressure differential in inches wg.
   g. Cooling—coil static—pressure differential in inches wg.
   h. Heating—coil static—pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Outdoor—air damper position.
   l. Return—air damper position.
   m. Vortex damper position.

F. Apparatus—Coil Test Reports:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft.
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor—air, wet— and dry—bulb temperatures in deg F.
   e. Return—air, wet— and dry—bulb temperatures in deg F.
   f. Entering—air, wet— and dry—bulb temperatures in deg F.
   g. Leaving—air, wet— and dry—bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering—water temperature in deg F.
   k. Leaving—water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.

n. Refrigerant suction temperature in deg F.

o. Inlet steam pressure in psig.

G. Electric–Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:
   a. System identification.
   b. Location.
   c. Coil identification.
   d. Capacity in Btu/h.
   e. Number of stages.
   f. Connected volts, phase, and hertz.
   g. Rated amperage.
   h. Air flow rate in cfm.
   i. Face area in sq. ft.
   j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):
   a. Heat output in Btu/h.
   b. Air flow rate in cfm.
   c. Air velocity in fpm.
   d. Entering–air temperature in deg F.
   e. Leaving–air temperature in deg F.
   f. Voltage at each connection.
   g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat–Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross–section and record the following:

1. Report Data:
   a. System and air–handling–unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg.
   e. Duct size in inches.
   f. Duct area in sq. ft..
   g. Indicated air flow rate in cfm.
   h. Indicated velocity in fpm.
   i. Actual air flow rate in cfm.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.

J. Air–Terminal–Device Reports:

1. Unit Data:
   a. System and air–handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
   g. Type and model number.
   h. Size.
   i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary air flow rate as needed in cfm.
   d. Preliminary velocity as needed in fpm.
   e. Final air flow rate in cfm.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

K. System–Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
   b. Location and zone.
   c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm.
   b. Entering—water temperature in deg F.
   c. Leaving—water temperature in deg F.
   d. Water pressure drop in feet of head or psig.
   e. Entering—air temperature in deg F.
   f. Leaving—air temperature in deg F.

L. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.15 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
   2. Check the following for each system:
      a. Measure airflow of at least 10% of air outlets.
      b. Measure water flow of at least 5% of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      d. Verify that balancing devices are marked with final balance position.
      e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
   1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by:
      a. Architect.
   2. The TAB contractor’s test and balance engineer shall conduct the inspection in the presence of:
      a. Architect.
   3. The following entity shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day:
      a. Architect.
   4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of “FAILED” measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor’s final payment.

D. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB 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 TAB during near-peak summer and winter conditions.

END OF SECTION 230593
SECTION 230713

DUCT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Outdoor, concealed supply and return.
6. Outdoor, exposed supply and return.

B. Related Sections:
1. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water–vapor permeance thickness, and jackets (both factory– and field–applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field–applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality–control reports.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. 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.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; SOFTR All-Service Duct Wrap.

G. Mineral–Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory–Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   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.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral–Fiber Adhesive: Comply with MIL–A–3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges – Marathon Industries; 225.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. FSK Jacket Adhesive, and ASJ Adhesive: Comply with MIL–A–3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
b. Eagle Bridges – Marathon Industries; 225.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small–Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL–PRF–19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor–Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Vimasco Corporation; 749.


3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.


C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   e. Vimasco Corporation; WC–1/WC–5.
2. Water–Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625–inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL–A–3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Products: Subject to compliance with requirements, provide one of the following:
      c. Vimasco Corporation; 713 and 714.
   3. Fire–resistant, water–based lagging adhesive and coating for use indoors to adhere fire–resistant lagging cloths over duct insulation.
   4. Service Temperature Range: 0 to plus 180 deg F.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges – Marathon Industries; 405.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95–44.
      d. Mon–Eco Industries, Inc.; 44–05.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire– and water–resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: Aluminum.
   6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 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. FSK Jacket: Aluminum–foil, fiberglass–reinforced scrim with kraft–paper backing; complying with ASTM C 1136, Type II.
2.7 FIELD–APPLIED JACKETS

A. Field–applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.


C. Metal Jacket:
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
      c. RPR Products, Inc.; Insul–Mate.

      a. Sheet and roll stock ready for shop or field sizing
      b. Finish and thickness are indicated in field–applied jacket schedules.

D. 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. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.

   2. Adhesive: As recommended by jacket material manufacturer.

2.8 TAPES

A. FSK Tape: Foil–face, vapor–retarder tape matching factory–applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABL, Ideal Tape Division; 491 AWF FSK.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      c. Compac Corporation; 110 and 111.
      d. Venture Tape: 1525 CW NT, 1528 CW, and 1528 CW/SQ.

   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
5. Elongation: **2 percent**.
6. Tensile Strength: **40 lbf/inch** in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

**B. Aluminum–Foil Tape:** Vapor–retarder tape with acrylic adhesive.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   
   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. **Width:** **2 inches**.
3. **Thickness:** **3.7 mils**.
4. **Adhesion:** **100 ounces force/inch** in width.
5. **Elongation:** **5 percent**.
6. **Tensile Strength:** **34 lbf/inch** in width.

### 2.9 SECUREMENTS

**A. Bands:**

1. **Products:** Subject to compliance with requirements, provide one of the following:
   
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. **Aluminum:** **ASTM B 209**, Alloy 3003, 3005, 3105, or 5005; Temper H–14, **0.020 inch** thick, **3/4 inch** wide with **wing seal**.

3. **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– or zinc–coated steel pin, fully annealed for capacitor–discharge welding, **0.135–inch**–diameter shank, length to suit depth of insulation indicated.
   
   a. **Products:** Subject to compliance with requirements, provide one of the following:
      
      1) AGM Industries, Inc.; CWP–1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.

2. **Cupped–Head, Capacitor–Discharge–Weld Pins:** Copper– or zinc–coated steel pin, fully annealed for capacitor–discharge welding, **0.135–inch**–diameter shank, length to suit depth of insulation indicated with integral **1–1/2–inch** galvanized carbon–steel washer.
   
   a. **Products:** Subject to compliance with requirements, provide one of the following:
      
      1) AGM Industries, Inc.; CHP–1.
      2) GEMCO; Cupped Head Weld Pin.
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. **Products**: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon–steel sheet, **0.030 inch** thick by **2 inches** square.
   c. Spindle: **Copper– or zinc–coated, low–carbon steel** fully annealed, **0.106–inch** diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated–Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. **Products**: Subject to compliance with requirements, provide one of the following:
      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
   b. Baseplate: Perforated, nylon sheet, **0.030 inch** thick by **1–1/2 inches** in diameter.
   c. Spindle: Nylon, **0.106–inch** diameter shank, length to suit depth of insulation indicated, up to **2–1/2 inches**.
   d. 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. **Products**: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul–Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.
   b. Baseplate: Galvanized carbon–steel sheet, **0.030 inch** thick by **2 inches** square.
   c. Spindle: **Copper– or zinc–coated, low–carbon steel**, fully annealed, **0.106–inch** diameter shank, length to suit depth of insulation indicated.
   d. Adhesive–backed base with a peel–off protective cover.
PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.
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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at:
   a. 2 inch o.c.
   b. For below ambient services, apply vapor–barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor–barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

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.

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: 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 Section 078413 "Penetration Firestopping" firestopping and fire–resistive joint sealers.

INSTALLATION OF MINERAL–FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area, for:
      a. 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 one edge and one 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 two 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.
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.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area, for:
   a. 50 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.
   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 one edge and one 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.

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.

3.6 FIELD–APPLIED JACKET INSTALLATION

A. Where glass–cloth jackets are indicated, install directly over bare insulation or insulation with factory–applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer’s recommended adhesive.
4. Install jacket with 1–1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor–retarder jackets and exposed insulation with vapor–barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch 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.

3.7 FINISHES

A. Insulation with ASJ, Glass–Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 “Exterior Painting” and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two 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.

C. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Testing Agency:
   a. Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the “Duct Insulation Schedule, General” Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Outdoor, concealed supply and return.
   6. Outdoor, exposed supply and return.

B. Items Not Insulated:
   1. Fibrous–glass ducts.
   2. Factory–insulated flexible ducts.
   4. Flexible connectors.
   6. Factory–insulated access panels and doors.

3.10 Insulation shall have an R value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat–oval, supply–air duct insulation shall be one of the following:
   1. Mineral–Fiber Blanket: 2 inches thick and 0.75–lb/cu. ft. nominal density.

B. Concealed, round and flat–oval, return–air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

C. Concealed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

E. Concealed, rectangular, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

F. Concealed, rectangular, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

G. Concealed, rectangular, outdoor-air and combustion-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

H. Concealed, outdoor-air plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

I. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

J. Exposed, round and flat-oval, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

K. Exposed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

L. Exposed, rectangular, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

M. Exposed, rectangular, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

N. Exposed, rectangular, outdoor-air and combustion-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

END OF SECTION 230713
SECTION 230719
HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Condensate drain piping.
   2. Chilled-water piping.
   3. Heating hot-water piping.

B. Related Sections:
   1. Section 230713 "Duct Insulation."

1.3 DEFINITIONS:

A. Refer to Section 230500 “Common Work Results for HVAC”.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail 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.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.
B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface–Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 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.

1.7 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.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field–applied jackets and finishes and for space required for maintenance.

1.9 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS


B. Insulation for below–ambient service requires a vapor–barrier.
C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. 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.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Calcium Silicate:
   1. Products: Subject to compliance with requirements, provide the following:
      a. Industrial Insulation Group (IIG); Thermo-12 Gold.
   2. Preformed Pipe Sections: Flat-, curved-, and grooved–block sections of noncombustible, inorganic, hydrous calcium silicate with a non–asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
   3. Flat-, curved-, and grooved–block sections of noncombustible, inorganic, hydrous calcium silicate with a non–asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
   4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553,
   1. Type II and ASTM C 1290, Factory–applied jacket requirements are specified in "Factory–Applied Jackets" Article.
   2. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 "Product Requirements."
   3. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; SOFTR All–Service Duct Wrap.

I. Mineral–Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Micro–Lok.
      b. Knauf Insulation; 1000–Degree Pipe Insulation.
      c. Manson Insulation Inc.; Alley–K.
      d. Owens Corning; Fiberglas Pipe Insulation.
      e. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A:
         1) with factory–applied ASJ–SSL. Factory–applied jacket requirements are specified in "Factory–Applied Jackets" Article.

J. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
2.2 INSULATING CEMENTS

   
   1. Products: Subject to compliance with requirements, provide the following:
      

   
   1. Products: Subject to compliance with requirements, provide the following:
      
      a. Ramco Insulation, Inc.; Ramcote 1200 and Quik–Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium–silicate–based adhesive with a service temperature range of **50 to 800 deg F**.
   
   1. Products: Subject to compliance with requirements, provide one of the following:
      
      b. Eagle Bridges – Marathon Industries; 290.
      e. Vimasco Corporation; 760.

   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral–Fiber Adhesive: Comply with MIL–A–3316C, Class 2, Grade A.
   
   1. Products: Subject to compliance with requirements, provide one of the following:
      
      b. Eagle Bridges – Marathon Industries; 225.

   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL–A–3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   
   1. Products: Subject to compliance with requirements, provide one of the following:
      
      b. Eagle Bridges – Marathon Industries; 225.


2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL–PRF–19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor–Barrier Mastic: Water based; suitable for indoor use on below–ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Vimasco Corporation; 749.

3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Vapor–Barrier Mastic: Solvent based; suitable for outdoor use on below–ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges – Marathon Industries; 570.

2. Water–Vapor Permeance: ASTM F 1249, 0.05 perm at 30–mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
D. Breather Mastic: Water based; suitable for indoor and outdoor use on above–ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   e. Vimasco Corporation; WC–1/WC–5.

2. Water–Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625–inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.

2.5 SEALANTS

A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire– and water–resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 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–SSL: ASJ with self–sealing, pressure–sensitive, acrylic–based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 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. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system:
   a. White
4. 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.

C. Metal Jacket:
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
      c. RPR Products, Inc.; Insul-Mate.
      a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications:
         1) 1-mil–thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications:
         1) 3-mil–thick, heat-bonded polyethylene and kraft paper.
      e. 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.

2.8 TAPES

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. Compac Corporation; 104 and 105.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   5. Elongation: 2 percent.
6. Tensile Strength: **40 lbf/inch** in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor–retarder tape matching field–applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: **2 inches**.
3. Thickness: **6 mils**.
4. Adhesion: **64 ounces force/inch** in width.
5. Elongation: 500 percent.
6. Tensile Strength: **18 lbf/inch** in width.

2.9 SECUREMENTS

A. Staples: Outward–clinching insulation staples, nominal **3/4–inch**– wide, stainless steel or Monel.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
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. Coordinate insulation installation with the trade installing heat tracing. 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. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarding materials, and thicknesses required for each item of 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. 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
      a. 2 inches o.c.
      b. For below–ambient services, apply vapor–barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer’s written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor–barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
O. 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.

P. For above—ambient services, do not install insulation to the following:

2. Testing agency labels and stamps.
3. Nameplates and data plates.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire—Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire—rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire—resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire—rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

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 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.

6. 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.

7. 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.

8. For services not specified to receive a field—applied jacket except for flexible elastomeric, 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.

9. 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. 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. 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 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
   2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
   3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

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 cut sections of block insulation of same material and thickness as pipe insulation.
   4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
   3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   2. Install insulation to flanges as specified for flange insulation application.
   3. Finish valve and specialty insulation same as pipe insulation.

3.7 INSTALLATION OF MINERAL–FIBER INSULATION

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. Instead, 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 PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. 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 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 FINISHES

A. Pipe Insulation with ASJ, Glass–Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 “Exterior Painting” and Section 099123 “Interior Painting.”

1. Flat Acrylic Finish: Two 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.

C. Do not field paint aluminum or stainless–steel jackets.
3.10 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.

3.11 Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
      1) 1/2 inch thick

B. Chilled Water, above 40 Deg F:

1. NPS 1-1/2 inch and Smaller: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe, Type I:
      1) 1-1/2 inches thick.

2. NPS 2 inch and Larger: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe, Type I:
      1) 1-1/2 inches thick.

3. Insulation runouts not exceeding 48 inches in length for connection to equipment shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick

C. Heating—Hot—Water Supply and Return, 200 Deg F and Below:

1. NPS 1 1/2 and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I:
      1) 1-1/2 inch thick

2. Greater than NPS 1-1/2 inch: Insulation shall be the following:
   a. Mineral—Fiber, Preformed Pipe, Type I or Pipe and Tank Insulation:
      1) 2 inches thick

3. Insulation for runouts not exceeding 48 inches in length for connection to equipment shall be the following:
   a. Mineral—Fiber, Preformed Pipe, Type I: 1 inch thick.
D. Steam and Steam Condensate, 0 to 15 PSI, 200 Deg F to 250 Deg F:
   1. NPS 1 and Smaller: Insulation shall be one of the following:
      a. Calcium Silicate: 
         1) 2 inches thick
      b. Mineral–Fiber, Preformed Pipe, Type I or II: 
         1) 1–1/2 inches thick
   2. NPS 1–1/4 and Larger: Insulation shall be one of the following:
      a. Calcium Silicate: 
         1) 3 inches
      b. Mineral–Fiber, Preformed Pipe, Type I or II or Pipe and Tank Insulation: 
         1) 2 inches thick
   3. Insulation for runouts not exceeding 48" in length for connection to equipment shall be the following:
      a. Mineral–Fiber, Preformed Pipe, Type I: 1–1/2 inch thick.

E. Steam and Steam Condensate, 16 to 60 PSI, 251 Deg F to 305 Deg F:
   1. NPS 1 and Smaller: Insulation shall be one of the following:
      a. Calcium Silicate: 3 inches thick.
      b. Mineral–Fiber, Preformed Pipe, Type I or II: 2 inches thick.
   2. NPS 1–1/4 and Larger: Insulation shall be one of the following:
      a. Calcium Silicate: 3 inches thick.
      b. Mineral–Fiber, Preformed Pipe, Type I or II or Pipe and Tank Insulation: 2 inches thick.
   3. Insulation for runouts not exceeding 48" in length for connection to equipment shall be the following:
      a. Mineral–Fiber, Preformed Pipe, Type I: 1–1/2 inch thick.

3.13 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, Concealed:
   1. None.

D. Piping, Exposed:
   1. PVC:
a. White: 30 mils thick.

END OF SECTION 230719
SECTION 232113

HYDRONIC PIPING

PART 1 – GENERAL

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

1.2 SUMMARY
A. Section includes pipe and fitting materials and joining methods for the following:
   1. Hot-water heating piping.
   2. Chilled-water piping.
   5. Dielectric fittings.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of the following:
   1. Steel pipe and fittings.
   2. Copper pipe, tubing and fittings.
   3. Dielectric fittings.
B. Delegated–Design Submittal:
   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.
   3. Locations and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

1.4 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Other building services.
   3. Structural members.
B. Qualification Data: For Installer.
C. Welding certificates.

D. Field quality-control reports: Written reports as specified in Part 3 of this section including:
   1. Test procedures used.
   2. Test results showing compliance with specified requirements.
   3. Failed test results with corrective action taken to achieve compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. All grooved joint couplings, fittings, valves and specialties shall be the products of a single manufacturer.
   1. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

1.6 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related sections.

E. Coordinate size and location of concrete bases. Cast anchor–bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section “Through–Penetration Firestop Systems” for fire and smoke wall and floor assemblies.

PART 2 – PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn–Temper Copper Tubing: ASTM B 88, Type L.
2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.


D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought–Steel Fittings: ASTM A 234, wall thickness to match adjoining pipe.

G. Wrought Cast– and Forged–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 and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Victaulic Company.
   b. Anvil International, Inc.
   c. Tyco–Grinnel

2. Joint Fittings: ASTM A 536, Grade 65–45–12 ductile iron; ASTM A 53, Type F, E, or S, Grade B factory–fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders designed and constructed to accept grooved–end couplings.

   a. Rigid Type: Coupling housings shall be cast with offsetting, angle–pattern bolt pads to provide joint rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.
   b. Gasket: High temperature EPDM gasket, suitable for water service to +250 deg F, without use of special lubricants.
   c. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for the elimination of flexible connectors.
   d. 14” and Larger: Two–segment coupling, with lead–in chamfer on housing key and a wide–width gasket having a center–leg.

4. Combinations of grooved mechanical–joint couplings and short nipples may also be used.
2.3 JOINING MATERIALS

A. Pipe–Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8–inch (3.2–mm) maximum thickness unless otherwise indicated.
      a. Full–Face Type: For flat–face, Class 125, cast–iron and cast–bronze flanges.
      b. Narrow–Face Type: For raised–face, Class 250, cast–iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.


D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper–phosphorus alloys for joining copper with copper; or BAg–1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      c. Capitol Manufacturing Company.
      d. Central Plastics Company.
      e. Elster Perfection.
      f. Grinnell Mechanical Products.
      g. Matco–Norca.
      h. Pipeline Seal and Insulator, Inc.
      i. Precision Plumbing Products, Inc.
      j. Victaulic Company.
      k. Watts Regulator Co.
      l. Zurn Industries, LLC.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld–neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. End Connections: Threaded, or flanged.

E. End Connections: Grooved.

F. Dielectric Couplings: Galvanized–steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300–psig minimum working pressure at 225 deg F.
G. Dielectric Nipples or Waterways: Electroplated steel with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

PART 3 – EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be any of the following:
   1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2–1/2 and larger, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Chilled-water piping, aboveground, NPS 2–1/2 and larger, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

E. Condensate–drain piping shall be the following:
   1. Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

F. Air–Vent Piping:
   1. Inlet: Same as service where installed with metal–to–plastic transition fittings for plastic piping systems according to piping manufacturer’s written instructions.
   2. Outlet: Type K, annealed–temper copper tubing with soldered or flared joints.

G. Safety–Valve–Inlet and –Outlet Piping for Hot–Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal–to–plastic transition fittings for plastic piping systems according to piping manufacturer’s written instructions.
3.2 PIPING INSTALLATIONS

A. PRE–WORK / PRE–REQUISITES

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

2. The Contractor shall study the architectural, structural, mechanical, electrical and other drawings to eliminate conflict of piping with other structure lighting or other services.

B. CONDITION

1. All installed pipe lines shall be free from dents, scars, and burrs, with ends reamed smooth.

2. All piping shall be clean and free from acids and loose dirt when installed and shall be kept clean during the completion of the installation.

3. Install piping free of sags and bends.

4. All installed pipe lines shall remain straight against strains tending to cause distortion during system operation. The contractor shall make proper allowance for pipe line expansion and contraction so that no unsightly distortion, noise, damage or improper operation results therefrom.

C. SELECTION

1. Select system components with pressure rating equal to or greater than system operating pressure.

2. No street type fittings shall be used.

3. No short nipples shall be used except at drain valves.

4. Plugs of rags, wools, cottons, waste, or similar materials may not be used for plugging.

D. ROUTING/ARRANGEMENT

1. Piping installations shall be neatly organized.

2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

3. Install groups of pipes parallel to each other.

4. Install piping spaced to permit application of insulation.

5. Install piping parallel and spaced to permit the servicing of valves.

6. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls or axis of the building.

7. Diagonal runs are prohibited unless specifically indicated otherwise.

8. Install fittings for all changes in direction.
9. No piping shall be run above any electrical panels, electrical equipment or access clearances for electrical for electrical panels or equipment. No piping shall be allowed to run through any electrical rooms.

10. Piping shall be arranged, placed and installed to facilitate equipment maintenance and shall be so arranged to not interfere with the installation of the air-conditioning equipment, ducts, or the removal of other equipment or devices. All specialties shall be so placed to permit easy operation and access.

11. All piping shall be so installed to insure noiseless circulation.

12. Install fittings for all branch connections.

13. Unless otherwise indicated, install branch connections to mains using tee fittings or forged steel branch fittings in main pipe, with the branch connected to the bottom of the main pipe.

14. For up-feed risers, connect the branch to the top of the main pipe.

15. Forged branch fittings shall be installed per the manufacturer’s recommendations.

E. ACCESS / ARRANGEMENT

1. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal. All piping shall be so arranged to not block access to manholes, access openings, etc.

2. Install piping at indicated slopes. If not indicated, install piping at a uniform grade of 0.2 percent where possible, upward in direction of flow. Traps are to be avoided where–ever possible.

3. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

4. When insulated pipes are supported by a roller hanger they shall be protected from damage by suitable pipe covering protection saddles. Saddles shall support pipe on roller and shall be packed with insulation.

5. Install valves according to Section 230523 “General–Duty Valves for HVAC Piping.”

6. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, at each coil on all sides of automatic valves where valves do not have union connections, elsewhere as indicated, and wherever necessary to prevent undue difficulty in making repairs or replacement. Unions are not required at flanged connections.

7. Install flanges in piping, NPS 2–1/2 and larger, at final connections of equipment and elsewhere as indicated. Install flanges on valves, apparatus, and equipment having 2 ½ inch NPS and larger connections. Flanges or unions as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment.

8. Install shutoff valve immediately upstream of each dielectric fitting. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

9. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 “Sleeves and Sleeve Seals for HVAC Piping.”

10. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 “Sleeves and Sleeve Seals for HVAC Piping.”

11. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 “Escutcheons for HVAC Piping.”
12. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS ¾” nipple and ball valve in blow-down connection of strainers NPS 2” and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2”.

13. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration-producing equipment.

F. DRAINAGE

1. Drain valves shall be installed at all low points in all piping systems to allow for complete drainage of piping systems.

2. Install drains, consisting of a tee fitting, NPS ¾” ball valve, and short NPS ¾” threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

3. All piping systems shall be installed so that they can be easily drained by means of drainage of low points of all piping without disconnecting pipe.

4. If not specifically indicated on the drawings, the frequency of draining shall determine whether drain caps, plugs, cocks, or valves are to be used.

G. IDENTIFICATION

1. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.3 DIELECTRIC FITTING INSTALLATION

A. Make connections according to the following, unless otherwise indicated:

1. Install dielectric nipples or waterways in piping NPS 2” and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install waterways, in piping NPS 2½” and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Install Dielectric Fittings into Hydronic Piping Systems: Install dielectric nipples, waterways or couplings to connect piping materials of dissimilar metals.

4. End Connections: Threaded, or flanged.

5. End Connections: Grooved.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Steel roof deck shall not be used to support loads from piping, ductwork or equipment, unless noted otherwise. Hanger loads less than 50 lbs. may be hung from the steel roof deck in cases when hanging from the steel roof deck cannot be avoided; the attachment method must distribute the load across the deck as approved by the Structural Engineer.
C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Adjustable roller hangers and spring hangers for individual horizontal piping 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. Provide copper–clad hangers and supports for hangers and supports in direct contact with copper pipe.
   6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. 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, 3/8 inch.
   2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 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, 1/2 inch.
   6. NPS 3 and Larger: Maximum span, 12 feet; minimum rod size, 1/2 inch.

E. 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 1–1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   4. NPS 1–1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   6. NPS 2–1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. PVC and CPVC Piping Hanger Spacing: Space hangers according to pipe manufacturer’s written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. PP Piping Hanger Spacing: Install vinyl–coated hangers with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1 and Smaller: 36 inches with 3/8–inch rod.
   2. NPS 1–1/4 to NPS 2: 48 inches with 3/8–inch rod.
   3. NPS 2–1/2 to NPS 3–1/2: 48 inches with 1/2–inch rod.
   4. NPS 4 and NPS 5: 48 inches with 5/8–inch rod.
   6. Space all sizes of fiberglass composite reinforced PP pipe according to the manufacturer’s written instructions.

H. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1–1/4 and larger.

I. Support piping and tubing not listed in this article according to MSS SP–69 and manufacturer’s written instructions.

3.5 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.


E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. 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.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to “Quality Assurance” Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts.
   1. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer’s written instructions for pipe wall thickness. Use grooved–end fittings and rigid, grooved–end–pipe couplings.
   2. Installed in accordance with the manufacturer’s written recommendations.
   3. Ends shall be clean and free from indentations, projections or roll marks.
   4. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service.
   5. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings.
   6. Training: The coupling manufacturer’s factory–direct trained representative shall provide on–site training for the contractor’s field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. The distributor’s representative will not be acceptable.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

3.7 FIELD QUALITY CONTROL

A. 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 hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety 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. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system’s working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the “SE” value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure—reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113
SECTION 232116

HYDRONIC PIPING SPECIALTIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:
   1. Hot-water heating piping.
   2. Makeup-water piping.
   3. Condensate-drain piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Valves: Include flow and pressure drop curves based on manufacturer’s testing for calibrated-orifice balancing valves and automatic flow-control valves.
   2. Air-control devices.
   3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
PART 2 – PRODUCTS

2.1 VALVES

A. **Globe, Check, Ball, and Butterfly Valves**: Comply with requirements specified in Section 230523 “General–Duty Valves for HVAC Piping. Gate valves are not allowed on this project.

B. Refer to Part 3 “Valve Applications” Article for applications of each valve.

C. Bronze, Calibrated–Orifice or Venturi, Balancing Valves, NPS 2 and smaller:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump.
      c. Flow Design Inc.
      d. Gerand Engineering Co.
      e. Griswold Controls.
      f. Taco.
      g. Tour & Andersson; available through Victaulic Company.
      h. Tyco–Grinnell
      i. Nexus Valve, Inc.
   2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
   4. Plug: Resin.
   5. Seat: PTFE.
   6. End Connections: Threaded or socket.
   8. Handle Style: Lever, with memory stop to retain set position.
   9. CWP Rating: Minimum **125 psig**.
   10. Maximum Operating Temperature: **250 deg F**.

D. Cast–Iron or Steel, Calibrated–Orifice or Venturi, Balancing Valves, NPS 2 ½ and larger:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amtrol, Inc.
      b. Armstrong Pumps, Inc.
      c. Bell & Gossett Domestic Pump.
      d. Flow Design Inc.
      e. Gerand Engineering Co.
      f. Grinnell.
      g. Griswold Controls.
      h. Taco.
      i. Tour & Andersson; available through Victaulic Company.
      j. Spence Engineering Company Inc.
      k. Watts Regulator Co.
      l. Nexus Valve, Inc.
   2. Body: Cast–iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
5. Disc: Glass and carbon–filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
9. Handle Style: Lever, with memory stop to retain set position.
11. Maximum Operating Temperature: 250 deg F.


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.

2. Body: Bronze or brass.
3. Disc: Glass and carbon–filled PTFE.
6. Diaphragm: EPT.
7. Low inlet–pressure check valve.
8. Inlet Strainer: Brass, removable without system shutdown.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Conbraco Industries, Inc.
   e. Kunkle.
   f. Spence Engineering Company, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon–filled PTFE.
6. Diaphragm: EPT.
8. Inlet Strainer: Brass, removable without system shutdown.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
G. Automatic Flow–Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump.
   c. Flow Design Inc.
   d. Griswold Controls.
   e. Taco
   f. Nexus Valve, Inc.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Tamper proof, self–cleaning, and removable, for inspections and replacement.
   a. Corrosion resistant.
4. Combination Assemblies: Include bronze or brass–alloy ball valve.
5. Identification Tag: Attached by chain and marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations:
8. Maximum Operating Temperature: 200 deg F.
9. Fitted with pressure and temperature test valves.
10. Equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case.

2.2 AIR–CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Taco, Inc.

2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Manually operated with ball valve in the down position.
8. CWP Rating: 150 psig.
9. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Bell & Gossett Domestic Pump.
   c. Hoffman Specialty ITT; Fluid Handling Div.
d. Spirax–Sarco.
e. Spirovent.
f. Taco, Inc.
g. Honeywell–Baukman.

2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
5. Inlet Connection: **NPS 1/2**.
6. Discharge Connection: **NPS 1/4**.
7. CWP Rating: **150 psig**.
8. Maximum Operating Temperature: **240 deg F**.

### 2.3 HYDRONIC PIPING SPECIALTIES

#### A. Y–Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. Hoffman Specialty ITT; Fluid Handling Div.
c. Metraflex Co.
d. Mueller
e. Spirax Sarco.
f. Trane Co.
g. Tyco–Grinnell.
h. Tour & Andersson; available through Victaulic Company.
i. Watts Regulator Co.
j. Nexus Valve

2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2–1/2** and larger.
4. Strainer Screen: Stainless–steel, or perforated stainless–steel basket:
   a. **20–**mesh strainer.
5. CWP Rating: **125 psig**.

#### B. Diverting Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump.
d. Taco, Inc.
2. Body: Cast Iron or Wrought Copper
3. Ends: Threaded or Soldered
5. CWP Rating: **125 psig**.
6. Maximum Operating Temperature: **250 deg F**.
PART 3 – EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff–duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated–orifice, balancing valves at each branch connection to return main.

C. Install calibrated–orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat–transfer coils, and elsewhere as required for system air venting.

B. Automatic air vents may cause damage to ceilings and other finished surfaces. Air vents aid in system filling. Air removal after initial startup is accomplished by air separator or boiler diptube. Manual air vents may be a better solution.

C. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat–transfer coils and elsewhere as required for air venting.

END OF SECTION 232116
SECTION 233001
COMMON DUCT REQUIREMENTS

PART 1 – PRODUCTS

1.1 SUMMARY

A. Includes But Not Limited To:

1. General procedures and requirements for ductwork.
2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
3. Soundproofing procedures for duct penetrations of walls, ceilings, and floors in mechanical equipment rooms.

B. Related Sections:
1. Section 23 0500: Common Work Results for HVAC
2. Section 23 0593: Testing Adjusting and Balancing for HVAC.

1.2 SUBMITTALS

A. Samples: Sealer and gauze proposed for sealing ductwork.

B. Quality Assurance / Control:

1. Manufacturer’s installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
2. Specification data on sealer and gauze proposed for sealing ductwork.

1.3 QUALITY ASSURANCE

A. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.

B. Pre–Installation Conference: Schedule conference immediately before installation of ductwork.

PART 2 – PRODUCTS

2.1 Finishes, Where Applicable: Colors as selected by Architect.

2.2 Duct Hangers:

A. One inch by 18 ga galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches apart. Do not use wire hangers.
1. Attaching screws at trusses shall be 2 inch No. 10 round head wood screws. Nails not allowed.
2. Attach threaded rod to steel joist with Grinnell Steel washer plate Fig. 60 – ph–1. Double nut connection.

PART 3 – EXECUTION

3.1 INSTALLATION

A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.

B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.

C. Hangers And Supports:
   1. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.
   2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
   3. Attach strap hangers to ducts with cadmium–plated screws. Use of pop rivets or other means will not be accepted.
   4. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.
   5. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

3.2 CLEANING

A. Clean interior of duct systems before final completion.

END OF SECTION 233001
SECTION 233113

METAL DUCTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall **round** ducts and fittings.
   4. Sealants and gaskets.
   5. Hangers and supports.

B. Related Sections:
   1. Section 230593 “Testing, Adjusting, and Balancing for HVAC” for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
   3. Section 230713 “Duct Insulation” for duct insulation.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible” and performance requirements and design criteria indicated in “Duct Schedule” Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Adhesives.
   2. Sealants and gaskets.

B. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static–pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire–rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
13. Duct fabrication shall not begin until shop drawings have been submitted and reviewed by the mechanical engineer.

C. Delegated–Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire–rated construction.
6. Items penetrating finished ceiling including, but not limited to the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

B. Field quality–control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:


B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 — "Systems and Equipment" and Section 7 — "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 — "HVAC System Construction and Insulation."

PART 2 – PRODUCTS

2.1 SINGLE–WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible" based on indicated static–pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Figure 2–1, "Rectangular Duct/Transverse Joints," for static–pressure class, applicable sealing requirements, materials involved, duct–support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Figure 2–2, "Rectangular Duct/Longitudinal Seams," for static–pressure class, applicable sealing requirements, materials involved, duct–support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible."

D. Duct dimensions shown on drawings are inside clear dimensions.

E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static–pressure class, applicable sealing requirements, materials involved, duct–support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible."

2.2 SINGLE–WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static–pressure class unless otherwise indicated.

B. Duct dimensions shown on drawings are inside clear dimensions.

C. Transverse Joints: Select joint types and fabricate according to SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Figure 3–1, "Round Duct Transverse Joints," for static–pressure class, applicable sealing requirements, materials involved, duct–support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Not allowed.

E. Tees and Laterals: Select types and fabricate according to SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Figure 3–5, "90 Degree Tees and Laterals," and Figure 3–6, "Conical Tees," for static–pressure
class, applicable sealing requirements, materials involved, duct–support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
   1. Where black– and galvanized–steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. 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.

2.4 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: 4 inches.
   5. Mold and mildew resistant.
   6. Maximum Static–Pressure Class: 10–inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
   10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water–Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static–Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.

D. Solvent–Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Base: Synthetic rubber resin.
   4. Solids Content: Minimum 60 percent.
   5. Shore A Hardness: Minimum 60.
   7. Mold and mildew resistant.
   8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   9. VOC: Maximum 395 g/L.
   10. Maximum Static–Pressure Class: 10-inch wg, positive or negative.
   11. Service: Indoor or outdoor.
   12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.
   6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint 0–Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static–pressure class, positive or negative.
   2. EPDM O–ring to seal in concave bead in coupling or fitting spigot.
   3. Double–lipped, EPDM O–ring seal, mechanically fastened to factory–fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS


B. Hanger Rods for Corrosive Environments: Electrogalvanized, all–thread rods or galvanized rods with threads painted with zinc–chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Table 5–1, "Rectangular Duct Hangers Minimum Size," and Table 5–2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized–Steel Ducts: Galvanized steel complying with ASTM A 603.
E. Steel Cables for Stainless–Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium–plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic–locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self–tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 – EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air–handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory– or shop–fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of \( 2 \text{ inch} \), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non–fire–rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least \( 1–1/2 \text{ inches} \).

K. Where ducts pass through fire–rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 “Air Duct Accessories” for fire and smoke dampers.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."

2. Unconditioned Space, Supply–Air Ducts in Pressure Classes 2–Inch wg and Lower: Seal Class A.

3. Unconditioned Space, Supply–Air Ducts in Pressure Classes Higher Than 2–Inch wg: Seal Class A.

4. Unconditioned Space, Exhaust Ducts: Seal Class A.

5. Unconditioned Space, Return–Air Ducts: Seal Class A.

6. Conditioned Space, Supply–Air Ducts in Pressure Classes 2–Inch wg and Lower: Seal Class A.

7. Conditioned Space, Supply–Air Ducts in Pressure Classes Higher Than 2–Inch wg: Seal Class A.

8. Conditioned Space, Exhaust Ducts: Seal Class A.

9. Conditioned Space, Return–Air Ducts: Seal Class A.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder–actuated fasteners, or structural–steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder–actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder–actuated concrete fasteners for standard–weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA’s "HVAC Duct Construction Standards — Metal and Flexible," Table 5–1, “Rectangular Duct Hangers Minimum Size,” and Table 5–2, “Minimum Hanger Sizes for Round Duct,” for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull–out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA’s "HVAC Duct Construction Standards — Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized–steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

2. Test the following systems:
   a. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
   b. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
   c. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
   d. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

4. Test for leaks before applying external insulation.

5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   
   2. Any liner showing evidence that is has wet at any time shall be removed and replaced with new liner.
      a. Disinfect affected sheet metal, and pins.
      b. Install new liner per specifications
      c. Seal friable edges and seams of repaired liner.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new duct system before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.
   
   1. Create new openings and install access panels appropriate for duct static—pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 “Air Duct Accessories” for access panels and doors.
   
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   
   3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
   
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
   
   1. Air outlets and inlets (registers, grilles, and diffusers).
   
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   
   
   5. Return—air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum—collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous–glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous–glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash–down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA–registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer’s written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Section 230593 “Testing, Adjusting, and Balancing for HVAC.”

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Ductwork running in areas where there are no ceilings or when noted on the drawings shall be doubled wall duct and shall meet the requirements indicated below.

C. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive 2–inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 16.
   d. SMACNA Leakage Class for Round: 8.

2. Ducts Connected to Constant–Volume Air–Handling Units:
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 8.
   d. SMACNA Leakage Class for Round: 4.

3. Ducts Connected to Equipment Not Listed Above:
a. Pressure Class: Positive \textit{4–inch wg.}

b. Minimum SMACNA Seal Class: \textbf{A.}

c. SMACNA Leakage Class for \textbf{Rectangular: 4.}

d. SMACNA Leakage Class for \textbf{Round: 2.}

D. \textbf{Return Ducts:}

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive or negative \textit{2–inch wg.}
   b. Minimum SMACNA Seal Class: \textbf{A.}
   c. SMACNA Leakage Class for Rectangular: \textbf{16.}
   d. SMACNA Leakage Class for Round: \textbf{8.}

2. Ducts Connected to Air–Handling Units:
   a. Pressure Class: Positive or negative \textit{2–inch wg.}
   b. Minimum SMACNA Seal Class: \textbf{A.}
   c. SMACNA Leakage Class for Rectangular: \textbf{16.}
   d. SMACNA Leakage Class for Round: \textbf{8.}

3. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative \textit{3–inch wg.}
   b. Minimum SMACNA Seal Class: \textbf{A.}
   c. SMACNA Leakage Class for Rectangular: \textbf{8.}
   d. SMACNA Leakage Class for Round: \textbf{4.}

E. \textbf{Outdoor–Air (Not Filtered, Heated, or Cooled) Ducts:}

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive or negative \textit{2–inch wg.}
   b. Minimum SMACNA Seal Class: \textbf{A.}
   c. SMACNA Leakage Class for Rectangular: \textbf{16.}
   d. SMACNA Leakage Class for Round and Flat Oval: \textbf{4.}

2. Ducts Connected to Air–Handling Units:
   a. Pressure Class: Positive or negative \textit{3–inch wg.}
   b. Minimum SMACNA Seal Class: \textbf{A.}
   c. SMACNA Leakage Class for Rectangular: \textbf{8.}
G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Figure 4–2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Figure 4–3, "Vanes and Vane Runners," and Figure 4–4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Figure 3–4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Table 3–1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity **1000 fpm** or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity **1000 to 1500 fpm**: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity **1500 fpm** or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.
   b. Round Elbows, **12 Inches** and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, **14 Inches** and Larger in Diameter: Welded.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible,” Figure 4–6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry high efficiency take-off.
   b. Rectangular Main to Round Branch: 45-degree entry high efficiency take-off.

2. Round:
   a. Comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible,” Figure 3–5, "90 Degree Tees and Laterals," and Figure 3–6, "Conical Tees." Saddle taps are permitted in existing duct.
   b. Velocity **1000 to 1500 fpm**: 45-degree entry high efficiency tap.
   c. Velocity **1500 fpm** or Higher: 45-degree lateral.
END OF SECTION 233113
SECTION 233300
AIR DUCT ACCESSORIES

PART 1 — GENERAL

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

1.2 SUMMARY
A. Section Includes:
   2. Control dampers.
   3. Combination fire and smoke dampers.
   4. Turning vanes.
   5. Remote damper operators.
   6. Duct—mounted access doors.
   7. Flexible connectors.
   8. Flexible ducts.
   9. Duct accessory hardware.

B. Related Requirements:
   1. Division 23 “Diffusers, Registers and Grilles”.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      c. Control—damper installations.
      d. Fire—damper, smoke—damper, combination fire— and smoke—damper, pressure relief—damper, ceiling, and corridor damper installations, including sleeves; and duct—mounted access doors and remote damper operators.
      e. Wiring Diagrams: For power, signal, and control wiring.
1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling–mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

B. Source quality–control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 – PRODUCTS

2.1 ASSEMBLY DESCRIPTION


B. Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653.

1. Galvanized Coating Designation: G60.


B. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1–side bright finish for exposed ducts.

C. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.


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.
2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Warming and Ventilating; a division of Mestek, Inc.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. United Enertech

2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.

   a. 16GA 0.064--inch thick, galvanized sheet steel.

5. Blades:
   a. Multiple or single blade. Parallel-- or opposed--blade design. Stiffened damper blades for stability.
   b. Material:
      1) Galvanized --steel, 16GA 0.064 inch thick.

6. Blade Axles:
   a. Nonferrous metal
   b. Shall extend full length of damper blades in ducts with pressure classes of 3--inch wg or more.

7. Bearings:
   a. Material:
      1) Molded synthetic.
   b. Bearings at both ends of damper operating shafts in ducts with pressure classes of 3--inch wg or more.

8. Tie Bars and Brackets: Galvanized steel.

B. Low--Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Warming and Ventilating; a division of Mestek, Inc.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. United Enertech

2. Comply with AMCA 500--D testing for damper rating.

3. Low--leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

4. Suitable for horizontal or vertical applications.

5. Frames:
   a. Frame: Hat--shaped,
6. Blades:
   a. Multiple or single blade.
   b. Parallel– or opposed–blade design.
   c. Stiffen damper blades for stability.
   d. Material:
      1) Galvanized, roll–formed steel, 16GA 0.064 inch thick.

7. Blade Axes:
   a. Nonferrous metal.

8. Bearings:
   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3–inch wg or more shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals:
   a. Neoprene.

10. Jamb Seals: Cambered Stainless steel or aluminum.
11. Tie Bars and Brackets: Galvanized steel or aluminum.

12. Accessories:
   a. Include locking device to hold single–blade dampers in a fixed position without vibration.

C. Jackshaft:
   1. Size:
      a. 1–inch diameter.
   2. Material: Galvanized–steel pipe rotating within pipe–bearing assembly mounted on supports at each mullion and at each end of multiple–damper assemblies.
   3. Length and Number of Mountings: As required to connect linkage of each damper in multiple–damper assembly.

D. Damper Hardware:
   2. Include center hole to suit damper operating–rod size.
   3. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Pottorff.
   3. Ruskin Company.
   4. Young Regulator Company.
   5. United Enertech
B. Low-leakage rating, with linkage outside airstream, and bearing AMCA’s Certified Ratings Seal for both air performance and air leakage.

C. Frames:
   1. Section:
      a. Hat shaped.
   2. Material:
      a. 20 GA 0.40-inch-thick galvanized steel.
   3. Corners:
      a. Mitered—and—welded.

D. Blades: Multiple.
   1. Maximum blade width:
      a. 6 inches.
   2. Parallel—and—opposed—blade design.
   3. Material:
      a. Galvanized—steel.
   4. Thickness:
      a. 20 GA 0.40-inch—thick galvanized steel
   5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
      a. Closed—cell neoprene

E. Blade Axles:
   1. Section:
      a. 3/8-inch—square
   2. Material:
      a. Galvanized steel.
   3. Blade—linkage hardware:
      a. Zinc—plated steel and brass.
      b. Ends sealed against blade bearings:
   4. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:
   1. Type:
      a. Molded synthetic.
   2. Axles: Dampers in ducts with pressure classes of 3—inch wg or more shall have axles full length of damper blades.
   3. Bearings: Thrust bearings at each end of every blade. Bearings at both ends of each operating shaft.

2.5 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Nailor Industries Inc.
   3. Pottorff.
   4. Ruskin Company.
   5. United Enertech
B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4–inch wg static pressure class and minimum velocity of:
   1. 4000–fpm

D. Fire Rating:
   1. 1–1/2 hours.

E. Frame: Hat shaped, galvanized sheet steel. With or without mounting flange as required.
   1. Thickness:
      a. 16GA-0.064–inch
   2. Corners:
      a. Welded.


G. Smoke Detector: Integral, factory mounted and wired for single–point connection.
   1. UL Listed S1383.
   2. This is not required if a Fire Alarm is provided by division 26.

H. Blades: Horizontal, galvanized sheet steel.
   1. Type:
      a. Air–foil.
   2. Fit;
      a. Interlocking.
   3. Thickness:
      a. 0.063–inch–.

I. Leakage:
   1. Class I.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory–installed, galvanized sheet steel; length to suit wall or floor application with factory–furnished silicone calking.
   1. Thickness:
      a. 18GA 0.05–inch–.

L. Damper Motors:
   1. Locate outside air stream unless otherwise indicated,
   2. Action:
      a. Two–position.
   3. Voltage: to match fire alarm system (coordinate).
   4. Listed: UL, as part of damper assembly.
   5. Outdoor Motors and Motors in Outside–Air Intakes:
      a. Gaskets: O–ring gaskets designed to make motors weatherproof.
      b. Internal heaters: Equip to permit normal operation at minus 40 deg F.

M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   1. Electrical Connection: 115 V, single phase, 60 Hz.

N. Accessories:
1. Auxiliary switches:
   a. Signaling.
   b. Position indication.

2. Test Switch type:
   a. Momentary test switch.

3. Test Switch Mounting:
   a. Damper.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. METALAIRE, Inc.
2. SEMCO Incorporated.
4. Ductmate Industries, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Fabricate single blade vanes to comply with SMACNA’s “HVAC Duct Construction Standards—Metal and Flexible.”


C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin–bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible"; Figures 4–3, "Van e and Vane Runners," and 4–4, "Vane Support in Elbows."

E. Vane Construction:
   1. Single wall

F. Vane Spacing:
   1. 1–1/2" spacing between turning vanes
   2. 3–1/4” spacing not allowed.

G. Vane Construction: Single wall for ducts up to 36 inches wide and additional bracing for larger dimensions.

2.7 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Potterff.
2. Ruskin Company; Tomkins PLC.
3. Young Regulator Company.

B. Cable Type:
   1. Description: Cable system designed for remote manual damper adjustment.
   2. Tubing/Sheathing: Galvinsed, Brass, Copper or Aluminum.
3. Cable: Stainless steel or Steel.
4. Wall–Box Mounting: Coordinate with Architect.
5. Wall–Box Cover–Plate Material: Coordinate with Architect.

C. Activated Electric Type:
1. Description: Electrically activated zone control damper for remote adjustment. When an adjustment is needed the system is powered up.
3. Portable 9 volt system. No field power requirement.
4. Mounting: Recessed Wall Box or Diffuser or Hand Held.
5. Wall–Box Cover Finish: Coordinate with Architect.
6. Wall–Box Porting: 1 to 6 ports or more.

2.8 DUCT–MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. McGill AirFlow LLC.
3. Pottorff.
5. Ruskin Company


1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1–by–1–inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend–over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 inches Square:
      1) Hinges:
      a) Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 inches, provide outside and inside handles:
      1) Hinges:
      a) Three hinges and two compression latches.
   d. Access Doors Larger Than 24 by 48 inches, provide outside and inside handles:
      1) Hinges:
      a) Continuous and two compression latches with outside and inside handles.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
2. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a wide fabric strip attached to two narrower metal strips. Provide strips of metal compatible with connected ducts.
   1. Wide Strip:
      a. 3–1/2 inches.
   2. Narrow Strips:
      a. 0.028–inch thick, galvanized sheet steel.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

   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.

2.10 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexmaster U.S.A., Inc.
   2. McGill AirFlow LLC.
   3. Themaflex

B. Ducts shall conform to the requirements for Class I connectors when tested in accordance with "Standard for Factory Made Air Ducts Materials and Air Duct Connectors" (UL 181).

C. Ducts shall also pass the 15 minute U.L. flame penetration test as specified in the UL 181 Standard.

D. Insulated, Flexible Duct: Two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor–barrier film.
   1. Pressure Rating: 10–inch wg positive and 1.0–inch wg negative.
   3. Temperature Range: Minus 10 to plus 160 deg F.
   4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

E. Flexible Duct Connectors:
1. **Clamps**: in sizes *3 through 18 inches*, to suit duct size.
   a. **Material**: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action.

2.11 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.

C. **Splitter Damper Accessories**: Zinc-plated damper blade bracket; *1/4-inch*, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

D. **Flexible Duct Clamps**: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes *3 to 18 inches* to suit duct size.

2.22 HIGH EFFICIENCY TAKE-OFFS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

   1. Air-Rite
   2. Hercules Industries
   3. Sheet Metal Connectors, Inc.
   4. Spiral Manufacturing Co. Inc.
   5. Ferguson

B. **Materials**:

   1. 24 gauge galvanized sheet metal meeting ASTM A653 and A924

C. **Take-off shall meet SMACNA third edition Section 4.8 figure 4.6 – 45 degree entry.**

D. Rectangular opening with flanged sides on all sides. Complete with closed cell neoprene gasket to provide a tight seal.

PART 3 – EXECUTION

3.1 INSTALLATION

**General**

A. Install duct accessories according to applicable details in SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized–steel accessories in galvanized–
steel and fibrous–glass ducts, stainless–steel accessories in stainless–steel ducts, and aluminum accessories in
aluminum ducts.

C. Use the Remote Damper Operator when they are called out on the drawings or when the damper cannot be easily
accessed.

D. Install high efficiency take–off on all branch duct take–offs. Provide take–off with balancing damper as shown on
drawings. Spin–in fittings are not allowed.

Flexible Ducts / Flexible Duct Connectors

E. Install flexible connectors to connect ducts to equipment.

F. Flexible duct connections from the main trunk ducts to diffuser boots shall be furnished and installed as shown on
the drawings. Flexible ductwork shall only be used as indicated on the drawings.

G. Where flexible duct is indicated, use insulated flexible duct for supply air return and exhaust air.

H. Flexible ductwork shall be run in straight lengths.

I. Provide support in flexible duct every three feet.

J. Flexible ducts shall have compression fittings on both ends.

K. Flexible ductwork is not allowed to bend 90 degrees. If a bend is needed use sheet–metal hard elbows. Hard
turns, offsets, or kinks will not be allowed.

L. Flexible ducts shall connect to trunk duct with high efficiency takeoffs.

M. Connect flexible ducts to metal ducts with draw bands.

N. Connect terminal units to supply ducts:
   1. With maximum 12–inch lengths of flexible duct.

O. Do not use flexible ducts to change directions.

Volume Damper

P. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger
ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as
liner, and terminate liner at nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

Q. Set dampers to fully open position before testing, adjusting, and balancing. Exception: Pressure relief damper.

R. A balance damper with locking quadrant will be provided downstream of take–off from trunk duct.

Fans And Test Holes

S. For fans developing static pressures of 5–inch wg and more, cover flexible connectors with loaded vinyl sheet
held in place with metal straps.
T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of \( \frac{1}{4}\)-inch movement during start and stop of fans.

U. Install duct test holes where required for testing and balancing purposes.

V. Install test holes at fan inlets and outlets and elsewhere as indicated.

**FIRE, SMOKE AND FIRE–SMOKE DAMPERS**

W. Install fire and smoke dampers according to UL listing.
   1. Install fusible links in fire dampers.

X. For round ductwork 24-inch and smaller a true round fire damper with the same rating may be used.

**Access Doors**

Y. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On upstream side of duct coils.
   2. **Upstream** from duct filters.
   3. At outdoor–air intakes and mixed–air plenums.
   4. At drain pans and seals.
   5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be **standard access doors** and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   7. At each change in direction and at maximum 50-foot spacing.
   8. **Upstream** from turning vanes.
   9. Upstream or downstream from duct silencers.
   10. Control devices requiring inspection.
   11. Elsewhere as indicated.

Z. Install access doors with swing against duct static pressure.

AA. **Access Door Sizes:**
   1. One–Hand or Inspection Access: **8 by 5 inches.**
   2. Two–Hand Access: **12 by 6 inches.**
   3. Head and Hand Access: **18 by 10 inches.**
   4. Head and Shoulders Access: **21 by 14 inches.**
   5. Body Access: **25 by 14 inches.**

BB. Label access doors according to Section 230553 “Identification for HVAC Piping and Equipment” to indicate the purpose of access door.

3.2 **FIELD QUALITY CONTROL**

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

3.3 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 23 Section “Testing, Adjusting, and Balancing for HVAC.”

END OF SECTION 233300
SECTION 233713
DIFFUSERS, REGISTERs, AND GRILLES

PART 1 – GENERAL

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

1.2 SUMMARY
A. This section includes ceiling– and wall–mounted diffusers, registers, and grilles.
B. Related Sections:
   1. Section 233714 “Fixed Louvers” for fixed and louvers and wall vents, whether or not they are connected to ducts.
   2. Section 233300 “Air Duct Accessories” for fire and smoke dampers and volume–control dampers not integral to diffusers, registers, and grilles.
   3. Section 230594 “General Testing, Adjusting and Balancing” for balancing diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static–pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling–mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.
B. Source quality–control reports.
1.5 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.


PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kruegar.
2. Nailor Industries Inc.
4. Titus.

2.2 REGISTERS, GRILLES, & DIFFUSERS

A. General: The frames for all registers, grilles, and diffusers shall match type of ceiling where they are to be installed. Special frames shall be provided for narrow T–bar ceilings. Refer to reflected ceiling plan and other specification divisions for ceiling type. See drawings AND schedules for additional information.

B. Refer to reflected ceiling plan and other specification divisions for ceiling type.

1. Ceiling supply air diffusers in rooms with ceilings and without ceilings shall be Titus Omni Architectural Square Panel with baked enameled finish, directional blow clips, and earthquake tabs. Border type shall match ceiling system.
3. Ceiling return–air grilles in other than lay–in ceiling shall be Titus 8F with perforated faceplate, baked enamel finish.
5. Transfer grilles in ceilings shall be the same as specified for return–air grilles for that type of ceiling. Transfer grilles in walls shall be the same type as specified for return–air grilles in walls.
6. Supply air diffusers in conference rooms and open office areas with hanging open lattice ceilings shall be Titus model XC–310 heavy duty ring operated diffuser of the sizes and mounting type shown on the plans. The diffuser shall be constructed of 18–gauge steel with a contoured outer cone. The airflow discharge pattern shall be field adjustable from horizontal to vertical by rotating a ring operator to open and close the inner vane assembly. The ring operator shall be adjustable with a pole for remote access. The finish shall be black. The interior of the diffuser shall also be black.
2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, “Method of Testing for Rating the Performance of Air Outlets and Inlets.”

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer’s written instructions, coordination drawings, original design, and referenced standards.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, 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 233713
SECTION 233714
FIXED LOUVERS

PART 1 – GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Fixed, extruded–aluminum louvers.
B. Related Requirements:
   1. Section 099113 "Exterior Painting" for field painting louvers.

1.3 DEFINITIONS
A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
   1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
   2. Show mullion profiles and locations.
C. Samples: For each type of metal finish required.
1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500–L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.2/D1.2M, "Structural Welding Code – Aluminum."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory–applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500–L.


2.3 FIXED, EXTRUDED–ALUMINUM LOUVERS

A. Horizontal, Drainable–Blade Louver:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Airolite Company, LLC (The).
      b. Pottorf.
      c. Ruskin Company; Tomkins PLC.
   2. Louver Performance Ratings:
      b. Point of Beginning Water Penetration: Not less than 1250 fpm.
      c. Air Performance – intake: Not more than 0.10–inch wg static pressure drop at 900–fpm free–area velocity.
d. Air Performance – exhaust: Not more than 0.15-inch wg static pressure drop at 1000-fpm free-area velocity.

3. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.
   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
   1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded–aluminum screen frames at corners with clips.
   2. Finish: Same finish as louver frames to which louver screens are attached.
   3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

2.5 BLANK–OFF PANELS

A. Insulated, Blank–Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
   1. Thickness: 2 inches.
   2. Metal Facing Sheets: Aluminum sheet, not less than 0.032–inch nominal thickness.
   3. Metal Facing Sheets: Galvanized–steel sheet, not less than 0.028–inch nominal thickness.
   4. Metal Facing Sheets: Stainless–steel sheet, not less than 0.031–inch nominal thickness.
   6. Edge Treatment: Trim perimeter edges of blank–off panels with louver manufacturer’s standard channel frames, with corners mitered and with same finish as panels.
   7. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
   8. Panel Finish: Same type of finish applied to louvers, but black color.

2.6 MATERIALS


B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.
   1. Contractor shall use hex–head screws for exposed fasteners screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless–steel fasteners.
3. For color–finished louvers, use fasteners with heads that match color of louvers.

D. Postinstalled Fasteners for Concrete and Masonry: Torque–controlled expansion anchors, made from stainless–steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold–applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Color Anodic Finish: AAMA 611, or thicker.
   1. Color: As selected by Architect from full range of industry colors and color densities.

C. Baked–Enamel or Powder–Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer’s written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Color and Gloss As selected by Architect from manufacturer’s full range.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous—metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weather-tight louver joints are required. Comply with Section 079200 “Joint Sealants” for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory—applied finish coating.

END OF SECTION 233714
SECTION 235313
CONDENSATE RETURN PUMPS

PART 1 – GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Condensate return pumps & receiver tank.

1.3 DEFINITION
   A. NPSH: Net-positive suction head.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include rated capacity, temperature and NPSH required, pump performance curves with selection points clearly indicated, and furnished specialties and accessories.
   B. Shop Drawings: Include plans, elevations, sections, details, dimensions, weights, loadings, required clearances, method of field assembly, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS
   A. Field quality–control test reports.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For feedwater equipment to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE
   A. Regulatory Requirements: Fabricate and test unit according to ASME PTC 12.1, "Closed Feedwater Heaters."
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Shipping: Clean flanges and exposed—metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed—in plugs.

B. Store units in dry location.

C. Retain protective flange covers and machined—surface protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with manufacturer’s written rigging instructions.

1.9 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor—bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 – PRODUCTS

2.1 CONDENSATE RETURN PUMP UNITS

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. Aurora Pump; Pentair Pump Group.
2. Domestic Pump; a unit of ITT Fluid Technology.
3. MEPCO (Marshall Engineered Products Co.).
4. PVI Industries, LLC.
5. Roth Pump Company; a subsidiary of Roy E. Roth Co.

B. Description: Factory assembled and tested unit consisting of a receiver, duplex return pumps, controls, and the following features and accessories:

1. Lifting eyes.
2. Companion flanges.
3. Pump, suction and discharge isolation valve, inlet strainer, discharge check valve.

C. Receiver:

2. Finish: Primer under enamel topcoat.
D. Return Pump: Flange-mounted, multistage centrifugal pump; rated for 300 minimum working pressure and a continuous water temperature of at least 250 deg F with the following features:

1. Impeller: Stainless steel.
2. Seals: Mechanical.

E. Control panel shall be unit mounted and factory wired and include the following:

1. NEMA 250, Type 1 enclosure.
2. Single-point field power interface circuit breaker.
   a. Branch power circuit to each motor and to controls with a disconnect switch.
3. NEMA-rated motor controller for each motor, and include a hand-off-auto switch and overcurrent protection.
   a. Alternating controls for duplex units with intermittent operation as indicated by control sequence.
4. Terminal blocks with numbered and color-coded wiring to match wiring diagram.
5. Wiring outside of an enclosure in a metal raceway. Make connections to motor with liquidtight conduit.
6. Removable control mounting plate.
8. Audible alarm and silence switch.
10. Fused control-circuit transformer.
11. Microprocessor-based controller.

F. Duplex–Pump Control Sequence:
1. Lead and lag pumps alternate to equalize run time.
2. Lead pump failure, lag pump automatically starts if lead pump cannot maintain set point.
5. Visual and audible alarm indication of pump failure.

G. Building Management System Interface: Factory install hardware to enable building management system to monitor and display points.

1. Hardwired Monitoring Points: On/off status for each pump, failure alarm for each pump, receiver low-water-level alarm, receiver high-water-level alarm.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Before unit installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting feedwater unit performance, maintenance, and operations.

1. Final unit locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting: Install feedwater unit on cast-in-place concrete equipment base using seismically restrained spring isolators.

2. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Install on 4-inch high concrete base.

B. Install unit to permit access for maintenance.

C. Support piping independent of pumps.

D. Install base-mounted pumps on concrete bases with grouted base frames.

E. Install parts and accessories shipped loose.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Install overflow drain piping to nearest floor drain.

D. Install vents and extend to outdoors; terminate with elbow turned down and an insect screen.

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. Report results in writing.

B. Tests and Inspections:

1. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with manufacturer's written instructions.
2. Test and adjust controls and safety. Replace damaged and malfunctioning controls and equipment.
3. Check bearing lubrication.
4. Verify proper motor rotation.
5. Start up service.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 CLEANSING

A. Clean equipment internally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer’s written instructions.

B. Clean strainers.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain feedwater units. Refer to Division 01 Section “Demonstration and Training.”

END OF SECTION 235313
SECTION 237330

MODULAR INDOOR AIR HANDLING UNITS

PART 1 – GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install custom air handling units as described in Contract Documents.

B. Products Installed But Not Supplied Under This Section:
   1. Control valve.
   2. Low limit control Freezestats.

1.2 SUBMITTALS

A. Product Data:
   1. Indicate dimensions, weights, capacities, fan capacities, fan performance, motor electrical characteristics, casing construction details, wiring interconnections, gauges, and finishes of materials.
   2. Indicate filter sizes and quantities, and filter frames.
   3. Provide coil selection work sheets showing proper consideration for altitude, air density, and fouling factor.
   4. Manufacturer installation instructions.
   5. Fan curves with specified operating point clearly plotted.
   6. Sound power levels for air handling unit(s) at scheduled conditions.
   7. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts list, and wiring diagrams.

B. Close–Out:
   1. Record Documents:
      a. Show unit configuration in direction of airflow.
      b. Indicate assembly and unit dimensions.

1.3 QUALITY ASSURANCE

A. Certification Requirements:
   1. Certify air handling unit capacity, static pressure, fan speed, brake horsepower, and selection procedures in accordance with ARI 430–89.
   2. Certify air coils capacities, pressure drops and selection procedures in accordance with ARI 410–87.
   3. Certify sound power levels for air handling unit(s) at scheduled conditions.
4. Units with factory wiring shall be UL/ETL/CSA Approved.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver air handlers to site on factory-installed 4 inch high base rail.

1.5 MAINTENANCE

A. Extra Materials: In addition to construction set, provide one additional set pleated media filters and one set of cartridge filters.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Air Handling Units: (Approved Manufacturers: Carrier, Trane and York)

1. Casing:

   a. Construct non-load exterior panels of minimum 16 ga galvanized steel.
      1) Removal of exterior panels shall not affect structural integrity of unit.
      2) Apply final shop coat zinc rich protective paint to units with welds on exterior surfaces or welds that have burned through from interior welds. Manufacturer’s standard color.
      3) Walls constructed of 2 inches thick double wall acoustical thermal panels.
      4) Interior walls: Minimum 18 ga perforated (solid) galvanized steel.

   b. Insulate sections handling conditioned air with 2 inches 3 lb/cu ft double density matt faced fiberglass covered with inner panel of 18 ga minimum perforated galvanized steel. Install insulation using adhesive. Insulation edges protected with metal lagging.

   c. For routine service access, supply unit with full height, galvanized, double wall, hinged, access doors.
      1) 16 ga steel exterior and 22 ga solid metal interior liner.
      2) Continuously welded corners on doors.
      3) Insulation as specified above.
      4) Provide two ‘Ventlock – 310’ latches operable from either side of door.
      5) Doors shall be fully gasketed with continuous 1/2 inch closed cell hollow, round, black gasket with metal encapsulated reinforced backing mechanically fastened to door frame.
      6) Door frames shall be 12 ga galvanized steel.
      7) Door must swing against the air pressure.

   d. Base shall be constructed from structural steel 4 inch minimum channel iron around perimeter of unit with intermediate channel and angle iron supports.
      1) 12 ga checker plate floor shall be installed on base.
      2) Floor shall be flat, reinforced from below with seams continuously welded.
      3) Provide base with lifting lugs.
      4) Insulate base with one inch thick insulation sheeted with 22 ga galvanized steel liner.
      5) Provide auxiliary drains in fan sections downstream of cooling coils and in mixing sections.
6) Drain connections shall terminate at side of unit.

e. On units provided with cooling coils, extend drain pan under complete coil section.

1) On horizontal draw through units, provide under complete supply fan section.
2) Provide drain connections on both sides of each drain pan.
3) Drain pans shall be of sealed double wall stainless steel construction with Manufacturer's standard insulation sandwiched between pan layers.
4) Seamless bottom drain pan broken for multiple slopes to single drain outlet.

2. FANS (See Schedules)

a. The fans shall be of the centrifugal plenum (plug) or as scheduled, designed without a scroll type housing. Fans shall incorporate a wheel, heavy gauge reinforced steel inlet plate with removable spun inlet cone, structural steel frame, and shaft and bearings in AMCA Arrangement 3 configuration to form heavy duty integral unit.

b. All fan wheels shall have tapered spun wheel cones or shrouds providing stable flow and high rigidity. The wheels shall be non-overloading type.

c. The blades shall be continuously welded, die-formed Airfoil type, designed for maximum efficiency and quiet operation. Partial welding will not be acceptable on airfoil blades.

d. Impellers shall be statically and dynamically balanced and complete fan assembly shall be test balanced at the operating speed prior to shipment.

e. Shafts are to be AISI C-1018, 1040 or 1045 hot rolled steel accurately turned, ground, polished, and ring gauged for accuracy.

f. Shafts to be sized for first critical speed of at least 1.43 times the maximum speed for the class. Bearings are to be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum class RPM.

g. Cantilevered vane blades are to be used through Size 490 to minimize air performance insertion losses and noise. Operating mechanism shall be out of the inlet airstream.

3. Motors and Drives:

a. Drive sheaves shall be machined cast iron.

b. Sheave selections and belt lengths shall be in accordance with drive manufacturer for specific motor loads being encountered.

c. Provide metal belt guard with openings for tachometer readings. Size belt guard to allow either sheave to be increased by two sizes.

4. Coils:

a. Provided by same company as supplier of air handling units and designed with aluminum plate fins and copper tubes.

b. Fins shall have collars drawn, belled, and firmly bonded to tubes with mechanical expansion of tubes.

1) Soldering or tinning shall not be used in bonding process.
2) Mount coils in unit casing to be accessible for service and can be removed from unit through side or top.
3) Capacities, pressure drops, and selection procedure shall be certified in accordance with ARI Standard 410.

c. Provide factory installed extended drain and vent connections for water coils.
   1) Drain pans shall be continuously welded and coated with asphalt.
   2) Interconnect intermediate drain pans with one inch drain lines.

d. Water Cooling Coils:
   1) Enclosed in insulated coil section.
   2) Coil headers and U-bends shall not be exposed.
   3) Water flow counter to airflow.
   4) Proof tested to 300 psig and leak tested to 200 psig air pressure under water.
   5) Round copper pipe headers.
   6) 5/8 inch outside dimension tubes with minimum 0.035 inch wall thickness.
   7) Coils shall be drainable.
   8) Coordinate coil connections with Drawings for access.

e. Water Heating Coils:
   1) Enclosed in coil section.
   2) Coil headers and U-bends shall not be exposed.
   3) Water flow counter to airflow.
   4) Provide supply header to ensure distribution of hot water to each tube of coil.
   5) Proof tested to 300 psig and leak tested to 200 psig air pressure under water.
   6) 5/8 inch outside dimension tubes, with minimum 0.025 inch wall thickness.
   7) Coordinate coil connections with Drawings for access.
   8) Coils shall be drainable.

5. Filters:

a. Provide factory-fabricated flat filter section of same construction and finish as unit casing with filter guides and hinged, double wall access doors with automotive style gasket for minimum leakage for filter removal.
   1) Provide filter rack for 2 inch thick medium efficiency pre-filters and 12 inch thick final filters where shown. Rack shall be of galvanized steel and equipped with gaskets to limit leakage to less than 3 percent.
   2) Fabricate filter boxes to flange to other unit components.
   3) Provide blockouts as required to prevent air bypass around filters.

b. 2 inch thick medium efficiency pleated media, disposable type pre-formed pleated design, with filtering media area being at least 4.6 times face area with 16 pleats per linear foot.
   1) Media:
      a) Reinforced non-woven cotton fabric, treated with adhesive similar to Vyclad B, and continuously laminated to supporting steel wire grid conforming to configuration of pleats.
      b) Rated average efficiency of at least 36.5 percent when tested by ASHRAE Type test (atmospheric) and be capable of operating with variable face velocities up to 500 FPM without impairing efficiency.
      c) Initial resistance shall not exceed 0.30 inch WG at 500 FPM, or 0.12 inches WG at 300 FPM.
   2) UL Class II
3) Approved Products.
   a) DP2–40 by Airguard Industries Inc, Louisville, KY (502) 969–2304.
   b) HC Type 40 by Environmental Filter Corporation (EFC), Santa Rosa, CA (510) 744–2087.
   c) 30/30 by Farr Company, Los Angeles, CA (310) 536–6332.

c. Filter Gauges:
   1) Magnahelic gauges accurate to plus or minus 2 percent of full scale.
   2) Provide probes and shut off valves with each gauge.
   3) Pipe gage can read drop across filters.
   4) Category Four Approved Product. See Section 01 6000 for definitions of Categories.
       a) Series 2000 by Drywer.

6. Dampers:
   a. Internally mounted outside air, return air, and exhaust air dampers.
      1) Air foil design and galvanized construction.
      2) Parallel or opposed blade type with metal compressible jamb seals and extruded vinyl blade
         edge seals on all blades.
      3) Blades shall rotate on stainless steel sleeve bearings.
      4) 60 inch maximum bumper blade length.
      5) Extend damper shafts minimum 6 inches outside of unit cabinet for mounting of damper
         operators. Provide nylon bearings where shaft penetrates cabinet.
      6) Maximum Leakage Rates: 4 cfm/square foot at 4 inches Wg.
      7) Approved Products.
         a) Honeywell: D642/D643.
         b) Ruskin: CD50.

2.2 FABRICATION
   A. Fabricate draw—through type air handling units suitable for scheduled air pressure operation.
   B. Fabricate units with supply fan sections, coil section, mixing box section, filter section, humidifier section, and
      discharge plenum.
   C. Permanently join flanged panel surfaces and seal with individual strip sealer tape.
   D. Turn wall and roof seams inward to provide clean, flush exterior finish.
   E. Seal panel seams during assembly to produce airtight unit.
   F. Size spring isolators to provide 99 percent isolation efficiency.

2.3 SOURCE QUALITY CONTROL
   A. Factory—fabricate and test air handling units of sizes, capacities, and configuration in accordance with Contract
      Documents.
   B. On units not shipped fully assembled, tag each section to indicate location in direction of airflow to facilitate
      assembly at job site.
   C. Base performance on altitude conditions.
PART 3 – EXECUTION

3.1 INSTALLATION

A. Furnish and install vibration isolation pads under mounting rail at load points indicated by unit manufacturer. Size shall be as recommended by unit manufacturer.

B. Level unit including spring isolators.

C. Provide each drain connection with deep seal trap and pipe all connections to drain.

D. Provide drain valve on each coil drain fitting and vent valve on each coil vent.

E. Thoroughly seal and calk pipe and conduit penetrations to casing.

F. Seal floor penetrations.

3.2 ADJUSTING

A. Check and align access doors to ensure smooth operation.

B. At start–up, check each fan motor for rotation and amp draw for each phase. Mark reading on fan scroll.

C. Adjust belt drives for tension and alignment.

3.3 PROTECTION

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 237330
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Division 26 shall comply with this section. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.

C. Architectural, Mechanical, Civil, Structural, and other applicable documents also apply to work of this section.

1.2 SUMMARY

A. Provide all labor, materials, and equipment as required for a complete operating and tested electrical system as described in the contract documents.

B. Related Requirements, including but not limited to:

1. Section 02 "Existing Conditions".
2. Section 03 "Concrete".
3. Section 05 “Metals”.
4. Section 06 “Woods Plastics, and Composites”.
5. Section 07 “Thermal and Moisture Protection:”
6. Section 08 “Openings”.
7. Section 09 “Finishes”.

1.3 CODES & ORDINANCES

A. All work shall be executed in accordance with all underwriters, public utilities, local and state codes, rules, and regulations applicable to the trade affected. Where work required by the drawings or specifications exceeds the codes rules, and regulations, it shall be done according to the documents. Where conflicts occur, the most stringent requirements shall apply.

B. Applicable codes: Work shall comply with currently adopted Edition:

1. International Building code
2. International Fire Code
4. National Electrical Code
5. International Mechanical Code
1.4 INDUSTRY STANDARDS

A. All work and equipment shall comply with the following standards. These standards refer to the latest adopted or published edition. Where conflicts occur, the most stringent requirement shall apply.

1. ETL Testing Laboratories (ETL)
2. Institute of Electrical and Electronic Engineers (IEEE)
3. National Fire Protection Association (NFPA)
4. National Electrical Manufacturers Association (NEMA)
5. National Electrical Safety code (NESC)
6. Occupational Safety and Health Standard (OSHA)
7. Underwriters Laboratories (UL)
8. Illuminating Engineering Society (IES)
10. Insulated Cable Engineers Association (ICEA)
11. American National Standards Institute (ANSI)
12. EIA/TIA

B. Compliance Verification:

1. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

1.5 INTERPRETATION OF DRAWINGS

A. Carefully review the documents prior to bid. Submit requests for clarification to the Architect/Engineer in writing prior to final addendum.

B. Electric equipment is shown at a small scale, and is shown at its approximate location only. The drawings shall not be scaled for roughing in measurements, except where dimensions are specifically shown. Refer to the Architectural and Mechanical drawings, and coordinate with applicable shop drawings of other trades, to locate electrical equipment. Coordinate with other trades to avoid interferences, and to provide sufficient space for the installation of all equipment. Where conflicts occur, notify the Architect in writing, for clarification.

C. Visit the site prior to bid to determine how existing conditions shall affect the electrical installation. Include all costs required due to existing site conditions in the bid.

1.6 DEFINITIONS

A. Provide: Furnish, install, and connect, unless noted otherwise.

B. Furnish: Purchase and deliver to the site. Include all essential items for performing the function.

C. Install: Physically install the equipment per industry standards, codes, and Contract Documents.

D. Connect: Make final connections to the equipment, and place into operation per manufacturer’s instructions.
1.7 SAFETY REGULATION

A. Comply with all local, State, Federal, and OSHA safety requirements in performance with this work. Refer to the General Conditions. Provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.8 PERMITS & FEES

A. Include all fees for permits, inspections, and connections required by work of this Division, unless noted otherwise. The Contractor shall obtain the necessary permits to perform the work unless noted otherwise.

1.9 TEMPORARY POWER:

A. Make arrangements with the Owner for temporary power.

B. Provide temporary power, complete with main disconnect, and wiring for lighting and power outlets for construction tools and equipment. Verify requirements with General Conditions. Comply with NEC for temporary power requirements.

1.10 SUBMITTALS AND SHOP DRAWINGS

A. As soon as possible after the contract is awarded, the Contractor shall submit to the Architect, the manufacturer’s data on products and materials, and shop drawings, to be used in the installation of electrical systems for this project. Review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the Engineer’s office. If the Contractor’s schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review.

B. Written approval of the Owner’s Representative shall be obtained before installing any equipment or materials for the project. Review of the submittals by the Owner’s Representative is for general conformance with the Contract Documents and shall not relieve the Contractor from compliance with the Contract Documents.

C. Verify all dimensional information to insure proper clearance for installation of equipment. Submitted literature shall bear the Contractor’s stamp, indicating that he has reviewed all equipment being submitted, that each item will fit within the available space. Notify the Architect, in writing, for additional instructions where proposed equipment is found to be in conflict with available space.

D. By description, catalog number, and manufacturer’s names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications, or if given written prior approval. Design equipment is the equipment listed on the drawings, or if not listed on the drawings is the equipment first named in the specifications.

E. If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer’s current, recognized, hourly rates.

F. Submittal Format: Unless noted otherwise in the General Conditions, the project submittals may be submitted as either hard copies, or in electronic format as noted below. Mixing the two formats is not acceptable. Partial submittals will not be reviewed until the complete submittal is received. Provide copies of the descriptive
literature covering products and materials to be used in the installation of electrical systems for this project for review.

1. Electronic Submittal Format: Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single specification section and transmittal form with links enabling navigation to each item. Name file with submittal number or other unique identifier, including revision identifier. Electronic file shall be completely electronically searchable or it will be rejected. Provide means for insertion to permanently record Contractor’s review and approval markings and action taken by the Architect.

2. The title sheet of the submittal shall contain the project name, date of submission, Architect, Contractor, Sub Contractors, Suppliers, specification section number and title.

3. Provide a statement on the title sheet that the shop drawings comply with, and are submitted in accordance with the contract documents.

4. Provide manufacturer’s equipment cut sheets, brochures, and drawings which describe the proposed equipment. All relevant information shall be identified.

5. Submit electrical room layouts for all electrical rooms showing equipment dimensions and required clearances.

6. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment.

1.11 OPERATING AND MAINTENANCE MANUALS

A. Unless noted otherwise in the General Conditions, submit four (4) copies of the Operating and Maintenance Manuals and one (1) copy in PDF format. Follow same compilation format as listed for Hardcopy Submittal Format and Electronic Submittal Format.

B. Provide manufacturer’s operating and maintenance instructions. Provide vendor’s name, address, and phone number. List model and serial number for each piece of equipment. Include list of replacement parts and service schedules. Provide wiring diagrams and manufacturer’s warranties.

1.12 RECORD DRAWINGS

A. Refer to the General Conditions for As–Built Drawing submission requirements.

B. Keep one complete hard copy set of the contract documents on site. Record on a daily basis, any modifications to the documents due to addendums, changes, and field conditions. Show dimensions for concealed work including conduits buried below slab or below grade, concrete ductbanks, direct burial cable, utility lines, etc.

1.13 WARRANTY

A. In addition to the requirements of the General Conditions, warranty the complete electrical installation to be in accordance with the contract documents, to be free from defects and in proper working order. Repair or replace any defective equipment or installation for a period of one (1) year from the date of final acceptance, or as noted otherwise. Defective lamps shall be replaced for a period of two (2) months from the date of final acceptance.

B. Submit written warranties and guarantees. List the Project name and the Contractor’s business name and contact information.
C. Submit warranty information for each product including name, address, and telephone number of warranty service. Include procedures for filing a claim.

PART 2 – PRODUCTS

2.1 GENERAL

A. All materials shall be new unless specifically noted otherwise.

2.2 SUBSTITUTIONS:

A. Substitutions of specified products, approved installers, etc. may be considered prior to bid. Submit proposed substitutions a minimum of eight (8) working days prior to the bid date. Provide complete information for proposed equipment including catalog cut sheets. Certify that the proposed equipment is equal to the specified equipment. Where substitution of a proposed installer is requested, submit company/installer’s resume indicating years of experience, certifications, etc. Any allowed substitutions shall be included in the addendum. Do not bid unapproved equipment or work by unapproved installers.

B. Provide samples as requested by the Architect/Engineer for review of proposed equipment prior to bid.

C. Substituted equipment shall comply with the intent of the contract documents. The Contactor shall bear all costs arising from conflicts arising due to the use of substituted equipment.

D. Value engineering substitutions shall not be offered by the Contractor without a request from the Architect/Engineer.

2.3 SPARE PARTS

A. Provide spare parts as specified in Division 26 sections. Deliver spare parts to the Owner’s Representative prior to substantial completion. Obtain written receipt and include with as–built drawing submission.

PART 3 – EXECUTION

3.1 CUTTING AND PATCHING

A. No cutting or drilling of structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the electrical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.

B. When concrete, asphalt, grading landscaping, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

C. Provide roof jacks and flange extending a minimum of 9 inches under roofing materials, for raceways and cables which penetrate the roof. Seal opening with approved sealant. Provide drip loop for cables, and weather head on raceway, which penetrates the roof. Coordinate installation requirements with Division 7.
D. Seal and caulk as required to waterproof all conduit penetrations. Any penetrations through vapor barriers shall be made vapor tight. See Division 7, Thermal and Moisture Protection for material and installation requirements.

3.2 ACCESS
A. Provide access doors in walls, ceilings and floors for access to electrical equipment such as junction boxes, pull boxes, cable trays, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless noted otherwise. Coordinate location of doors with the Architect prior to installation. If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910.

B. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this Division.

3.3 CONCRETE BASES
A. Concrete work for electrical equipment shall be provided by this Division. Provide equipment housekeeping pads, utility company equipment pads, vaults, light pole bases, etc.

B. All floor or ground mounted electrical equipment shall be set on minimum 4-inch high reinforced concrete bases, unless noted otherwise. Such bases shall extend 6 inches beyond equipment on all sides, or as shown on the drawings, and shall have a 1-inch beveled edge all around. Verify equipment dimensions with shop drawings, and do not exceed NEC 240-24 allowed mounting heights by the addition of housekeeping pad. Notify Architect of any discrepancy prior to installation.

3.4 CLEANING AND PAINTING
A. Upon completion of all tests and adjustments, and all systems have been pronounced satisfactory for permanent operation, clean all exposed raceway, junction boxes, pullboxes, fixtures, etc. and leave them ready for painting. Refinish any damaged finish, and leave everything in proper working order.

B. Remove all stains, finger marks, and grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by work of this Division. Clean light fixtures and interior and exterior of all electrical equipment.

C. Painting of exposed raceway, junction boxes, pullboxes, surface metal raceway, etc., is work of Division 9, Painting.

D. All equipment which is indicated to be furnished in factory prefinished conditions, and painted by the Electrical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

E. Upon completion of work of this Division, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

3.5 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS
A. All equipment and materials shall be properly stored and protected against damage, theft, moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have...
performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor’s expense.

3.6 POWER OUTAGES:

A. Power outages, as required for installation of electrical work, shall be scheduled with the Owner a minimum of (7) days prior to outages, and shall be performed during non-standard working hours, unless noted otherwise. Include all costs in bid for overtime hours and utility company disconnection and reconnection fees.

3.7 EQUIPMENT STARTUP AND TESTING:

A. Each major piece of equipment shall be started and tested by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided, and shall be included with the Warranty.

B. Notify Architect/Engineer prior to all testing for this Division, a minimum of three (3) business days prior to testing. Engineer shall observe all tests to insure the proper operation of the electrical system.

C. The Manufacturer’s Representative shall provide instructions to the owner’s maintenance personnel for operation and maintenance of the equipment.

3.8 FINAL REVIEW:

A. The Project Forman shall accompany the Engineer and remove coverplates, panelboard covers, access panels, etc. as requested, to allow review of the entire electrical system.

END OF SECTION 26 0100
SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Electrical equipment coordination and installation.
   2. Common electrical installation requirements.

1.3 DEFINITIONS


B. NBR: Acrylonitrile–butadiene rubber.

1.4 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 (must meet NEC requirement).
   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.

PART 2 – PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
   2. Cast–Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile–iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
3. Sleeves for Conduits Penetrating Non–Fire–Rated Gypsum Board Assemblies: Galvanized–steel sheet; 0.0239–inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw–fastening the sleeve to the board.


7. Sleeves for Rectangular Openings:
   i. Material: Galvanized sheet steel.
   ii. Minimum Metal Thickness:
      a. For sleeve cross–section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross–section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE–SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.

C. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

D. Pressure Plates: Carbon steel.

E. Connecting Bolts and Nuts: Carbon steel, with corrosion–resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE–SEAL FITTINGS

A. Description: Manufactured plastic, sleeve–type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. HOLDRITE.
2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non–fire–rated walls or floors.


C. Design Mix: 5000–psi, 28–day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS


1. Grade: Pourable (self–leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small–Scale Environmental Chambers.”

B. Silicone Foams: Multicomponent, silicone–based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

3 EXECUTION

3.1 SLEEVE INSTALLATION FOR NON–FIRE–RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above–Grade Non–Fire–Rated Concrete and Masonry–Unit Floors and Walls:

1. Interior Penetrations of Non–Fire–Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4–inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed, or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core–drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non–Fire–Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior–Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 SLEEVE–SEAL–SYSTEM INSTALLATION
A. Install sleeve–seal systems in sleeves in exterior concrete walls and slabs–on–grade at raceway entries into building.
B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE–SEAL–FITTING INSTALLATION
A. Install sleeve–seal fittings in new walls and slabs as they are constructed.
B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
C. Secure nailing flanges to concrete forms.

4 EXECUTION

4.1.1.1 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.
4.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot–type flashing units applied in coordination with roofing work.

B. Aboveground, Exterior–Wall Penetrations: Seal penetrations using cast–iron 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.

4.2.1.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire–rated floor and wall assemblies for electrical installations to restore original fire–resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section “Penetration Firestopping.”

END OF SECTION 260500
SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Building wires and cables rated 600 V and less.
      2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS
   B. NBR: Acrylonitrile–butadiene rubber.
   C. MC: Metal clad cable. No MC cable is acceptable on this project.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   B. Comply with NFPA 70.

PART 2 – PRODUCTS

2.1 CONDUCTORS AND CABLES
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Alcan Products Corporation; Alcan Cable Division.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.
6. Engineer approved equal.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN–THWN, XHHW and SO.

D. Multiconductor Cable: Comply with NEMA WC 70 for cable, Type SO with ground wire.

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.
   6. Engineer approved equal.

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. Feeders: Copper for all feeders. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS (XHHW insulated conductors may be substituted for THHN)

A. Exposed Feeders: Type THHN–THWN–2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN–THWN–2, single conductors in raceway.

C. Exposed Branch Circuits: Type THHN–THWN–2, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN–THWN–2, single conductors in raceway or metal– clad type MC cable per NEC 517.

E. Class 1 Control Circuits: Type THHN–THWN–2, in raceway.

F. Class 2 Control Circuits: Type THHN–THWN–2, 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. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
   F. Identify and color–code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS
   A. Tighten electrical connectors and terminals according to manufacturer's published torque–tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.
   B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 FIRESTOPPING
   A. Apply firestopping to electrical penetrations of fire–rated floor and wall assemblies to restore original fire–resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.6 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.
      3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
         a. Follow–up Infrared Scanning: Perform an additional follow–up infrared scan of each splice 11 months after date of Substantial Completion.
b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

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 260519
SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.3 ACTION 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 NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 – PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned–copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors (if required):

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor unless otherwise shown.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1–5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1–5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS (if required)

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 APPLICATIONS

A. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air–Duct Equipment Circuits: Install insulated equipment grounding conductor to duct–mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

2.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit. (If routed through conduit use PVC schedule 40 conduit or, if steel, bond strap or jumper to both ends of the conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic–welded connectors for outdoor locations; if a disconnect–type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping (if required):
1. **Metal Water Service Pipe:** Install insulated copper grounding conductors, in PVC conduit, from building’s main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug--type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. **Water Meter Piping:** Use braided--type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. **Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.**

D. **Bonding Interior Metal Ducts:** Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

2.6 **LABELING**

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

2.7 **FIELD QUALITY CONTROL**

A. Perform tests and inspections.

1. Engage trained individuals to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

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.
3. Test completed grounding system at each location.

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: 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 260526
SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Hangers and supports for electrical equipment and systems.
      2. Construction requirements for concrete bases, if noted on the drawings.
   B. Related Sections include the following:
      1. Division 26 Section "Vibration Controls for Electrical Systems" for products and installation requirements necessary for compliance with vibration criteria.

1.3 DEFINITIONS
   A. EMT: Electrical metallic tubing.
   B. IMC: Intermediate metal conduit.
   C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS
   A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   B. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS
   A. Product Data: For the following:
      1. Steel slotted support systems.
      2. Nonmetallic slotted support systems.
B. Shop Drawings: Show fabrication and installation details, as required.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases, if shown on drawings. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section “Roof Accessories.”

PART 2 – PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA–4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
   a. Allied Tube & Conduit.
   b. Cooper B–Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.

3. Nonmetallic Coatings: Manufacturer’s standard PVC, polyurethane, or polyester coating applied according to MFMA–4.
4. Painted Coatings: Manufacturer’s standard painted coating applied according to MFMA–4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch–diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Allied Tube & Conduit.
   b. Cooper B–Line, Inc.; a division of Cooper Industries.
   c. Fabco Plastics Wholesale Limited.
   d. Seasafe, Inc.
2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: The use of these products is only acceptable if approved by the Owner and GC in writing.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.
PART 3 – EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze--type supports fabricated with steel slotted or other 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 two--bolt conduit clamps.

D. Spring--steel clamps designed for supporting single conduits without bolts may be used for 1--1/2--inch 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. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface--Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle--type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP--69 or Spring--tension clamps.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, disconnect switches, control enclosures, pull and junction boxes, and other devices on slotted--channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site--fabricated metal supports.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Comply with requirements in Division 09 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.

END OF SECTION 260529
SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.


D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile–butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members in the paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Qualification Data: For professional engineer and testing agency.

E. Source quality—control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 – PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Afflex Inc.
   3. Allied Tube & Conduit; a Tyco International Ltd. Co.
   4. Anamet Electrical, Inc.; Anaconda Metal Hose.
   5. Electri–Flex Co.
   7. Maverick Tube Corporation.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. PVC–Coated Steel Conduit: PVC–coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch (1 mm), minimum.

F. EMT: ANSI C80.3.

G. FMC: Zinc–coated steel or aluminum.

H. LFMC: Flexible steel conduit with PVC jacket.
I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Fittings for EMT: Steel, compression type.
   2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

J. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
7. ElecSYS, Inc.
8. Electri–Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole–Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC–40–PVC, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B–Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold–down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw–cover type.
2.4 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
7. RACO; a Hubbell Company.
10. Spring City Electrical Manufacturing Company.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast–Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast or sheet metal, semi–adjustable, rectangular.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast–Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

H. 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.

I. Cabinets:

1. NEMA 250, Type 1, galvanized–steel box with removable interior panel and removable front, finished inside and out with manufacturer’s standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

   a. Carson Industries LLC.
   b. Christy Concrete Products.
   c. Nordic Fiberglass, Inc.
PART 3 – EXECUTION

3.1  RACEWAY APPLICATION

A.  Comply with the following indoor applications, unless otherwise indicated:

1.  Exposed, Not Subject to Physical Damage:  EMT.
2.  Exposed, Not Subject to Severe Physical Damage:  EMT.
3.  Exposed and Subject to Severe Physical Damage:  Rigid steel conduit.
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.  Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air:  EMT.
8.  Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts:  EMT.
9.  Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable:  EMT.
10.  Boxes and Enclosures:  NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

B.  Minimum Raceway Size:  1/2-inch (16-mm) trade size.

C.  Raceway Fittings:  Compatible with raceways and suitable for use and location.

1.  Rigid Steel Conduit:  Use threaded rigid steel conduit fittings, unless otherwise indicated.

D.  Install nonferrous conduit or tubing for circuits operating above 60 Hz.  Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

E.  Do not install aluminum conduits in contact with concrete.

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 26 Section "Hangers and Supports for Electrical Systems."

E.  Arrange stub–ups so curved portions of bends are not visible above the finished slab.

F.  Install no more than the equivalent of three 90–degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G.  Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H.  Thraeded 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.
I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. 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. Label empty conduits with destination information.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

L. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations.

M. 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.

N. Set metal floor boxes level and flush with finished floor surface.

3.3 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533
SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE


B. Comply with NFPA 70.


D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive–attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer’s wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 – PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather– and chemical–resistant coating and matching wraparound adhesive tape for securing ends of legend label.

OR

D. Snap–Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color–coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 ARMORED AND METAL–CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. 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.
2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size. Use one of the following methods:

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather– and chemical–resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self–locking cable tie fastener.

D. 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.

E. Snap–Around Labels: Slit, pretensioned, flexible, preprinted, color–coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 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 wide.

B. Self–Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather– and chemical–resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap–Around Labels: Slit, pretensioned, flexible, preprinted, color–coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Marker Tapes: Vinyl or vinyl–cloth, self–adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 WARNING LABELS AND SIGNS


B. Self–Adhesive Warning Labels: Factory–printed, multicolor, pressure–sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked–Enamel Warning Signs:

   1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
   2. 1/4–inch grommets in corners for mounting.
   3. Nominal size, 7 by 10 inches.

D. Metal–Backed, Butyrate Warning Signs:

   1. Weather–resistant, nonfading, preprinted, cellulose–acetate butyrate signs with 0.0396–inch galvanized–steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER — ELECTRICAL SHOCK HAZARD — EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING — OSHA REGULATION — AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 42 INCHES ". For 480 V equipment. Adjust depth to 36” for 208/120V equipment.
3. Additional warning signs as directed on the drawings.

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/16” for devices and 1/2” high for equipment and enclosures.

2.8 CABLE TIES

A. General—Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

B. UV—Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

   1. Minimum Width: 3/16 inch (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).

C. Plenum—Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

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 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

b. Colors for 208/120–V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Field–Applied, Color–Coding Conductor Tape: Apply in half–lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

B. Install instructional sign including the color–code for grounded and ungrounded conductors using adhesive–film–type labels.

C. Auxiliary Electrical Systems Conductor Identification: Identify field–installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory–installed connections.

D. Accessible Raceways, Armored and Metal–Clad Cables, More Than 600 V: Snap–around labels. Install labels at 10–foot (3–m) to 30–foot (10–m) maximum intervals.

E. 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. Provide circuit number for each wire enclosed in the j–box or pull box.

F. Power–Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color–coding conductor tape to identify the phase and voltage (or panel and circuit number on circuits up to 600V).

1. Color–Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch–circuit conductors.

a. Color shall be factory applied or field applied with adhesive tape of the correct color for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

b. Colors for 208/120–V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Field–Applied, Color–Coding Conductor Tape: Apply in half–lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
G. Power–Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive–backed phase tags, and a separate tag with the circuit designation.

H. Install instructional sign including the color–code for grounded and ungrounded conductors using adhesive–film–type labels.

I. Conductors to Be Extended in the Future: Attach engraved tags 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.

K. Workspace Indication: Where acceptable to the Owner, install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush–mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self–adhesive warning labels.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
      c. Mechanical equipment with multiple sources.

M. 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.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8–inch– (10–mm–) high letters for emergency instructions at equipment used for power transfer or load shedding.

O. 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: Adhesive film label with clear protective overlay or self–adhesive, 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 to Be Labeled:
   a. Enclosures and electrical cabinets.
   b. Access doors and panels for concealed electrical items.
   c. Emergency system boxes and enclosures.
   d. Enclosed switches.
   e. Enclosed circuit breakers.
   f. Enclosed controllers.
   g. Remote–controlled switches and control devices.
   h. Monitoring and control equipment.
   i. Panelboards.

END OF SECTION 260553
PART 1 – GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Time switches (LCP).
   2. Indoor occupancy or vacancy sensors.
B. Related Requirements:
   1. Division 26 Section “Wiring Devices” for wall–box dimmers, wall–switch occupancy or vacancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: Show installation details for occupancy and light–level sensors.
   1. Interconnection diagrams showing field–installed wiring.
   2. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 – PRODUCTS

2.1 TIME SWITCHES (LCP)
A. Basis–of–Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
5. NSi Industries LLC; TORK Products.
6. Tyco Electronics; ALR Brand.
7. Engineer approved equal.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: DPST.
3. Contact Rating: 30–A inductive or resistive, 240–V ac.
4. Programs: Number of channels as per drawings; each channel is individually programmable with 40 on–off operations per week, plus four seasonal schedules that modify the basic program, and an annual holiday schedule that overrides the weekly operation on holidays.
5. Astronomic Time: All channels.
6. Automatic daylight savings time changeover which can be locked out of operation for Arizona use.
7. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 INDOOR OCCUPANCY SENSORS (Vacancy Sensors)

A. Basis–of–Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bryant Electric; a Hubbell company.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D; a brand of Schneider Electric.
12. Watt Stopper.
13. Engineer approved equal.

B. General Requirements for Sensors: Wall– or ceiling–mounted, solid–state indoor occupancy sensors (vacancy sensors) with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights with switch and remain on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: 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. Sensor has 24–V dc, 150–mA, Class 2 power source, as defined by NFPA 70.
5. 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.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the “on” function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. Dual–Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is 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.

2.3 SWITCHBOX–MOUNTED OCCUPANCY/VACANCY SENSORS

A. Basis–of–Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bryant Electric; a Hubbell company.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Lutron Electronics Co., Inc.
8. NSI Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D; a brand of Schneider Electric.
12. Watt Stopper.
13. Engineer approved equal.


1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

C. Wall–Switch Sensor:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: Dual technology – PIR and ultrasonic.
3. Switch Type: SP, dual circuit, field selectable manual "on," automatic "off."
4. Voltage: Dual voltage, 120 and 277 V, dual-technology type.
5. Ambient–Light Override: Concealed, field–adjustable, light–level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor and switches lights off if .
6. Concealed, field–adjustable, "off" time–delay selector at up to 30 minutes.
7. Adaptive Technology: Self–adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote–Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low–Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded–copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low–Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded–copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low–Voltage Electrical Power Conductors and Cables."

PART 3 – EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling–mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire–suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Provide additional sensors where necessary.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low–Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power–limited and nonpower–limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
3.3 IDENTIFICATION
   A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
      1. Identify controlled circuits in lighting contactors.
      2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
   B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL
   A. Engage a trained individual to test and inspect components, assemblies, and equipment installations, including connections.
   B. Perform the following tests and inspections with the assistance of a factory–trained individual:
      1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
      2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   C. Lighting control devices will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING
   A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on–site assistance in adjusting sensors to suit actual occupied conditions. Provide a visit to Project during other–than–normal occupancy hours for this purpose.
      1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner’s operations.

3.6 DEMONSTRATION
   A. Coordinate demonstration of products specified in this Section with demonstration requirements for low–voltage, programmable lighting control systems.

END OF SECTION 260923
SECTION 262416

PANELBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch–circuit panelboards.
3. Load centers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time–current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log–log graph paper; include selectable ranges for each type of overcurrent protective device.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section “Operation and Maintenance Data,” include the following:

1. Manufacturer’s written instructions for testing and adjusting overcurrent protective devices.
2. Time–current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 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. Keys: Two spares for each type of panelboard cabinet lock.

1.6 QUALITY ASSURANCE
A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
D. Comply with NEMA PB 1.
E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 PROJECT CONDITIONS
A. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
      b. Altitude: Not exceeding 4300 feet (1300 m).
B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 4300 feet (1300 m).
1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor–bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace parts that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344.


1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.

2. Front: Secured to box with concealed trim clamps. For surface–mounted fronts, match box dimensions; for flush–mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Skirt for Surface–Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

6. Finishes:

a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer’s standard two–coat, baked–on finish consisting of prime coat and thermosetting topcoat.


C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:

2. Equipment Ground Bus: Adequate for feeder and branch–circuit equipment grounding conductors; bonded to box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.
   2. Main and Neutral Lugs: Mechanical type.
   3. Ground Lugs and Bus–Configured Terminators: Mechanical type.
   4. Feed–Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short–Circuit Current Rating: Rated for fully rated system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for fully rated short–circuit rating by an NRTL.

2.2 DISTRIBUTION PANELBOARDS

A. Basis–of–Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler–Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.
   5. Engineer approved equal.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault–type latch with tumbler lock; keyed alike.
   1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or lugs only.


2.3 LIGHTING AND APPLIANCE BRANCH–CIRCUIT PANELBOARDS

A. Basis–of–Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler–Hammer Business Unit.
4. Square D; a brand of Schneider Electric.
5. Engineer approved equal.

B. Panelboards: NEMA PB 1, lighting and appliance branch–circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt–on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Basis–of–Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler–Hammer Business Unit.
4. Square D; a brand of Schneider Electric.
5. Engineer approved equal.

B. Molded–Case Circuit Breaker (MCCB): Comply with UL 489, with full rating to meet available fault currents.

2. Electronic trip circuit breakers with rms sensing; field–replaceable rating plug or field–replicable electronic trip for breakers 200 A and larger; and the following field–adjustable settings:
   a. Instantaneous trip.
   b. Long– and short–time pickup levels.
   c. Long– and short–time time adjustments.
   d. Ground–fault pickup level, time delay, and I^2t response.

3. GFCI Circuit Breakers: Single– and two–pole configurations with Class A ground–fault protection (6–mA trip).

4. Molded–Case Circuit–Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; HACR for HVAC loads, etc.
   d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field–adjustable 0.1–
to 0.6–second time delay.
   e. Auxiliary Contacts: One SPDT switch with “a” and “b” contacts; “a” contacts mimic circuit–breaker contacts and “b” contacts operate in reverse of circuit–breaker contacts.
   f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
   g. Handle Padlocking Device: Fixed attachment, for locking circuit–breaker handle in on or off position.
2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: Install floor mounted panelboards on concrete bases, 4-inch (100–mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section “Cast-in-Place Concrete.”

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.


G. Install filler plates in unused spaces.
H. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner’s final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." Include “FED FROM....” Information on all nameplates.

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative or trained individual to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Engage a trained individual to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.
E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as required to coordinate with other overcurrent devices.

END OF SECTION 262416
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Wall–box motion sensors.
5. Communications outlets.
6. Cord and plug sets.

B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground–fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch–circuit conductor.

D. RFI: Radio–frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Receptacles, wall switches and motion sensors.

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: Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers’ Names: Shortened versions (shown in parentheses) of the following manufacturers’ names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device–Kellems (Hubbell).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5–20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper; 5351 (single), 5352 (duplex).
   b. Hubbell; HBL5351 (single), CR5352 (duplex).
   c. Leviton; 5891 (single), 5352 (duplex).
   d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5–20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

WIRING DEVICES
2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; GF20.
   b. Pass & Seymour; 2084.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber–insulated, stranded–copper conductors, with Type SOW–A jacket; with green–insulated grounding conductor and equipment–rating ampacity plus a minimum of 30 percent.

2.5 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
   b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
   c. Leviton; 1221–2 (single pole), 1222–2 (two pole), 1223–2 (three way), 1224–2 (four way).
   d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Key–Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; 2221L.
   b. Hubbell; HBL1221L.
c. Leviton; 1221-2L.
d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.6 VACANCY AND OCCUPANCY SENSORS

A. Wall-Switch Vacancy Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Hubbell.
   b. Leviton.
   c. Watt Stopper
d. Or engineer approved equal.

2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

2.7 RECEPTACLES IN PUBLIC AREAS SHALL BE TAMPERPROOF.

2.8 WALL PLATES

B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish. Tamper resistant where shown TR.
2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting; Smooth, high-impact thermoplastic, 0.035-inch– (1-mm–); thick, satin-finished stainless steel 0.04-inch– (1-mm–); thick, brushed brass with factory polymer finish 0.05-inch– (1.2-mm–); thick anodized aluminum 0.04-inch– (1-mm–); thick steel with chrome-plated finish.
3. Material for Unfinished Spaces: Galvanized steel; Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic; Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
5. Final selections shall be by Architect during submittals. Provide samples for Architects’ use.

C. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20–A circuits, splice No. 12 AWG pigtails for device connections.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal–to–metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra–deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section “Identification for Electrical Systems.”
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

2. Switches: Identify space being controlled with engraved lettering on face of plate. Provide panelboard and circuit number of circuit being switched.

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 5 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 262726
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers’ technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short–circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time–current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

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.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

   1. Manufacturer’s written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.8 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).
1.9 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler–Hammer Business Unit.
4. Square D; a brand of Schneider Electric.
5. Engineer approved equal.

B. Type GD, General Duty, Single Throw, 240–V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600–V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated 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. Lugs: Mechanical type, suitable for number, size, and conductor material.
4. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler–Hammer Business Unit.
4. Square D; a brand of Schneider Electric.
5. Engineer approved equal.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
C. Type HD, Heavy Duty, Single Throw, 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.

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. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
   4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall–mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section “Identification for Electrical Systems.”
   1. Identify field–installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated–plastic nameplate.
3.4 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 appropriate.

END OF SECTION 262816
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Interior solid-state luminaires that use LED technology
   2. Luminaire supports.
   3. Exit Signs.

1.3 SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
   5. Include photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each luminaire type.
      a. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers’ codes.
1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer’s laboratory is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Each led luminaire type shall be binned within a three–step MacAdam Ellipse to ensure color consistency among luminaires.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period LED Luminaires: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598.

E. Lamp base complying with ANSI C81.61.

F. Recessed Luminaires: Comply with NEMA LE 4.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

I. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

J. Recessed Fixtures: Comply with NEMA LE 4.

K. Bulb shape complying with ANSI C79.1.
L. CRI of minimum 80 CCT as indicated on the luminaire schedule.

M. Rated lamp life of 50,000 hours.

N. Lamps dimmable from 100 percent to 5 percent of maximum light output.

O. Internal drivers with plug connectors.

P. Lamp modules shall be field replaceable with plug connectors.

Q. Fixtures shall match Fixture Schedule shown on drawings or Engineer approved equal.

2.2 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit entry without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during entry and when secured in operating position.

C. Diffusers and Globes:
   1. Glass: Annealed crystal glass unless otherwise indicated.
   2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:
      a. “USE ONLY” and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI for all luminaires.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 0529 “Hangers and Supports for Electrical Systems” for channel and angle iron supports and nonmetallic channel and angle supports.
B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish shall match luminaire.


D. Rod Hangers: 3/16-inch minimum diameter, cadmium–plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking–type plug.

2.5 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Operating at nominal voltage of as indicated on the lighting fixture schedule.
   2. Lamps for AC Operation: Fluorescent, two for each luminaire; 20,000 hours of rated lamp life.
   3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
   4. Self–Powered Exit Signs (Battery Type): Internal emergency power unit.
   5. Master/Remote Sign Configurations:
      a. Master Unit: Comply with requirements above for self–powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
      b. Remote Unit: Comply with requirements above for self–powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

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 luminaire to verify actual locations of luminaire and electrical connections before fixture installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

3.3 INSTALLATION

A. Comply with NECA 1.
B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.

D. Supports:
   
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Ceiling–Grid–Mounted Luminaire Supports: Use grid as a support element.
   
   1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches from luminaire corners.
   2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
   3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
   4. Install at least two independent support rods or wires from structure to tabs on luminaire. Wires or rods shall have breaking strength of the luminaire weight at a safety factor of 3.

F. Flush–Mounted Luminaire Support:
   
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.

G. Wall–Mounted Luminaire Support:
   
   1. Attached to structural members in walls or Attached to a minimum 20 gauge backing plate attached to wall structural members or as required to support fixture weight.
   2. Do not attach luminaires directly to gypsum board.

H. Suspended Luminaire Support:
   
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod or cable supports for suspension for each unit length of luminaire chassis, including one at each end as recommended by the luminaire manufacture.
   4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Clean all dust, dirt and fingerprints from luminaire, reflectors, lens and finishes.
3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 “Identification for Electrical Systems.”

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

B. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

   1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Luminaire will be considered defective if it does not pass operation tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits if requested to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

   1. During adjustment visits, inspect all luminaires. Replace luminaires that are defective.

   2. Parts and supplies shall be manufacturer’s authorized replacement parts and supplies.

   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 5116
SECTION 28 3111
FIRE ALARM SYSTEM ADDITION

PART 1 – GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Design, furnish and install modifications and additions to the existing fire alarm system for the remodel with changes to the existing fire alarm and detection system as required to meet NFPA 72 and project requirements. The new system for the remodel must be fully compatible with the existing NAU fire alarm system.
   2. Furnish and install panels, devices, raceway, cable and conductors, boxes, and miscellaneous items necessary for complete system addition including changes to the existing fire alarm system.

B. Related Requirements:
   1. Division 26: Quality of and installation standards for wiring, raceway, conduit, and boxes.

1.2 REFERENCES

A. National Fire Protection Association:

B. Underwriters Laboratories:
   2. UL 268, ‘Smoke Detectors for Fire Alarm Systems’.
   5. UL 864, ‘Control Units and Accessories for Fire Alarm Systems’.

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Prepared by authorized factory representative and including:
         1) Single line diagram of actual system. Typical riser diagrams are not acceptable.
         2) Complete wiring diagrams.
         3) Manufacturer’s original catalog data and descriptive information on each piece of equipment to be used.
         4) Battery Calculations.
         5) Voltage drop calculations.
         6) Plan sheets showing final device and equipment locations.

B. Informational Submittals:
   1. Certificates:
      a. Certificate of completion, from Manufacturer’s Representative, in accordance with NFPA 72 requirements.

   2. Qualification Statement:
      a. Installer:
1) Provide NICET Certification documentation.

C. Closeout Submittals:
   1. Include following information in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
         2) Provide instruction manual from Manufacturer that explains what is to be done in event of various indications.
      b. Record Documentation:
         1) Include copy of approved shop drawings.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. System shall meet approval of authority having jurisdiction (AHJ). NEC and local ordinances and regulations shall govern unless more stringent requirements are specified.
   2. Equipment, devices, and cable shall be UL or Factory Mutual listed for use in fire alarm systems.

B. Qualifications:
   1. Installer:
      a. Project Forman or Person in Charge at all times to be NICET Level III Certified for work performed by this Section.
      b. Provide Certificate documentation before installation.

PART 2 – PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
   1. Type One Acceptable Manufacturers:
      a. Match existing system.

B. Performance:
   1. Design Criteria:
      a. Automatic fire alarm system consisting of control panel and/or control panel additions, power supplies, alarm initiating devices, notification appliances, and off–site communicating devices. System shall be non–coded and addressable (if that is compatible with existing system), and monitored for integrity of conductors.
      b. Class B initiating device circuits and Class B notification appliance circuits including end–of–line devices.
      c. Equipment and accessories furnished under this Specification shall be standard products of single manufacturer, or include written statement by Control Panel Manufacturer confirming compatibility of components and inclusion of these components under system warranty.
      d. Monitor all duct smoke detectors provided by others in this area.

C. Operation:
   1. Operation Sequences:
      a. Operation of manual station or automatic activation of any smoke detector, heat detector, or sprinkler flow device shall:
         1) Cause system notification appliances to operate.
         2) Indicate zone in alarm on control panel.
3) Initiate off-site alarm notification system.
4) Indicate zone or device in alarm on remote annunciator.

b. System shall return to normal when operated device is returned to normal and control panel is
manually reset, except alarms may be silenced as specified below.

c. Alarm may be silenced by switch in control panel.
   1) Ring Back Feature: When silenced, this shall not prevent the resounding of subsequent alarms
      if another zone should alarm.

d. When alarms are silenced, zone indicating red LEDs on control panel and remote annunciator shall
   remain indicated until operated device is returned to normal and control panel is manually reset.

e. Green pilot LED, or other visual annunciation, shall normally be on indicating that system is receiving
   normal power. In addition, failure of normal power shall be annunciated.

f. Trouble alarm and annunciation, operating together, shall signal trouble condition. Following
   conditions shall signal trouble condition:
   1) Failure of normal power.
   2) Opens or short circuits on indicating circuits.
   3) Disarrangements in system wiring.
   4) Control panel circuit board removal.
   5) Ground faults.
   6) Trouble silencing switch shall silence trouble alarm, but visual annunciation shall remain on
      until system is restored to normal. As ring-back feature, trouble alarm shall resound as
      reminder to return silencing switch to normal position.

g. Supervisory LED, separate from trouble LED, and alarm, operating together, shall signal operation of
   supervisory device. Alarm silence switch shall operate in same manner as trouble alarm.

D. Components:
   1. Control Panel – Existing, Upgrade as required.
   2. Off-Site Alarm Notification System – Existing, Upgrade as required.
   3. Alarm Initiating Devices to be added as required:
      a. Smoke Detectors:
         1) Photoelectric type.
         2) Listed under UL Standard 268.
         3) Provide visual indication of alarm on unit.
      b. Heat Detectors:
         1) Non-settable 135 deg F (57 deg C) fixed temperature.
         2) Provide visible indication that device has operated.
         3) Listed under UL Standard 521.
      c. Manual Fire Alarm Boxes:
         1) Non-coded and double-action requiring two actions to initiate alarm. Breakable glass type is
            not approved.
         2) Box shall mechanically latch when actuated and require key to reset. Key shall match control
            panel door lock.
         3) Provide STI-1200 clear polycarbonate covers.
   4. Notification Appliances to be added as required:
      a. Color: Match Existing
      b. Combination Horn / Strobe – Match existing:
         1) Wall mounted flush or semi-flush.
         2) Non-coded audible output of 90 dB minimum at 10 feet (3 meters).
         3) Integ rally mounted flashing light unit with block letters ‘FIRE.’ Minimum light intensity of 15
            candela and flash rate between one and three Hertz.
         4) Listed under UL Standards 464 and 1971.
      c. Strobe Only – Match Existing:
         1) Wall mounted flush or semi-flush.
         2) Integ rally mounted flashing light unit with block letters ‘FIRE.’ Adjustable light intensity of 15–
            110 candela and flash rate between one and three Hertz.
   5. Booster panels to be added as required.
PART 3 – EXECUTION

3.1 INSTALLATION

A. Install fire alarm and detection systems additions as required, in accordance with Equipment Manufacturer’s written instructions, and complying with applicable portions of NEC, NFPA, and NECA’s ‘Standard of Installation’.

1. Mounting Heights:
   a. Unless otherwise indicated, mount center of outlets or boxes at following heights above finish floor:
      1) Control Panel: 72 inches (1 800 mm) to top.
      2) Wall–Mounted Horn / Strobe: 80 inches (2 1032 mm). 6 inches (150 mm) below ceiling, whenever ceiling is below 80 inches (2 1032 mm).
      3) Wall–Mounted Strobe: 80 inches (2 1032 mm). 6 inches (150 mm) below ceiling, whenever ceiling is below 80 inches (2 1032 mm).
      4) Manual pull stations: 48 inches (1 200 mm).

2. Locate fire alarm manual stations 24 inches (600 mm) minimum away from any light switch.

B. Identification:

   1. Label zone indicators on control unit indicating location and type of initiating device, i.e., CORRIDOR SMOKE, FLOW SWITCH, AIR SYSTEM SMOKE, etc. Labels shall be engraved plastic laminate, or other permanent labeling system as supplied by Control Unit Manufacturer.
   2. Post copy of wire identification list additions inside fire alarm panel door or other area accessible to fire alarm service personnel.
   3. Print location of circuit disconnecting means inside panel.

C. Conductors:

   1. Install conductors in conduit.
   2. Fire alarm system conductors from different zones may be combined in common conduit. Make certain that raceway size and wire quantity, size, and type is suitable for equipment supplied and is within NEC standards. Label pull and junction boxes 'FIRE ALARM.'
   3. Install conductors and make connections to water flow switches and duct smoke detectors.
   4. Loop wires through each device on zone for proper supervision. Tee–taps not permitted.
   5. Minimum conductor size shall be 12 AWG unless otherwise specified.

D. Do not install ceiling mounted detectors within 36 inches (900 mm) of air discharge grilles. Do not install manual fire alarm boxes within 24 inches (610 mm) of light switches.

3.2 FIELD QUALITY CONTROL

A. Field Tests:

   1. Provide factory–trained representative to perform complete system testing in presence of Owner’s representative and local fire department personnel upon completion of installation.
      a. Test each initiating and annunciating device for proper operation, except fixed temperature heat detectors.
      b. Test operation of trouble annunciation on each circuit.
      c. Perform complete testing of control panel functions including off–site monitoring.

3.3 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:

   1. Instruct Owner’s Representative in proper operation and maintenance procedures.
3.4 PROTECTION

A. Provide dust protection for installed smoke detectors until ready for testing.

B. Protect conductors from cuts, abrasion and other damage during construction.

END OF SECTION