SPH Environmental Toxicology Labs

Project No. 206825
September 1, 2020

UNIVERSITY OF WASHINGTON
Capital Planning & Development

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BELLEVUE, WA 98006
206 965 0529

LAB PLANNING
THE ESTIME GROUP
P.O. Box 11712
Bainbridge Island, WA 98110-5712
206.428.3777

HAZARDOUS MATERIALS
PBS
214 EAST GALER ST, SUITE 300
SEATTLE, WA 98102
206 233 9639
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END OF SECTION
ADVERTISEMENT FOR BIDS

University of Washington
SPH Environmental Toxicology Labs, Project Number 206825
Date of Bid Opening: December 10, 2020
A/E’s estimate: $1,262,079

NOTICE TO CONTRACTORS:

Bid Submittal: Sealed bids will be received by the University of Washington Facilities, Project Delivery Group, at the University Facilities Building, Box 352205, ground floor, Seattle, WA 98195, on the University of Washington Seattle campus. A campus map can be found online at http://www.washington.edu/maps/. Seattle campus parking and traffic regulations and parking rates can be found online at http://www.washington.edu/facilities/transportation/. Bidders are responsible for all parking costs and for complying with parking regulations. Failure to comply with parking regulations may result in citation and possible impound of vehicle.

Bid Submittal: The University of Washington is taking precautions to limit exposure and impacts related to COVID-19. To comply with the Governor’s “Safe Start” plan, the requirement to submit a sealed bid is waived. Bids will be received by the University of Washington, Project Delivery Group, by email at PDGbids@uw.edu.

The Bid Form will be received up to 3:00 p.m. on December 10, 2020 Bids will then be publicly opened and read aloud. Bids received after the date and hour above stated will not receive consideration.
COVID Option: The Bid Form will be received up to 3:00 p.m. on December 10, 2020 Bids will then be publicly opened and read aloud via Zoom Version 5.0 (required) (Join Zoom Meeting https://washington.zoom.us/j/99532733425

Meeting ID: 995 3273 3425
One tap mobile
+12532158782,,99532733425# US (Tacoma)
+12063379723,,99532733425# US (Seattle)

Dial by your location
+1 253 215 8782 US (Tacoma)
+1 206 337 9723 US (Seattle)
+1 346 248 7799 US (Houston)
+1 602 753 0140 US (Phoenix)
+1 669 219 2599 US (San Jose)
+1 669 900 6833 US (San Jose)
+1 720 928 9299 US (Denver)
+1 971 247 1195 US (Portland)
+1 213 338 8477 US (Los Angeles)
+1 312 626 6799 US (Chicago)
+1 470 250 9358 US (Atlanta)
+1 470 381 2552 US (Atlanta)
+1 646 518 9805 US (New York)
+1 646 876 9923 US (New York)
+1 651 372 8299 US (St. Paul)
+1 786 635 1003 US (Miami)
+1 267 831 0333 US (Philadelphia)
+1 301 715 8592 US (Germantown)
Meeting ID: 995 3273 3425
Find your local number: https://washington.zoom.us/u/acRQ6hwaRb

Join by SIP
99532733425@zoomcrc.com

Bids received after the date and hour above stated will not receive consideration. Attendance in person is not allowed.

**Project Description:** The project includes the following work: Renovation of existing lab rooms 193, 194, 2299, 2297, and 2295, rooms 180, 198, 190, 191, and 196 in the Roosevelt Building located at 4245 Roosevelt Way NE. Work includes, but is not limited to, updating finishes, replacing ceilings, reconfiguration of lighting, partial removal and replacement of casework, relocation of hoods, and installation of partitions for auxiliary spaces in the labs. Work in the garage (room 180) includes installation of a fenced enclosure and movable storage racks. Work in rooms 190 and 198 includes reconfiguration of equipment and electrical modifications. Work in room 191 and 196 includes minor finish updates and installation of equipment and movable storage racks. The primary work area is 2,565 sf on the first floor and 2,800 sf on the second floor.

All construction operations must comply with the most current Covid 19 related rules and guidance from the Governor’s Office. All activities must also comply with all related and applicable requirements issued by the Washington State Department of Labor and Industries and Public Health Agencies having jurisdiction.

**Questions:** Questions about this project should be directed to:

A/E Name: MITHUN, Inc
Contact Person: Evan Bourquard, AIA
Phone Number: (206) 971 5636
Email: evanb@mithun.com

Pre-Bid Site Meeting: The Project site is available for inspection by prospective bidders at a pre-bid site meeting and walk-through at 9:00 AM on November 18, 2020 at the main entrance to the Roosevelt Building located at 4245 Roosevelt Way NE. Access to the project site is restricted. This will be the only opportunity for bidders to visit the Project site.

Bid Documents: Bidders may obtain or access plans, specifications, and addenda for this project at https://facilities.uw.edu/projects/business-opportunities/solicitations. Contractors who would like to be included on the Planholder's list shall either attend a pre-bid meeting or request to be added by emailing PDGbids@uw.edu.

Bid Guarantee: A surety company bid bond on a form acceptable to Owner, a cashier’s check or a certified check payable to the order of University of Washington, or cash, shall accompany each bid in an amount not less than five percent (5%) of the Base Bid. No bidder may withdraw its bid after the hour set for the opening thereof, unless the award of the contract is delayed for a period exceeding 60 days.

Apprentice Utilization: Mandatory apprentice utilization of at least 15% of the total labor hours worked on the contract is required. Apprentices must be registered as apprentices with the State Apprenticeship and Training Council. Bidders may contact the Department of Labor & Industries, Apprenticeship Program at 360-902-5320 to obtain information on apprenticeship programs. The Contract includes monetary incentives for meeting the goals, and monetary penalties for not meeting the goals.
BUSINESS EQUITY: The University of Washington is committed to providing optimal opportunity for participation in contracting by Business Equity Enterprises (BEE). The University of Washington defines a Business Equity Enterprise (BEE) as “any entity licensed to do business in the State of Washington, including a corporation, partnership, sole proprietorship, or other legal entity that meets any of the following:”


Lesbian/Gay/Bisexual/Transgender Business Enterprise (LGBTBE): More than 50% owned and controlled by at least one person who is a member of the LGBT community.

Minority Business Enterprise (MBE): More than 50% owned and controlled by at least one person who is a member of one or more of the following minority groups:

- Asian Pacific American
- Black American
- Hispanic American
- Native American
- Subcontinent Asian American

Minority Women’s Business Enterprise (MWBE): More than 50% owned and controlled by at least one woman who is a member of one or more of the above minority groups.

Small Business Enterprise (SBE): A business entity that:

- Can attest that it is owned and operated independently from all other businesses and
- Conforms to the U.S. Small Business Administration Size Standards of the North American Industry Classification System (NAICS) Codes in which it is to be engaged at the UW; or
- Is certified with the OMWBE.

Veteran’s Business Enterprise (VBE): Certified with the Washington State Department of Veteran’s Affairs (DVA)

Women’s Business Enterprise (WBE): More than 50% owned and controlled by one or more women. The University of Washington has determined that an overall aspirational goal of 20% Business Equity Enterprise (BEE) utilization, inclusive of 15% minority and women-owned business utilization, is practicable and attainable on this construction project; that goal is negotiable based upon the specialized nature of the work and the relative availability of BEE to perform the specific work scopes identified in this project. The University of Washington welcomes the participation of all BEE, irrespective of gross revenues, including those that are self-designated and those that are state (OMWBE) certified. Participation may be on a direct basis in response to this invitation to bid, or as a subcontractor or supplier.

Safety Plans: Prior to the issuance of the Notice to Proceed, the Contractor will be required to submit to the Owner a copy of its company safety program. See Modifications to the General Conditions, Part 5 for details.

The Owner reserves the right to reject any or all bids and to waive as an informality any irregularities in the bids received.

Date(s) of Publication: November 10, 2020

END OF SECTION
1. CONTRACTOR'S REGISTRATION

   All bidders must be registered by the Washington State Department of Labor and Industries in accordance with R.C.W. 18.27.020.

2. SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK

   A. Bidder acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the Work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the Work or its cost.

   B. The Project site is available for inspection for prospective bidders at a pre-bid site meeting and walk-through, as indicated in the Advertisement for Bids, and existing conditions should be examined. This will be the only opportunity for bidders to visit the project site.

   C. Bidder acknowledges that it has satisfied itself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by Owner, as well as from the drawings and specifications made a part of these Contract Documents.

   D. Bidder acknowledges that adjoining areas will be conducting normal operations during the work. Bidder should anticipate pedestrian and traffic congestion, limited parking, and the requirement that the work be coordinated with ongoing operations.

   E. Bidder acknowledges that its bid is based upon a schedule and assumptions which incorporate these conditions.

   F. Owner assumes no responsibility for any conclusions or interpretations made by bidder based on the information made available by Owner. Should a bidder find discrepancies or omissions in the drawings or specifications, or should bidder be in doubt as to their meaning, bidder shall at once notify the Owner. If appropriate, Owner will send written instructions to all bidders by addenda. Questions received less than 10 days before the time of bid opening may not be answered. All addenda issued shall be incorporated into these Contract Documents.

3. PREPARATION OF BIDS

   Bidder shall comply with the following instructions in preparing its bid.

   A. The name, address, and Contractor's license number of bidder shall be typed or printed on the bid in the space provided. The name must match the name on the bid guarantee.

   Bids must be (1) submitted on the forms furnished by Owner or on copies of those forms, and (2) manually signed in ink.

   B. Bidders shall submit bids in the format provided in the Bid Form. Only the amounts and information asked for in the Bid Form furnished will be considered as the bid. All blank spaces must be filled in.

   C. Bidder shall bid upon all alternates indicated in the Bid Form. When bidding on alternates for which there is no charge, bidder shall write the words "No Charge" in the space provided on the Bid Form. If a bidder fails to bid an alternate, or notes "no bid," it will be construed as meaning that there will be no change in the Contract Sum and that the alternate is included in the Contract Sum. Alternate bids will not be considered unless requested in the Bid Form.
D. Bidder shall submit with within one hour of the published bid submittal time, Part II of its Bid Form, the names of the subcontractors with whom the bidder, if awarded the contract, will subcontract for performance of the work of heating, ventilation and air conditioning, plumbing as described in chapter 18.106 RCW, and electrical as described in chapter 19.28 RCW, or to name itself for the work; or within 48 hours after the published bid submittal time, the names of the subcontractors with whom the bidder, if awarded the contract, will subcontract for the work of structural steel installation and rebar installation. The Bidder shall not list more than one subcontractor for each category of work identified, unless subcontractors vary with bid alternates, in which case the bidder must indicate which subcontractor will be used for which alternate. Failure of the bidder to submit as part of the bid the names of such subcontractors or to name itself to perform such work or the naming of two or more subcontractors to perform the same work shall render the bidder's bid nonresponsive and, therefore, void. The requirement of this section to name the bidders’ proposed heating, ventilation and air conditioning, plumbing and electrical subcontractors applies only to proposed heating, ventilation and air conditioning, plumbing, and electrical subcontractors who will contract directly with the Bidder.

E. The cost of trench safety systems for trench excavation that exceeds a depth of four feet must be identified as a lump sum amount on the Bid Form as well as included in the Base Bid amount. The costs of trench safety systems shall not be considered as incidental to any other contract item, and any attempt to include the trench safety systems as an incidental cost is prohibited. Identification of this amount is an acknowledgment that the bidder has considered proper safety provisions in the estimate but does not relieve the bidder of responsibility for full compliance with all laws and statutes regardless of their actual cost. If this project will involve trench excavation in excess of a depth of four feet, bidder must include a lump sum dollar amount. "N/A" and ‘zero” are not responsive.

F. Bidders shall acknowledge all addenda by identifying the addendum number(s) in the space provided on the Bid Form. Notwithstanding any automatic notification methods utilized by Bidder, Bidder is responsible for checking Owner’s bid posting website for any addenda issued up to and until the bid opening date and time specified in Section 00 11 00.

G. Bidder shall include in the bid all allowances provided in the Bid Form. Owner will pay the difference if the actual cost exceeds the allowance.

4. TAXES

The bid shall include all taxes imposed by law except Washington State Sales Tax. Sales tax shall not be included in the bid price, except that the retail sales tax upon sales and rentals to prime contractors and subcontractors of tools, equipment, and material primarily for use by the Contractor rather than for resale as a component part of the finished structure, shall be included in the bid price. A proportionate amount of State sales tax will be added to each progress payment, collected from Owner, and paid to the State by Contractor.

5. BID GUARANTEE

Bidder shall furnish a bid guarantee in the form of a firm commitment, such as bid bond, postal money order, cash or cashier's check payable to Owner, in the amount of at least 5% of the base bid. Owner reserves the right to hold the bid guarantees of all bidders until the successful bidder has entered into the contract and furnished the required bonds and insurance certificates, or for a period of 60 days, whichever is the shorter time.
6. FILING FEES

Applicable state laws concerning prevailing wages, hours, workers' compensation and other conditions of employment are called to the attention of bidders for their compliance. Bidder shall include in the bid any filing fees required to comply with applicable labor laws.

7. SPECIFIED PRODUCTS

Bids must be based upon use of items named in the specifications, or approved equals or substitutions. In certain cases, specific items have been named because of operational or maintenance considerations; approval of equals or substitutions should not be assumed.

Requests for approval of equals or substitutions must be made in writing and received by the A/E at least 10 days prior to the date of bid opening. Said request must include complete descriptions, technical data, and performance records. Any approval of the proposed equal or substitution will be made by addendum issued to all bidders. See Section 01 25 00, Substitution Procedures, for instructions.

8. SUBMISSION AND WITHDRAWAL OF BIDS

A. Bids and bid modifications shall be submitted in sealed envelopes or packages (1) addressed to the office specified in the advertisement for bids and (2) showing the project title, bid opening date and time, and the name and address of bidder.

B. Part I of the Bid Form may be modified if in writing and received prior to the deadline for submittal of Part I. Part II of the Bid Form may be modified if in writing and received prior to the deadline for submittal of Part II.

C. Receipt of bids and bid modifications by telegraph, facsimile, telephone, or orally will not be considered.

D. A bidder may withdraw its bid by submitting a written request before the bid opening time. Owner will return the bid unopened after Contract award.

9. LATE SUBMISSIONS

A. Any bid, bid modification or request to withdraw a bid which is received after the deadlines set forth herein will not be considered.

B. The only acceptable evidence to establish the time of receipt at the office designated in the advertisement for bid is the time/date stamped or printed by Owner on the bid wrapper or other documentary evidence of receipt maintained by Owner.

10. BID EVALUATION

Bids which are incomplete, or which are conditioned in any way, or which contain erasures, alterations, or items not called for in the Bid Form, or which are not in conformity with the law or with these Instructions, shall be rejected as nonresponsive if the irregularity is material and may be rejected as nonresponsive if the irregularity is not material. Failure to submit either Part I or Part II of the Bid Form within the allotted times as described in the Advertisement for Bid, Section 00 11 00, shall render the entire bid nonresponsive.
If the bid includes a supplemental schedule of unit prices for labor and materials, or other items for the purpose of establishing a cost basis for unforeseen contract changes, Owner reserves the right to reject, without impairing the balance of the bid, any or all such predetermined unit prices.

Owner reserves the right to reject any or all bids and to waive any informalities or nonmaterial irregularities in the bids received.

The determination of the low responsive bid shall be made by Owner based upon any combination of the base bid and alternates which, in Owner's sole discretion, is in Owner's best interest considering price, schedule and other factors. The numbering of the alternates in the Bid Form bears no relationship to the order in which the alternates may be selected by Owner.

In accordance with RCW 39.04.380, for a public works bid received from a nonresident contractor from a state that provides an in-state percentage bidding preference, a Comparable Percentage Disadvantage (CPD) will be applied to the bid of that nonresident contractor. The CPD is the percent advantage provided by the nonresident contractor’s home state. For the purpose of determining the successful bidder, Owner will multiply the nonresident contractor bid amount by the CPD. The “bid amount” shall be the total of the base bid and all accepted alternate bid items. The CPD shall be added to the nonresident contractor bid amount to establish the Nonresident Disadvantage Total. The Nonresident Disadvantage Total shall be compared to the Washington state contractor bid amounts.

See example below:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska Nonresident Contractor Bid Amount</td>
<td>$100,000</td>
</tr>
<tr>
<td>Multiplied by the Alaska CPD</td>
<td>x 0.05</td>
</tr>
<tr>
<td>Alaska CPD Total</td>
<td>$ 5,000</td>
</tr>
<tr>
<td>Alaska Nonresident Contractor Bid Amount</td>
<td>$100,000</td>
</tr>
<tr>
<td>Alaska CPD Total</td>
<td>+ $5,000</td>
</tr>
<tr>
<td>Nonresident Disadvantage Total</td>
<td>$105,000</td>
</tr>
</tbody>
</table>

If the Nonresident Disadvantage Total is lower than all other Washington contractor bid amounts, the Alaska nonresident contractor is the low bidder and will be awarded a contract for the bid amount of $100,000, provided that they are determined to be a responsive and responsible bidder.

If the Nonresident Disadvantage Total is higher than a Washington contractor bid amount, the Washington bidder will be awarded a contract for the bid amount, provided that they are determined to be a responsive and responsible bidder.

11. LOW RESPONSIBLE BIDDER

A. It is the intent of Owner to award a contract to the low responsible bidder. Before award, the bidder must meet the following bidder responsibility criteria to be considered a responsible bidder. The bidder may be required by the Owner to submit documentation demonstrating compliance with the criteria. The bidder must:

1. Have a current certificate of registration in compliance with chapter 18.27 RCW, which must have been in effect at the time of bid submittal.
2. Have a current Washington Unified Business Identifier (UBI) number.
3. If applicable:
   a. Have Industrial Insurance (workers’ compensation) coverage for the bidder’s employees working in Washington, as required in Title 51 RCW;
b.  Have a Washington Employment Security Department number, as required in Title 50 RCW;

c.  Have a Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW.

4.  Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065(3).

5.  If applicable, provide evidence of the required contractor training from Washington State Department of Labor & Industry. Chapter 39.04.350 and 39.06.020 RCW.

6.  Within the three-year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the Washington Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of Chapter 49.46, 49.48, or 49.52 RCW.

B.  In addition to the bidder responsibility criteria above, the bidder must also meet the following relevant supplemental bidder responsibility criteria applicable to the project:

1.  Performance Evaluations: The Bidder shall not have received one or more overall evaluations of “Deficient” or “Inadequate” as part of the Owner’s Contractor Performance Evaluation Program.

2.  Debarment by Owner: The Bidder shall not be currently debarred by the Owner from contracting with the Owner for having received overall evaluations of their performance of “Deficient” or “Inadequate” on three or more projects of the Owner physically completed during the preceding five (5) year period.

C.  As evidence that the bidder meets the bidder responsibility criteria in paragraph B above, the apparent low bidder must submit documentation as may be required below to the Owner within 48 hours of the bid submittal deadline. The Owner reserves the right to request such documentation from other bidders also.

1.  Performance Evaluations: The Owner shall use its own records of the Bidder’s Performance Evaluation Reports on previous projects to evaluate the Bidder’s compliance with this criterion. The bidder is not required to submit any documentation for this item, unless the bidder has information different from the Owner’s records.

2.  Debarment by Owner: The Owner shall use its own records of debarment to evaluate the Bidder’s compliance with this criterion. The bidder is not required to submit any documentation for this item, unless the bidder has information different from the Owner’s records.

D.  If the Owner determines the bidder does not meet the bidder responsibility criteria in paragraph B above and is therefore not a responsible bidder, the Owner shall notify the bidder in writing with the reasons for its determination. If the bidder disagrees with this determination, it may appeal the determination within 24 hours of receipt of the Owner’s determination by presenting additional information to the Owner. The Owner will consider the additional information before issuing its final determination. If the final determination affirms that the bidder is not responsible, the Owner will not execute a contract with any other bidder until two business days after the bidder determined to be not responsible has received the final determination.
12. CONTRACT AWARD AND EXECUTION

The formal acceptance by the Owner of the lowest responsive bid of a responsible bidder will be in the form of a notice of award of public works contract issued by the Owner to the bidder. Within 7 days of the notice of award date, bidder shall submit an executed Contract (see Appendix A); certificate of insurance and endorsements as required in the Contract Documents; and Payment and Performance Bonds using AIA Document A312, most current edition, or other form acceptable to Owner, in Contract Award Amount plus Washington State Sales Tax. If the successful bidder, after award of the Contract, fails to execute all Contract Documents or provide insurance documentation and bonds as required within the time specified, Owner may revoke award of the Contract and the bid guarantee may be retained by Owner.

END OF SECTION
BID FORM

- **PART I:** (To be submitted no later than 2:00 p.m. on the bid submittal date indicated in Section 00 11 00).

**TO:** Board of Regents  
University of Washington  
Seattle, Washington 98195

The undersigned Bidder submits the following bid:

**BASE BID:**

Pursuant to and in compliance with the Contract Documents, including the Advertisement for Bids and Instructions for Bidders, the Bidder hereby certifies that it has carefully examined the Contract Documents entitled:

SPH Environmental Toxicology Labs, Project Number 206825

Prepared by MITHUN, Inc

and the conditions affecting the Work, and being familiar with the site; and having made the necessary examinations, proposes to furnish all labor, materials, equipment, and services necessary to complete the Work in strict accordance with the Contract Documents for the above-named project for the following sum, which is hereby designated as the Base Bid:

<table>
<thead>
<tr>
<th>Base Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
</tr>
</tbody>
</table>

**SALES TAX:**

None of the sums stated in the foregoing include Washington State Sales Tax, except as designated in Article 4 of the Instructions for Bidders.

**TIME OF COMPLETION AND LIQUIDATED DAMAGES:**

The undersigned Bidder agrees, if awarded the Contract, to complete the Work of the Contract within the number of calendar days specified in Supplemental Conditions, Section 00 73 00, and also agrees to the amounts specified for Liquidated Damages. It is further agreed that the time for completion of the Work described herein is a reasonable time considering the average climatic range and usual industrial conditions prevailing in the locality.
TRENCH EXCAVATION SAFETY PROVISIONS:

If the Contract Documents contain any work which requires trenching exceeding a depth of four feet, all costs for adequate trench safety systems shall be identified as a separate bid item in compliance with Chapter 39.04 RCW and WAC 296-155-650. The purpose of this provision is to ensure that the Bidder agrees to comply with all the relevant trench safety requirements of Chapter 49.17 RCW. This bid amount shall be considered as part of the Base Bid set forth above. Bidder must include a lump sum dollar amount in blank below (even if the value is $0.00) to be responsive.

Trench Excavation Safety Provisions Only: N/A

CONTRACT AND BONDS:

If the Owner awards a contract based on this bid within sixty (60) days of the bid submittal deadline, the Bidder agrees to execute a contract for the above work, for compensation computed from the above stated sums, on the University of Washington Public Works Contract form, and to furnish Payment and Performance Bonds and acceptable evidence of insurance as required by the Contract Documents.

BID GUARANTEE:

Pursuant to paragraph 5 of the Instruction to Bidders, Section 00 21 00, Bidder hereby certifies that it has furnished a bid guarantee for no less than 5% of the base bid, and that such guarantee accompanies this Bid Form.

The successful bidder shall submit an executed Contract, Payment and Performance Bonds, and acceptable evidence of insurance within seven (7) days after receipt of award notice and Public Works Contract form from the Owner. If the successful bidder, upon award of a contract by the Owner, fails to execute the Public Works Contract or submit the Payment and Performance Bonds and acceptable evidence of insurance as required within the time specified, Owner may revoke the award. Should the successful bidder fail to enter into a contract with Owner, the bid guarantee may be retained by Owner as liquidated damages, not as a penalty.

If a contract is not awarded within sixty (60) days after the bid submittal deadline, or if the bidder delivers a signed Public Works Contract, Payment and Performance Bonds, and acceptable evidence of insurance, then the certified or cashier’s check or cash submitted as the bid guarantee shall be returned to the bidder, or the Bid Bond shall become void.
<table>
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<tr>
<th>Bidder's Business Name:</th>
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</thead>
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<tr>
<td><strong>Type of Business:</strong></td>
</tr>
<tr>
<td>☐ Sole Proprietorship  ☐ Partnership  ☐ Corporation (State of Incorporation:___)  ☐ Other</td>
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<tr>
<td><strong>Physical Business Address (Must not be a P.O. Box):</strong></td>
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<tr>
<td>City:</td>
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<tr>
<td><strong>Business Telephone Number:</strong></td>
</tr>
<tr>
<td><strong>State of Washington numbers for the following:</strong></td>
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<tr>
<td>Contractor Registration No.:</td>
</tr>
<tr>
<td>Receipt is hereby acknowledged of Addenda No(s).: _____   _____   _____   _____   _____   _____   _____</td>
</tr>
<tr>
<td>Bidder is in compliance with the responsible bidder criteria requirement of RCW 39.04.350(1)(g).</td>
</tr>
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</table>

**OFFICIAL AUTHORIZED TO SIGN FOR BIDDER:**

"I certify (or declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct":

<table>
<thead>
<tr>
<th>Signature:</th>
<th>Date:</th>
</tr>
</thead>
</table>

| Print Name and Title | Location or Place Executed: (City, State) |
BID FORM:

- **PART II:** (To be submitted no later than 3:00 p.m. on the bid submittal date indicated in Section 00 11 00).

Bidder’s Business Name: ____________________________________________________________

A. Heating, Ventilation and Air Conditioning (HVAC), Plumbing, Electrical, Structural Steel Installation, and Rebar Installation subcontractors

List here the names of the subcontractors with whom the Bidder, if awarded the contract, will subcontract for performance of the work of HVAC, plumbing (as described in chapter 18.106 RCW) and electrical (as described in chapter 19.28 RCW), structural steel installation, rebar installation, or to name itself for the work. Substitution of any listed subcontractor may only be according to the procedure and parameters set forth in RCW 39.30.060.

**Subcontractor Name** | **Work To Be Performed**
--- | ---
________________________ | Electrical
________________________ | Plumbing
________________________ | HVAC
________________________ | Structural Steel Installation
________________________ | Rebar Installation

B. Structural Steel Installation and Rebar Installation subcontractors.

RCW 39.30.060.1.b, allows for the bidder to submit within forty-eight hours of the published bid submittal time, the names of the subcontractors with whom the Bidder will subcontract for the performance of the work of structural steel installation and rebar installation. Please indicate whether bidder intends to submit the names of subcontractors for the structural steel installation and rebar installation along with the , or will submit within forty-eight hours. 

Bidder has included subcontractor names for structural steel installation and rebar installation on this form

☐ Yes ☐ No

Bidder intends to submit subcontractor names for structural steel installation and rebar installation within forty-eight hours of the bid submittal date and time as indicated in Section 00 11 00. Failure of the bidder to submit subcontractor names within the time-frame will render the bidder’s bid nonresponsive and void.

☐ Yes ☐ No

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PART 1 – GENERAL PROVISIONS

1.01 DEFINITIONS

A. “Application for Payment” means a written request submitted by Contractor to A/E for payment of Work completed in accordance with the Contract Documents and approved Schedule of Values, supported by such substantiating data as Owner or A/E may require.

B. “Architect,” “Engineer,” or “A/E” means a person or entity lawfully entitled to practice architecture or engineering, representing Owner within the limits of its delegated authority.

C. “Change Order” means a written instrument signed by Owner and Contractor stating their agreement upon all of the following: (1) a change in the Work; (2) the amount of the adjustment in the Contract Sum, if any, and (3) the extent of the adjustment in the Contract Time, if any.

D. “Claim” means Contractor’s exclusive remedy for resolving disputes with Owner regarding the terms of a Change Order or a request for equitable adjustment, as more fully set forth in Part 8.

E. “Contract Award Amount” is the sum of the Base Bid and any accepted Alternates.

F. “Contract Documents” means the Advertisement for Bids, Instructions for Bidders, completed Bid Form, General Conditions, Modifications to the General Conditions, Supplemental Conditions, Public Works Contract, other Special Forms, Drawings and Specifications, and all addenda and modifications thereof.

G. “Contract Sum” is the total amount payable by Owner to Contractor, for performance of the Work in accordance with the Contract Documents, including all taxes imposed by law and properly chargeable to the Work, except Washington State sales tax.

H. “Contract Time” is the number of calendar days allotted in the Contract Documents for achieving Substantial Completion of the Work.

I. “Contractor” means the person or entity who has agreed with Owner to perform the Work in accordance with the Contract Documents.

J. “Day(s); Unless otherwise specified, day(s) shall mean calendar day(s).”

K. “Drawings” are the graphic and pictorial portions of the Contract Documents showing the design, location, and dimensions of the Work, and may include plans, elevations, sections, details, schedules, and diagrams.

L. “Final Acceptance” means the written acceptance issued to Contractor by Owner after Contractor has completed the requirements of the Contract Documents, as more fully set forth in Section 6.09 B.

M. “Final Completion” means that the Work is fully and finally complete in accordance with the Contract Documents, as more fully set forth in Section 6.09 A.

N. “Force Majeure” means those acts entitling Contractor to request an equitable adjustment in the Contract Time, as more fully set forth in paragraph 3.05A.

O. “Notice” means a written notice which has been delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended or, if delivered or sent by registered or certified mail, to the last business address known to the party giving notice.
P. “Notice to Proceed” means a notice from Owner to Contractor that defines the date on which the Contract Time begins to run.

Q. “Owner” means the state agency, institution, or its authorized representative with the authority to enter into, administer, and/or terminate the Work in accordance with the Contract Documents and make related determinations and findings.

R. “Person” means a corporation, partnership, business association of any kind, trust, company, or individual.

S. “Prior Occupancy” means Owner’s use of all or parts of the Project before Substantial Completion, as more fully set forth in Section 6.08 A.

T. “Progress Schedule” means a schedule of the Work, in a form satisfactory to Owner, as further set forth in Section 3.02.

U. “Project” means the total construction of which the Work performed in accordance with the Contract Documents may be the whole or a part and which may include construction by Owner or by separate contractors.

V. “Project Record” means the separate set of Drawings and Specifications as further set forth in paragraph 4.02A.

W. “Schedule of Values” means a written breakdown allocating the total Contract Sum to each principal category of Work, in such detail as requested by Owner.

X. “Specifications” are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work, and performance of related services.

Y. “Subcontract” means a contract entered into by Subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind for or in connection with the Work.

Z. “Subcontractor” means any person, other than Contractor, who agrees to furnish or furnishes any supplies, materials, equipment, or services of any kind in connection with the Work.

AA. “Substantial Completion” means that stage in the progress of the Work when the construction is sufficiently complete, as more fully set forth in Section 6.07.

AB. “Work” means the construction and services required by the Contract Documents, and includes, but is not limited to, labor, materials, supplies, equipment, services, permits, and the manufacture and fabrication of components, performed, furnished, or provided in accordance with the Contract Documents.

1.02 ORDER OF PRECEDENCE

Any conflict or inconsistency in the Contract Documents shall be resolved by giving the documents precedence in the following order:

1. Signed Public Works Contract, including any Change Orders.

2. Supplemental Conditions.

3. Modifications to the General Conditions.

4. General Conditions.
5. Specifications. Provisions in Division 1 shall take precedence over provisions of any other Division.

6. Drawings. In case of conflict within the Drawings, large scale drawings shall take precedence over small scale drawings.

7. Signed and Completed Bid Form.

8. Instructions to Bidders.

9. Advertisement for Bids.

1.03 EXECUTION AND INTENT

Contractor Representations: Contractor makes the following representations to Owner:

1. Contract Sum reasonable: The Contract Sum is reasonable compensation for the Work and the Contract Time is adequate for the performance of the Work, as represented by the Contract Documents;

2. Contractor familiar with project: Contractor has carefully reviewed the Contract Documents, visited and examined the Project site, become familiar with the local conditions in which the Work is to be performed, and satisfied itself as to the nature, location, character, quality and quantity of the Work, the labor, materials, equipment, goods, supplies, work, services and other items to be furnished and all other requirements of the Contract Documents, as well as the surface and subsurface conditions and other matters that may be encountered at the Project site or affect performance of the Work or the cost or difficulty thereof;

3. Contractor financially capable: Contractor is financially solvent, able to pay its debts as they mature, and possesses sufficient working capital to complete the Work and perform Contractor’s obligations required by the Contract Documents; and

4. Contractor can complete Work: Contractor is able to furnish the plant, tools, materials, supplies, equipment and labor required to complete the Work and perform the obligations required by the Contract Documents and has sufficient experience and competence to do so.

PART 2 – INSURANCE AND BONDS

2.01 CONTRACTOR’S LIABILITY INSURANCE

General insurance requirements: Prior to commencement of the Work, Contractor shall obtain all the insurance required by the Contract Documents and provide evidence satisfactory to Owner that such insurance has been procured. Review of the Contractor’s insurance by Owner shall not relieve or decrease the liability of Contractor. Companies writing the insurance to be obtained by this part shall be licensed to do business under Chapter 48 RCW or comply with the Surplus Lines Law of the State of Washington. Contractor shall include in its bid the cost of all insurance and bond costs required to complete the base bid work and accepted alternates. Insurance carriers providing insurance in accordance with the Contract Documents shall be acceptable to Owner, and its A.M. Best rating shall be indicated on the insurance certificates.

A. Term of insurance coverage: Contractor shall maintain the following insurance coverage during the Work and for one year after Final Acceptance. Contractor shall also maintain the following insurance coverage during the performance of any corrective Work required by Section 5.16.
1. **General Liability Insurance:** Commercial General Liability (CGL) on an Occurrence Form. Coverage shall include, but not be limited to:
   a. Completed operations/products liability;
   b. Explosion, collapse, and underground; and
   c. Employer’s liability coverage.

2. **Automobile Liability Insurance:**

B. **Industrial Insurance compliance:** Contractor shall comply with the Washington State Industrial Insurance Act and, if applicable, the Federal Longshoremen's and Harbor Workers' Act and the Jones Act.

C. **Insurance to protect for the following:** All insurance coverages shall protect against claims for damages for personal and bodily injury or death, as well as claims for property damage, which may arise from operations in connection with the Work whether such operations are by Contractor or any Subcontractor.

D. **Owner as Additional Insured:** All insurance coverages shall be endorsed to include Owner as an additional named insured for Work performed in accordance with the Contract Documents, and all insurance certificates shall evidence the Owner as an additional insured.

### 2.02 COVERAGE LIMITS

**Insurance amounts:** The coverage limits shall be as follows:

A. Limits of Liability shall not be less than $1,000,000 Combined Single Limit for Bodily Injury and Property Damage (other than Automobile Liability) Each Occurrence; Personal Injury and Advertising Liability Each Occurrence.

B. $2,000,000 Combined Single Limit Annual General Aggregate.

C. $2,000,000 Annual Aggregate for Products and Completed Operations Liability.

D. $1,000,000 Combined Single Limit for Automobile Bodily Injury and Property Damage Liability, Each Accident or Loss.

### 2.03 INSURANCE COVERAGE CERTIFICATES

A. **Certificate required:** Prior to commencement of the Work, Contractor shall furnish to Owner a completed certificate of insurance coverage.

B. **List Project info:** All insurance certificates shall name Owner’s Project number and Project title.

C. **Cancellation provisions:** All insurance certificates shall specifically require 45 Days prior notice to Owner of cancellation or any material change, except 30 Days for surplus line insurance.

### 2.04 PAYMENT AND PERFORMANCE BONDS

**Conditions for bonds:** Payment and performance bonds for 100% of the Contract Award Amount, plus state sales tax, shall be furnished for the Work, using the Payment Bond and Performance Bond form published by and available from the American Institute of Architects (AIA) – form A312. Prior to execution of a Change Order that, cumulatively with previous Change Orders, increases the Contract Award Amount by 15% or more, the Contractor shall provide either new payment and performance bonds for the
revised Contract Sum, or riders to the existing payment and performance bonds increasing the amount of
the bonds. The Contractor shall likewise provide additional bonds or riders when subsequent Change
Orders increase the Contract Sum by 15% or more. No payment or performance bond is required if the
Contract Sum is $35,000 or less and Contractor agrees that Owner may, in lieu of the bond, retain 50% of
the Contract Sum for the period allowed by RCW 39.08.010.

2.05 ALTERNATIVE SURETY

When alternative surety required: Contractor shall promptly furnish payment and performance bonds
from an alternative surety as required to protect Owner and persons supplying labor or materials required
by the Contract Documents if:

A. Owner has a reasonable objection to the surety; or
B. Any surety fails to furnish reports on its financial condition if required by Owner.

2.06 BUILDER’S RISK

A. Contractor to buy Property Insurance: Contractor shall purchase and maintain property insurance
in the amount of the Contract Sum including all Change Orders for the Work on a replacement
cost basis until Substantial Completion. For projects not involving New Building Construction,
“Installation Floater” is an acceptable substitute for the Builder’s Risk Insurance. The insurance
shall cover the interest of Owner, Contractor, and any Subcontractors, as their interests may
appear.

B. Losses covered: Contractor property insurance shall be placed on an “all risk” basis and insure
against the perils of fire and extended coverage and physical loss or damage including theft,
vandalism, malicious mischief, collapse, false work, temporary buildings, debris removal including
demolition occasioned by enforcement of any applicable legal requirements, and shall cover
reasonable compensation for A/E’s services and expenses required as a result of an insured loss.

C. Waiver of subrogation rights: Owner and Contractor waive all subrogation rights against each
other, any Subcontractors, A/E, A/E’s subconsultants, separate contractors described in
Section 5.20, if any, and any of their subcontractors, for damages caused by fire or other perils to the
extent covered by property insurance obtained pursuant to this section or other property
insurance applicable to the Work, except such rights as they have to proceeds of such insurance
held by Owner as fiduciary. The policies shall provide such waivers of subrogation by
endorsement or otherwise. A waiver of subrogation shall be effective to a person or entity even
though that person or entity would otherwise have a duty of indemnification, contractual or
otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person
or entity had an insurable interest in the property damaged.

PART 3 – TIME AND SCHEDULE

3.01 PROGRESS AND COMPLETION

Contractor to meet schedule: Contractor shall diligently prosecute the Work, with adequate forces,
achieve Substantial Completion within the Contract Time, and achieve Final Completion within a
reasonable period thereafter.

3.02 CONSTRUCTION SCHEDULE

A. Preliminary Progress Schedule: Unless otherwise provided in Division 1, Contractor shall, within
14 Days after issuance of the Notice to Proceed, submit a preliminary Progress Schedule. The
Progress Schedule shall show the sequence in which Contractor proposes to perform the Work,
and the dates on which Contractor plans to start and finish major portions of the Work, including dates for shop drawings and other submittals, and for acquiring materials and equipment.

B. **Form of Progress Schedule:** Unless otherwise provided in Division 1, the Progress Schedule shall be in the form of a bar chart, or a critical path method analysis, as specified by Owner. The preliminary Progress Schedule may be general, showing the major portions of the Work, with a more detailed Progress Schedule submitted as directed by Owner.

C. **Owner comments on Progress Schedule:** Owner shall return comments on the preliminary Progress Schedule to Contractor within 14 Days of receipt. Review by Owner of Contractor’s schedule does not constitute an approval or acceptance of Contractor’s construction means, methods, or sequencing, or its ability to complete the Work within the Contract Time. Contractor shall revise and resubmit its schedule, as necessary. Owner may withhold a portion of progress payments until a Progress Schedule has been submitted which meets the requirements of this section.

D. **Monthly updates and compliance with Progress Schedule:** Contractor shall utilize and comply with the Progress Schedule. On a monthly basis, or as otherwise directed by Owner, Contractor shall submit an updated Progress Schedule at its own expense to Owner indicating actual progress. If, in the opinion of Owner, Contractor is not in conformance with the Progress Schedule for reasons other than acts of Force Majeure as identified in Section 3.05, Contractor shall take such steps as are necessary to bring the actual completion dates of its work activities into conformance with the Progress Schedule, and if directed by Owner, Contractor shall submit a corrective action plan or revise the Progress Schedule to reconcile with the actual progress of the Work.

E. **Contractor to notify Owner of delays:** Contractor shall promptly notify Owner in writing of any actual or anticipated event which is delaying or could delay achievement of any milestone or performance of any critical path activity of the Work. Contractor shall indicate the expected duration of the delay, the anticipated effect of the delay on the Progress Schedule, and the action being or to be taken to correct the problem. Provision of such notice does not relieve Contractor of its obligation to complete the Work within the Contract Time.

### 3.03 OWNER’S RIGHT TO SUSPEND THE WORK FOR CONVENIENCE

A. **Owner may suspend Work:** Owner may, at its sole discretion, order Contractor, in writing, to suspend all or any part of the Work for up to 90 Days, or for such longer period as mutually agreed.

B. **Compliance with suspension; Owner’s options:** Upon receipt of a written notice suspending the Work, Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of cost of performance directly attributable to such suspension. Within a period up to 90 Days after the notice is delivered to Contractor, or within any extension of that period to which the parties shall have agreed, Owner shall either:

1. Cancel the written notice suspending the Work; or
2. Terminate the Work covered by the notice as provided in the termination provisions of Part 9.

C. **Resumption of Work:** If a written notice suspending the Work is cancelled or the period of the notice or any extension thereof expires, Contractor shall resume Work.

D. **Equitable Adjustment for suspensions:** Contractor shall be entitled to an equitable adjustment in the Contract Time, or Contract Sum, or both, for increases in the time or cost of performance.
directly attributable to such suspension, provided Contractor complies with all requirements set forth in Part 7.

3.04 OWNER’S RIGHT TO STOP THE WORK FOR CAUSE

A. Owner may stop Work for Contractor’s failure to perform: If Contractor fails or refuses to perform its obligations in accordance with the Contract Documents, Owner may order Contractor, in writing, to stop the Work, or any portion thereof, until satisfactory corrective action has been taken.

B. No Equitable Adjustment for Contractor’s failure to perform: Contractor shall not be entitled to an equitable adjustment in the Contract Time or Contract Sum for any increased cost or time of performance attributable to Contractor’s failure or refusal to perform or from any reasonable remedial action taken by Owner based upon such failure.

3.05 DELAY

A. Force Majeure actions not a default; Force Majeure defined: Any delay in or failure of performance by Owner or Contractor, other than the payment of money, shall not constitute a default hereunder if and to the extent the cause for such delay or failure of performance was unforeseeable and beyond the control of the party ("Force Majeure"). Acts of Force Majeure include, but are not limited to:

1. Acts of God or the public enemy;
2. Acts or omissions of any government entity;
3. Fire or other casualty for which Contractor is not responsible;
4. Quarantine or epidemic;
5. Strike or defensive lockout;
6. Unusually severe weather conditions which could not have been reasonably anticipated; and
7. Unusual delay in receipt of supplies or products which were ordered and expedited and for which no substitute reasonably acceptable to Owner was available.

B. Contract Time adjustment for Force Majeure: Contractor shall be entitled to an equitable adjustment in the Contract Time for changes in the time of performance directly attributable to an act of Force Majeure, provided it makes a request for equitable adjustment according to Section 7.03. Contractor shall not be entitled to an adjustment in the Contract Sum resulting from an act of Force Majeure.

C. Contract Time or Contract Sum adjustment if Owner at fault: Contractor shall be entitled to an equitable adjustment in Contract Time, and may be entitled to an equitable adjustment in Contract Sum, if the cost or time of Contractor’s performance is changed due to the fault or negligence of Owner, provided the Contractor makes a request according to Sections 7.02 and 7.03.

D. No Contract Time or Contract Sum adjustment if Contractor at fault: Contractor shall not be entitled to an adjustment in Contract Time or in the Contract Sum for any delay or failure of performance to the extent such delay or failure was caused by Contractor or anyone for whose acts Contractor is responsible.

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E. Contract Time adjustment only for concurrent fault: To the extent any delay or failure of performance was concurrently caused by the Owner and Contractor, Contractor shall be entitled to an adjustment in the Contract Time for that portion of the delay or failure of performance that was concurrently caused, provided it makes a request for equitable adjustment according to Section 7.03, but shall not be entitled to an adjustment in Contract Sum.

F. Contractor to mitigate delay impacts: Contractor shall make all reasonable efforts to prevent and mitigate the effects of any delay, whether occasioned by an act of Force Majeure or otherwise.

3.06 NOTICE TO OWNER OF LABOR DISPUTES

A. Contractor to notify Owner of labor disputes: If Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay timely performance in accordance with the Contract Documents, Contractor shall immediately give notice, including all relevant information, to Owner.

B. Pass through notification provisions to Subcontractors: Contractor agrees to insert a provision in its Subcontracts and to require insertion in all sub-subcontracts, that in the event timely performance of any such contract is delayed or threatened by delay by any actual or potential labor dispute, the Subcontractor or Sub-subcontractor shall immediately notify the next higher tier Subcontractor or Contractor, as the case may be, of all relevant information concerning the dispute.

3.07 DAMAGES FOR FAILURE TO ACHIEVE TIMELY COMPLETION

A. Liquidated Damages

1. Reason for Liquidated Damages: Timely performance and completion of the Work is essential to Owner and time limits stated in the Contract Documents are of the essence. Owner will incur serious and substantial damages if Substantial Completion of the Work does not occur within the Contract Time. However, it would be difficult if not impossible to determine the exact amount of such damages. Consequently, provisions for liquidated damages are included in the Contract Documents.

2. Calculation of Liquidated Damages amount: The liquidated damage amounts set forth in the Contract Documents will be assessed not as a penalty, but as liquidated damages for breach of the Contract Documents. This amount is fixed and agreed upon by and between the Contractor and Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain. This amount shall be construed as the actual amount of damages sustained by the Owner, and may be retained by the Owner and deducted from periodic payments to the Contractor.

3. Contractor responsible even if Liquidated Damages assessed: Assessment of liquidated damages shall not release Contractor from any further obligations or liabilities pursuant to the Contract Documents.

B. Actual Damages

Calculation of Actual Damages: Actual damages will be assessed for failure to achieve Final Completion within the time provided. Actual damages will be calculated on the basis of direct architectural, administrative, and other related costs attributable to the Project from the date when Final Completion should have been achieved, based on the date Substantial Completion is actually achieved, to the date Final Completion is actually achieved. Owner may offset these costs against any payment due Contractor.
PART 4 – SPECIFICATIONS, DRAWINGS, AND OTHER DOCUMENTS

4.01 DISCREPANCIES AND CONTRACT DOCUMENT REVIEW

A. Specifications and Drawings are basis of the Work: The intent of the Specifications and Drawings is to describe a complete Project to be constructed in accordance with the Contract Documents. Contractor shall furnish all labor, materials, equipment, tools, transportation, permits, and supplies, and perform the Work required in accordance with the Drawings, Specifications, and other provisions of the Contract Documents.

B. Parts of the Contract Documents are complementary: The Contract Documents are complementary. What is required by one part of the Contract Documents shall be binding as if required by all. Anything mentioned in the Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in the Specifications, shall be of like effect as if shown or mentioned in both.

C. Contractor to report discrepancies in Contract Documents: Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by Owner. If, during the performance of the Work, Contractor finds a conflict, error, inconsistency, or omission in the Contract Documents, it shall promptly and before proceeding with the Work affected thereby, report such conflict, error, inconsistency, or omission to A/E in writing.

D. Contractor knowledge of discrepancy in documents – responsibility: Contractor shall do no Work without applicable Drawings, Specifications, or written modifications, or Shop Drawings where required, unless instructed to do so in writing by Owner. If Contractor performs any construction activity, and it knows or reasonably should have known that any of the Contract Documents contain a conflict, error, inconsistency, or omission, Contractor shall be responsible for the performance and shall bear the cost for its correction.

E. Contractor to perform Work implied by Contract Documents: Contractor shall provide any work or materials the provision of which is clearly implied and is within the scope of the Contract Documents even if the Contract Documents do not mention them specifically.

F. Interpretation questions referred to A/E: Questions regarding interpretation of the requirements of the Contract Documents shall be referred to the A/E.

4.02 PROJECT RECORD

A. Contractor to maintain Project Record Drawings and Specifications: Contractor shall legibly mark in ink on a separate set of the Drawings and Specifications all actual construction, including depths of foundations, horizontal and vertical locations of internal and underground utilities and appurtenances referenced to permanent visible and accessible surface improvements, field changes of dimensions and details, actual suppliers, manufacturers and trade names, models of installed equipment, and Change Order Proposals (COP). This separate set of Drawings and Specifications shall be the “Project Record.”

B. Update Project Record weekly and keep on site: The Project Record shall be maintained on the project site throughout the construction and shall be clearly labeled “PROJECT RECORD.” The Project Record shall be updated at least weekly noting all changes and shall be available to Owner at all times.

C. Final Project Record to A/E before Final Acceptance: Contractor shall submit the completed and finalized Project Record to A/E prior to Final Acceptance.
4.03 **SHOP DRAWINGS**

A. **Definition of Shop Drawings:** “Shop Drawings” means documents and other information required to be submitted to A/E by Contractor pursuant to the Contract Documents, showing in detail: the proposed fabrication and assembly of structural elements; and the installation (i.e., form, fit, and attachment details) of materials and equipment. Shop Drawings include, but are not limited to, drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, samples, and similar materials furnished by Contractor to explain in detail specific portions of the Work required by the Contract Documents. For materials and equipment to be incorporated into the Work, Contractor submittal shall include the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the item. When directed, Contractor shall submit all samples at its own expense. Owner may duplicate, use, and disclose Shop Drawings provided in accordance with the Contract Documents.

B. **Approval of Shop Drawings by Contractor and A/E:** Contractor shall coordinate all Shop Drawings, and review them for accuracy, completeness, and compliance with the Contract Documents and shall indicate its approval thereon as evidence of such coordination and review. Where required by law, Shop Drawings shall be stamped by an appropriate professional licensed by the state of Washington. Shop Drawings submitted to A/E without evidence of Contractor’s approval shall be returned for resubmission. Contractor shall review, approve, and submit Shop Drawings with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of Owner or separate contractors. Contractor’s submittal schedule shall allow a reasonable time for A/E review. A/E will review, approve, or take other appropriate action on the Shop Drawings. Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings until the respective submittal has been reviewed and the A/E has approved or taken other appropriate action. Owner and A/E shall respond to Shop Drawing submittals with reasonable promptness. Any Work by Contractor shall be in accordance with reviewed Shop Drawings. Submittals made by Contractor which are not required by the Contract Documents may be returned without action.

C. **Contractor not relieved of responsibility when Shop Drawings approved:** Approval, or other appropriate action with regard to Shop Drawings, by Owner or A/E shall not relieve Contractor of responsibility for any errors or omissions in such Shop Drawings, nor from responsibility for compliance with the requirements of the Contract Documents. Unless specified in the Contract Documents, review by Owner or A/E shall not constitute an approval of the safety precautions employed by Contractor during construction, or constitute an approval of Contractor’s means or methods of construction. If Contractor fails to obtain approval before installation and the item or work is subsequently rejected, Contractor shall be responsible for all costs of correction.

D. **Variations between Shop Drawings and Contract Documents:** If Shop Drawings show variations from the requirements of the Contract Documents, Contractor shall describe such variations in writing, separate from the Shop Drawings, at the time it submits the Shop Drawings containing such variations. If A/E approves any such variation, an appropriate Change Order will be issued. If the variation is minor and does not involve an adjustment in the Contract Sum or Contract Time, a Change Order need not be issued; however, the modification shall be recorded upon the Project Record.

E. **Contractor to submit 5 copies of Shop Drawings:** Unless otherwise provided in Division 1, Contractor shall submit to A/E for approval 5 copies of all Shop Drawings. Unless otherwise indicated, 3 sets of all Shop Drawings shall be retained by A/E and 2 sets shall be returned to Contractor.
4.04 **ORGANIZATION OF SPECIFICATIONS**

**Specification organization by trade:** Specifications are prepared in sections which conform generally with trade practices. These sections are for Owner and Contractor convenience and shall not control Contractor in dividing the Work among the Subcontractors or in establishing the extent of the Work to be performed by any trade.

4.05 **OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS, AND OTHER DOCUMENTS**

A. **A/E, not Contractor, owns Copyright of Drawings and Specifications:** The Drawings, Specifications, and other documents prepared by A/E are instruments of A/E’s service through which the Work to be executed by Contractor is described. Neither Contractor nor any Subcontractor shall own or claim a copyright in the Drawings, Specifications, and other documents prepared by A/E, and A/E shall be deemed the author of them and will, along with any rights of Owner, retain all common law, statutory, and other reserved rights, in addition to the copyright. All copies of these documents, except Contractor’s set, shall be returned or suitably accounted for to A/E, on request, upon completion of the Work.

B. **Drawings and Specifications to be used only for this Project:** The Drawings, Specifications, and other documents prepared by the A/E, and copies thereof furnished to Contractor, are for use solely with respect to this Project. They are not to be used by Contractor or any Subcontractor on other projects or for additions to this Project outside the scope of the Work without the specific written consent of Owner and A/E. Contractor and Subcontractors are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications, and other documents prepared by A/E appropriate to and for use in the execution of their Work.

C. **Shop Drawing license granted to Owner:** Contractor and all Subcontractors grant a non-exclusive license to Owner, without additional cost or royalty, to use for its own purposes (including reproduction) all Shop Drawings, together with the information and diagrams contained therein, prepared by Contractor or any Subcontractor. In providing Shop Drawings, Contractor and all Subcontractors warrant that they have authority to grant to Owner a license to use the Shop Drawings, and that such license is not in violation of any copyright or other intellectual property right. Contractor agrees to defend and indemnify Owner pursuant to the indemnity provisions in Section 5.03 and 5.22 from any violations of copyright or other intellectual property rights arising out of Owner’s use of the Shop Drawings hereunder, or to secure for Owner, at Contractor’s own cost, licenses in conformity with this section.

D. **Shop Drawings to be used only for this Project:** The Shop Drawings and other submittals prepared by Contractor, Subcontractors of any tier, or its or their equipment or material suppliers, and copies thereof furnished to Contractor, are for use solely with respect to this Project. They are not to be used by Contractor or any Subcontractor of any tier, or material or equipment supplier, on other projects or for additions to this Project outside the scope of the Work without the specific written consent of Owner. The Contractor, Subcontractors of any tier, and material or equipment suppliers are granted a limited license to use and reproduce applicable portions of the Shop Drawings and other submittals appropriate to and for use in the execution of their Work under the Contract Documents.

**PART 5 – PERFORMANCE**

5.01 **CONTRACTOR CONTROL AND SUPERVISION**

A. **Contractor responsible for Means and Methods of construction:** Contractor shall supervise and direct the Work, using its best skill and attention, and shall perform the Work in a skillful manner. Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work, unless the
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Contract Documents give other specific instructions concerning these matters. Contractor shall disclose its means and methods of construction when requested by Owner.

B. Competent Superintendent required: Performance of the Work shall be directly supervised by a competent superintendent who has authority to act for Contractor. The superintendent must be satisfactory to the Owner and shall not be changed without the prior written consent of Owner. Owner may require Contractor to remove the superintendent from the Work or Project site, if Owner reasonably deems the superintendent incompetent, careless, or otherwise objectionable, provided Owner has first notified Contractor in writing and allowed a reasonable period for transition.

C. Contractor responsible for acts and omissions of self and agents: Contractor shall be responsible to Owner for acts and omissions of Contractor, Subcontractors, and their employees and agents.

D. Contractor to employ competent and disciplined workforce: Contractor shall enforce strict discipline and good order among all of the Contractor’s employees and other persons performing the Work. Contractor shall not permit employment of persons not skilled in tasks assigned to them. Contractor’s employees shall at all times conduct business in a manner which assures fair, equal, and nondiscriminatory treatment of all persons. Owner may, by written notice, request Contractor to remove from the Work or Project site any employee Owner reasonably deems incompetent, careless, or otherwise objectionable.

E. Contractor to keep project documents on site: Contractor shall keep on the Project site a copy of the Drawings, Specifications, addenda, reviewed Shop Drawings, and permits and permit drawings.

F. Contractor to comply with ethical standards: Contractor shall ensure that its owner(s) and employees, and those of its Subcontractors, comply with the Ethics in Public Service Act RCW 42.52, which, among other things, prohibits state employees from having an economic interest in any public works contract that was made by, or supervised by, that employee. Contractor shall remove, at its sole cost and expense, any of its, or its Subcontractors’ employees, if they are in violation of this act.

5.02 PERMITS, FEES, AND NOTICES

A. Contractor to obtain and pay for permits: Unless otherwise provided in the Contract Documents, Contractor shall pay for and obtain all permits, licenses, and inspections necessary for proper execution and completion of the Work. Prior to Final Acceptance, the approved, signed permits shall be delivered to Owner.

B. Allowances for permit fees: If allowances for permits or utility fees are called for in the Contract Documents and set forth in Contractor's bid, and the actual costs of those permits or fees differ from the allowances in the Contract Documents, the difference shall be adjusted by Change Order.

C. Contractor to comply with all applicable laws: Contractor shall comply with and give notices required by all federal, state, and local laws, ordinances, rules, regulations, and lawful orders of public authorities applicable to performance of the Work.

5.03 PATENTS AND ROYALTIES

Payment, indemnification, and notice: Contractor is responsible for, and shall pay, all royalties and license fees. Contractor shall defend, indemnify, and hold Owner harmless from any costs, expenses, and liabilities arising out of the infringement by Contractor of any patent, copyright, or other intellectual property right used in the Work; however, provided that Contractor gives prompt notice, Contractor shall not be responsible for such defense or indemnity when a particular design, process, or product of a
particular manufacturer or manufacturers is required by the Contract Documents. If Contractor has reason to believe that use of the required design, process, or product constitutes an infringement of a patent or copyright, it shall promptly notify Owner of such potential infringement.

5.04 **PREVAILING WAGES**

A. **Contractor to pay Prevailing Wages:** Contractor shall pay the prevailing rate of wages to all workers, laborers, or mechanics employed in the performance of any part of the Work in accordance with RCW 39.12 and the rules and regulations of the Department of Labor and Industries. The schedule of prevailing wage rates for the locality or localities of the Work, is determined by the Industrial Statistician of the Department of Labor and Industries. It is the Contractor’s responsibility to verify the applicable prevailing wage rate.

B. **Statement of Intent to Pay Prevailing Wages:** Before payment is made by the Owner to the Contractor for any work performed by the Contractor and subcontractors whose work is included in the application for payment, the Contractor shall submit, or shall have previously submitted to the Owner for the Project, a Statement of Intent to Pay Prevailing Wages, approved by the Department of Labor and Industries, certifying the rate of hourly wage paid and to be paid each classification of laborers, workers, or mechanics employed upon the Work by Contractor and Subcontractors. Such rates of hourly wage shall not be less than the prevailing wage rate.

C. **Affidavit of Wages Paid:** Prior to release of retainage, the Contractor shall submit to the Owner an Affidavit of Wages Paid, approved by the Department of Labor and Industries, for the Contractor and every subcontractor, of any tier, that performed work on the Project.

D. **Disputes:** Disputes regarding prevailing wage rates shall be referred for arbitration to the Director of the Department of Labor and Industries. The arbitration decision shall be final and conclusive and binding on all parties involved in the dispute as provided for by RCW 39.12.060.

E. **Statement with pay application; Post Statements of Intent at job site:** Each Application for Payment submitted by Contractor shall state that prevailing wages have been paid in accordance with the prefilled statement(s) of intent, as approved. Copies of the approved intent statement(s) shall be posted on the job site with the address and telephone number of the Industrial Statistician of the Department of Labor and Industries where a complaint or inquiry concerning prevailing wages may be made.

F. **Contractor to pay for Statements of Intent and Affidavits:** In compliance with chapter 296-127 WAC, Contractor shall pay to the Department of Labor and Industries the currently established fee(s) for each statement of intent and/or affidavit of wages paid submitted to the Department of Labor and Industries for certification.

G. **Certified Payrolls:** Consistent with WAC 296-127-320, the Contractor and any subcontractor shall submit a certified copy of payroll records if requested.

5.05 **HOURS OF LABOR**

A. **Overtime:** Contractor shall comply with all applicable provisions of RCW 49.28 and they are incorporated herein by reference. Pursuant to that statute, no laborer, worker, or mechanic employed by Contractor, any Subcontractor, or any other person performing or contracting to do the whole or any part of the Work, shall be permitted or required to work more than eight hours in any one calendar day, provided, that in cases of extraordinary emergency, such as danger to life or property, the hours of work may be extended, but in such cases the rate of pay for time employed in excess of eight hours of each calendar day shall be not less than one and one-half times the rate allowed for this same amount of time during eight hours of service.
B. **4-10 Agreements:** Notwithstanding the preceding paragraph, RCW 49.28 permits a contractor or subcontractor in any public works contract subject to those provisions, to enter into an agreement with its employees in which the employees work up to ten hours in a calendar day. No such agreement may provide that the employees work ten-hour days for more than four calendar days a week. Any such agreement is subject to approval by the employees. The overtime provisions of RCW 49.28 shall not apply to the hours, up to forty hours per week, worked pursuant to any such agreement.

5.06 **NONDISCRIMINATION**

A. **Discrimination prohibited by applicable laws:** Discrimination in all phases of employment is prohibited by, among other laws and regulations, Title VII of the Civil Rights Act of 1964, the Vietnam Era Veterans Readjustment Act of 1974, Sections 503 and 504 of the Vocational Rehabilitation Act of 1973, the Equal Employment Act of 1972, the Age Discrimination Act of 1967, the Americans with Disabilities Act of 1990, the Civil Rights Act of 1991, Presidential Executive Order 11246, Executive Order 11375, the Washington State Law Against Discrimination, RCW 49.60, and Gubernatorial Executive Order 85-09. These laws and regulations establish minimum requirements for affirmative action and fair employment practices which Contractor must meet.

B. **During performance of the Work:**

1. **Protected Classes:** Contractor shall not discriminate against any employee or applicant for employment because of race, creed, color, national origin, sex, age, marital status, or the presence of any physical, sensory, or mental disability, Vietnam era veteran status, or disabled veteran status, nor commit any other unfair practices as defined in RCW 49.60.

2. **Advertisements to state nondiscrimination:** Contractor shall, in all solicitations or advertisements for employees placed by or for it, state that all qualified applicants will be considered for employment, without regard to race, creed, color, national origin, sex, age, marital status, or the presence of any physical, sensory, or mental disability.

3. **Contractor to notify unions and others of nondiscrimination:** Contractor shall send to each labor union, employment agency, or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice advising the labor union, employment agency, or workers’ representative of Contractor’s obligations according to the Contract Documents and RCW 49.60.

4. **Owner and State access to Contractor records:** Contractor shall permit access to its books, records, and accounts, and to its premises by Owner, and by the Washington State Human Rights Commission, for the purpose of investigation to ascertain compliance with this section of the Contract Documents.

5. **Pass through provisions to Subcontractors:** Contractor shall include the provisions of this section in every Subcontract.

5.07 **SAFETY PRECAUTIONS**

A. **Contractor responsible for safety:** Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Work.

B. **Contractor safety responsibilities:** In carrying out its responsibilities according to the Contract Documents, Contractor shall protect the lives and health of employees performing the Work and other persons who may be affected by the Work; prevent damage to materials, supplies, and equipment whether on site or stored off-site; and prevent damage to other property at the site or adjacent thereto. Contractor shall comply with all applicable laws, ordinances, rules, regulations,
and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss; shall erect and maintain all necessary safeguards for such safety and protection; and shall notify owners of adjacent property and utilities when prosecution of the Work may affect them.

C. Contractor to maintain safety records: Contractor shall maintain an accurate record of exposure data on all incidents relating to the Work resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment. Contractor shall immediately report any such incident to Owner. Owner shall, at all times, have a right of access to all records of exposure.

D. Contractor to provide HazMat training: Contractor shall provide all persons working on the Project site with information and training on hazardous chemicals in their work at the time of their initial assignment, and whenever a new hazard is introduced into their work area.

1. Information. At a minimum, Contractor shall inform persons working on the Project site of:
   a. WAC: The requirements of chapter 296-62 WAC, General Occupational Health Standards;
   b. Presence of hazardous chemicals: Any operations in their work area where hazardous chemicals are present; and
   c. Hazard communications program: The location and availability of written hazard communication programs, including the required list(s) of hazardous chemicals and material safety data sheets required by chapter 296-62 WAC.

2. Training. At a minimum, Contractor shall provide training for persons working on the Project site which includes:
   a. Detecting hazardous chemicals: Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);
   b. Hazards of chemicals: The physical and health hazards of the chemicals in the work area;
   c. Protection from hazards: The measures such persons can take to protect themselves from these hazards, including specific procedures Contractor, or its Subcontractors, or others have implemented to protect those on the Project site from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and
   d. Hazard communications program: The details of the hazard communications program developed by Contractor, or its Subcontractors, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.

E. Hazardous, toxic or harmful substances: Contractor’s responsibility for hazardous, toxic, or harmful substances shall include the following duties:

1. Illegal use of dangerous substances: Contractor shall not keep, use, dispose, transport, generate, or sell on or about the Project site, any substances now or hereafter designated as, or which are subject to regulation as, hazardous, toxic, dangerous, or
harmful by any federal, state or local law, regulation, statute or ordinance (hereinafter collectively referred to as “hazardous substances”), in violation of any such law, regulation, statute, or ordinance, but in no case shall any such hazardous substance be stored more than 90 Days on the Project site.

2. **Contractor notifications of spills, failures, inspections, and fines:** Contractor shall promptly notify Owner of all spills or releases of any hazardous substances which are otherwise required to be reported to any regulatory agency and pay the cost of cleanup. Contractor shall promptly notify Owner of all failures to comply with any federal, state, or local law, regulation, or ordinance; all inspections of the Project site by any regulatory entity concerning the same; all regulatory orders or fines; and all responses or interim cleanup actions taken by or proposed to be taken by any government entity or private party on the Project site.

F. **Public safety and traffic:** All Work shall be performed with due regard for the safety of the public. Contractor shall perform the Work so as to cause a minimum of interruption of vehicular traffic or inconvenience to pedestrians. All arrangements to care for such traffic shall be Contractor’s responsibilities. All expenses involved in the maintenance of traffic by way of detours shall be borne by Contractor.

G. **Contractor to act in an emergency:** In an emergency affecting the safety of life or the Work or of adjoining property, Contractor is permitted to act, at its discretion, to prevent such threatened loss or injury, and Contractor shall so act if so authorized or instructed.

H. **No duty of safety by Owner or A/E:** Nothing provided in this section shall be construed as imposing any duty upon Owner or A/E with regard to, or as constituting any express or implied assumption of control or responsibility over, Project site safety, or over any other safety conditions relating to employees or agents of Contractor or any of its Subcontractors, or the public.

5.08 **OPERATIONS, MATERIAL HANDLING, AND STORAGE AREAS**

A. **Limited storage areas:** Contractor shall confine all operations, including storage of materials, to Owner-approved areas.

B. **Temporary buildings and utilities at Contractor expense:** Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be provided by Contractor only with the consent of Owner and without expense to Owner. The temporary buildings and utilities shall be removed by Contractor at its expense upon completion of the Work.

C. **Roads and vehicle loads:** Contractor shall use only established roadways or temporary roadways authorized by Owner. When materials are transported in prosecuting the Work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by federal, state, or local law or regulation.

D. **Ownership and reporting by Contractor of demolished materials:** Ownership and control of all materials or facility components to be demolished or removed from the Project site by Contractor shall immediately vest in Contractor upon severance of the component from the facility or severance of the material from the Project site. Contractor shall be responsible for compliance with all laws governing the storage and ultimate disposal. Contractor shall provide Owner with a copy of all manifests and receipts evidencing proper disposal when required by Owner or applicable law.

E. **Contractor responsible for care of materials and equipment on-site:** Contractor shall be responsible for the proper care and protection of its materials and equipment delivered to the Project site. Materials and equipment may be stored on the premises subject to approval of...
Owner. When Contractor uses any portion of the Project site as a shop, Contractor shall be responsible for any repairs, patching, or cleaning arising from such use.

F. **Contractor responsible for loss of materials and equipment**: Contractor shall protect and be responsible for any damage or loss to the Work, or to the materials or equipment until the date of Substantial Completion, and shall repair or replace without cost to Owner any damage or loss that may occur, except damages or loss caused by the acts or omissions of Owner. Contractor shall also protect and be responsible for any damage or loss to the Work, or to the materials or equipment, after the date of Substantial Completion, and shall repair or replace without cost to Owner any such damage or loss that might occur, to the extent such damages or loss are caused by the acts or omissions of Contractor, or any Subcontractor.

5.09 **PRIOR NOTICE OF EXCAVATION**

A. **Excavation defined; Use of locator services**: “Excavation” means an operation in which earth, rock, or other material on or below the ground is moved or otherwise displaced by any means, except the tilling of soil less than 12 inches in depth for agricultural purposes, or road ditch maintenance that does not change the original road grade or ditch flow line. Before commencing any excavation, Contractor shall provide notice of the scheduled commencement of excavation to all owners of underground facilities or utilities, through locator services.

5.10 **UNFORESEEN PHYSICAL CONDITIONS**

A. **Notice requirement for concealed or unknown conditions**: If Contractor encounters conditions at the site which are subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then Contractor shall give written notice to Owner promptly and in no event later than 7 Days after the first observance of the conditions. Conditions shall not be disturbed prior to such notice.

B. **Adjustment in Contract Time and Contract Sum**: If such conditions differ materially and cause a change in Contractor’s cost of, or time required for, performance of any part of the Work, the Contractor may be entitled to an equitable adjustment in the Contract Time or Contract Sum, or both, provided it makes a request therefore as provided in Part 7.

5.11 **PROTECTION OF EXISTING STRUCTURES, EQUIPMENT, VEGETATION, UTILITIES AND IMPROVEMENTS**

A. **Contractor to protect and repair property**: Contractor shall protect from damage all existing structures, equipment, improvements, utilities, and vegetation: at or near the Project site; and on adjacent property of a third party, the locations of which are made known to or should be known by Contractor. Contractor shall repair any damage, including that to the property of a third party, resulting from failure to comply with the requirements of the Contract Documents or failure to exercise reasonable care in performing the Work. If Contractor fails or refuses to repair the damage promptly, Owner may have the necessary work performed and charge the cost to Contractor.

B. **Tree and vegetation protection**: Contractor shall only remove trees when specifically authorized to do so, and shall protect vegetation that will remain in place.

5.12 **LAYOUT OF WORK**

A. **Advanced planning of the Work**: Contractor shall plan and lay out the Work in advance of operations so as to coordinate all work without delay or revision.
B. **Layout responsibilities:** Contractor shall lay out the Work from Owner-established baselines and bench marks indicated on the Drawings, and shall be responsible for all field measurements in connection with the layout. Contractor shall furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the Work. Contractor shall be responsible for executing the Work to the lines and grades that may be established. Contractor shall be responsible for maintaining or restoring all stakes and other marks established.

### 5.13 MATERIAL AND EQUIPMENT

A. **Contractor to provide new and equivalent equipment and materials:** All equipment, material, and articles incorporated into the Work shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in the Contract Documents. References in the Specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard quality and shall not be construed as limiting competition. Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of A/E, is equal to that named in the specifications, unless otherwise specifically provided in the Contract Documents.

B. **Contractor responsible for fitting parts together:** Contractor shall do all cutting, fitting, or patching that may be required to make its several parts fit together properly, or receive or be received by work of others set forth in, or reasonably implied by, the Contract Documents. Contractor shall not endanger any work by cutting, excavating, or otherwise altering the Work and shall not cut or alter the work of any other contractor unless approved in advance by Owner.

C. **Owner may reject defective Work:** Should any of the Work be found defective, or in any way not in accordance with the Contract Documents, this work, in whatever stage of completion, may be rejected by Owner.

### 5.14 AVAILABILITY AND USE OF UTILITY SERVICES

A. **Owner to provide and charge for utilities:** Owner shall make all reasonable utilities available to Contractor from existing outlets and supplies, as specified in the Contract Documents. Unless otherwise provided in the Contract Documents, the utility service consumed shall be charged to or paid for by Contractor at prevailing rates charged to Owner or, where the utility is produced by Owner, at reasonable rates determined by Owner. Contractor will carefully conserve any utilities furnished.

B. **Contractor to install temporary connections and meters:** Contractor shall, at its expense and in a skillful manner satisfactory to Owner, install and maintain all necessary temporary connections and distribution lines, together with appropriate protective devices, and all meters required to measure the amount of each utility used for the purpose of determining charges. Prior to the date of Final Acceptance, Contractor shall remove all temporary connections, distribution lines, meters, and associated equipment and materials.

### 5.15 TESTS AND INSPECTION

A. **Contractor to provide for all testing and inspection of Work:** Contractor shall maintain an adequate testing and inspection program and perform such tests and inspections as are necessary or required to ensure that the Work conforms to the requirements of the Contract Documents. Contractor shall be responsible for inspection and quality surveillance of all its Work and all Work performed by any Subcontractor. Unless otherwise provided, Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. Contractor shall give Owner timely notice of when and
where tests and inspections are to be made. Contractor shall maintain complete inspection records and make them available to Owner.

B. **Owner may conduct tests and inspections:** Owner may, at any reasonable time, conduct such inspections and tests as it deems necessary to ensure that the Work is in accordance with the Contract Documents. Owner shall promptly notify Contractor if an inspection or test reveals that the Work is not in accordance with the Contract Documents. Unless the subject items are expressly accepted by Owner, such Owner inspection and tests are for the sole benefit of Owner and do not:

1. constitute or imply acceptance;
2. relieve Contractor of responsibility for providing adequate quality control measures;
3. relieve Contractor of responsibility for risk of loss or damage to the Work, materials, or equipment;
4. relieve Contractor of its responsibility to comply with the requirements of the Contract Documents; or
5. impair Owner’s right to reject defective or nonconforming items, or to avail itself of any other remedy to which it may be entitled.

C. **Inspections or inspectors do not modify Contract Documents:** Neither observations by an inspector retained by Owner, the presence or absence of such inspector on the site, nor inspections, tests, or approvals by others, shall relieve Contractor from any requirement of the Contract Documents, nor is any such inspector authorized to change any term or condition of the Contract Documents.

D. **Contractor responsibilities on inspections:** Contractor shall promptly furnish, without additional charge, all facilities, labor, material and equipment reasonably needed for performing such safe and convenient inspections and tests as may be required by Owner. Owner may charge Contractor any additional cost of inspection or testing when Work is not ready at the time specified by Contractor for inspection or testing, or when prior rejection makes reinspection or retest necessary. Owner shall perform its inspections and tests in a manner that will cause no undue delay in the Work.

### 5.16 CORRECTION OF NONCONFORMING WORK

A. **Work covered by Contractor without inspection:** If a portion of the Work is covered contrary to the requirements in the Contract Documents, it must, if required in writing by Owner, be uncovered for Owner’s observation and be replaced at the Contractor’s expense and without change in the Contract Time.

B. **Payment provisions for uncovering covered Work:** If, at any time prior to Final Completion, Owner desires to examine the Work, or any portion of it, which has been covered, Owner may request to see such Work and it shall be uncovered by Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an adjustment in the Contract Sum for the costs of uncovering and replacement, and, if completion of the Work is thereby delayed, an adjustment in the Contract Time, provided it makes such a request as provided in Part 7. If such Work is not in accordance with the Contract Documents, the Contractor shall pay the costs of examination and reconstruction.

C. **Contractor to correct and pay for non-conforming Work:** Contractor shall promptly correct Work found by Owner not to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed, or
completed. Contractor shall bear all costs of correcting such nonconforming Work, including additional testing and inspections.

D. Contractor’s compliance with warranty provisions: If, within one year after the date of Substantial Completion of the Work or designated portion thereof, or within one year after the date for commencement of any system warranties established under Section 6.08, or within the terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, Contractor shall correct it promptly after receipt of written notice from Owner to do so. Owner shall give such notice promptly after discovery of the condition. This period of one year shall be extended, with respect to portions of Work first performed after Substantial Completion, by the period of time between Substantial Completion and the actual performance of the Work. Contractor’s duty to correct with respect to Work repaired or replaced shall run for one year from the date of repair or replacement. Obligations under this paragraph shall survive Final Acceptance.

E. Contractor to remove non-conforming Work: Contractor shall remove from the Project site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by Contractor nor accepted by Owner.

F. Owner may charge Contractor for non-conforming Work: If Contractor fails to correct nonconforming Work within a reasonable time after written notice to do so, Owner may replace, correct, or remove the nonconforming Work and charge the cost thereof to the Contractor.

G. Contractor to pay for damaged Work during correction: Contractor shall bear the cost of correcting destroyed or damaged Work, whether completed or partially completed, caused by Contractor’s correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

H. No Period of limitation on other requirements: Nothing contained in this section shall be construed to establish a period of limitation with respect to other obligations which Contractor might have according to the Contract Documents. Establishment of the time period of one year as described in Section 5.16D relates only to the specific obligation of Contractor to correct the Work, and has no relationship to the time within which the Contractor’s obligation to comply with the Contract Documents may be sought to be enforced, including the time within which such proceedings may be commenced.

I. Owner may accept non-conforming Work and charge Contractor: If Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, Owner may do so instead of requiring its removal and correction, in which case the Contract Sum may be reduced as appropriate and equitable.

5.17 CLEAN UP

Contractor to keep site clean and leave it clean: Contractor shall at all times keep the Project site, including hauling routes, infrastructures, utilities, and storage areas, free from accumulations of waste materials. Before completing the Work, Contractor shall remove from the premises its rubbish, tools, scaffolding, equipment, and materials. Upon completing the Work, Contractor shall leave the Project site in a clean, neat, and orderly condition satisfactory to Owner. If Contractor fails to clean up as provided herein, and after reasonable notice from Owner, Owner may do so and the cost thereof shall be charged to Contractor.

5.18 ACCESS TO WORK

Owner and A/E access to Work site: Contractor shall provide Owner and A/E access to the Work in progress wherever located.
5.19 OTHER CONTRACTS

Owner may award other contracts; Contractor to cooperate: Owner may undertake or award other contracts for additional work at or near the Project site. Contractor shall reasonably cooperate with the other contractors and with Owner’s employees and shall carefully adapt scheduling and perform the Work in accordance with these Contract Documents to reasonably accommodate the other work.

5.20 SUBCONTRACTORS AND SUPPLIERS

A. Subcontractor Responsibility: The Contractor shall include the language of this paragraph in each of its first tier subcontracts, and shall require each of its subcontractors to include the same language of this section in each of their subcontracts, adjusting only as necessary the terms used for the contracting parties. Upon request of the Owner, the Contractor shall promptly provide documentation to the Owner demonstrating that the subcontractor meets the subcontractor responsibility criteria below. The requirements of this paragraph apply to all subcontractors regardless of tier. At the time of subcontract execution, the Contractor shall verify that each of its first tier subcontractors meet the following bidder responsibility criteria:

1. Have a current certificate of registration as a contractor in compliance with chapter 18.27 RCW, which must have been in effect at the time of subcontract bid submittal;
2. Have a current Washington Unified Business Identifier (UBI) number;
3. If applicable, have:
   a. Industrial Insurance (workers’ compensation) coverage for the subcontractor’s employees working in Washington, as required in Title 51 RCW;
   b. A Washington Employment Security Department number, as required in Title 50 RCW;
   c. A Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW;
   d. An electrical contractor license, if required by Chapter 19.28 RCW;
   e. An elevator contractor license, if required by Chapter 70.87 RCW.
4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065 (3).
5. On a project subject to the apprenticeship utilization requirements in RCW 39.04.320, not have been found out of compliance by the Washington state apprenticeship and training council for working apprentices out of ratio, without appropriate supervision, or outside their approved work processes as outlined in their standards of apprenticeship under chapter 49.04 RCW for the one-year period immediately preceding the date of the Owner’s first advertisement of the project.

B. Provide names of Subcontractors and use qualified firms: Before submitting the first Application for Payment, Contractor shall furnish in writing to Owner the names, addresses, and telephone numbers of all Subcontractors, as well as suppliers providing materials in excess of $2,500. Contractor shall utilize Subcontractors and suppliers which are experienced and qualified, and meet the requirements of the Contract Documents, if any. Contractor shall not utilize any Subcontractor or supplier to whom the Owner has a reasonable objection, and shall obtain Owner’s written consent before making any substitutions or additions.
C. **Subcontracts in writing and pass through provision:** All Subcontracts must be in writing. By appropriate written agreement, Contractor shall require each Subcontractor, so far as applicable to the Work to be performed by the Subcontractor, to be bound to Contractor by terms of the Contract Documents, and to assume toward Contractor all the obligations and responsibilities which Contractor assumes toward Owner in accordance with the Contract Documents. Each Subcontract shall preserve and protect the rights of Owner in accordance with the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights. Where appropriate, Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. However, nothing in this paragraph shall be construed to alter the contractual relations between Contractor and its Subcontractors with respect to insurance or bonds.

D. **Coordination of Subcontractors; Contractor responsible for Work:** Contractor shall schedule, supervise, and coordinate the operations of all Subcontractors. No Subcontracting of any of the Work shall relieve Contractor from its responsibility for the performance of the Work in accordance with the Contract Documents or any other obligations of the Contract Documents.

E. **Automatic assignment of subcontracts:** Each subcontract agreement for a portion of the Work is hereby assigned by Contractor to Owner provided that:

1. **Effective only after termination and Owner approval:** The assignment is effective only after termination by Owner for cause pursuant to Section 9.01 and only for those Subcontracts which Owner accepts by notifying the Subcontractor in writing; and

2. **Owner assumes Contractor’s responsibilities:** After the assignment is effective, Owner will assume all future duties and obligations toward the Subcontractor which Contractor assumed in the Subcontract.

3. **Impact of bond:** The assignment is subject to the prior rights of the surety, if any, obligated under any bond provided in accordance with the Contract Documents.

5.21 **WARRANTY OF CONSTRUCTION**

A. **Contractor warranty of Work:** In addition to any special warranties provided elsewhere in the Contract Documents, Contractor warrants that all Work conforms to the requirements of the Contract Documents and is free of any defect in equipment, material, or design furnished, or workmanship performed by Contractor.

B. **Contractor responsibilities:** With respect to all warranties, express or implied, for Work performed or materials furnished according to the Contract Documents, Contractor shall:

1. **Obtain warranties:** Obtain all warranties that would be given in normal commercial practice;

2. **Warranties for benefit of Owner:** Require all warranties to be executed, in writing, for the benefit of Owner;

3. **Enforcement of warranties:** Enforce all warranties for the benefit of Owner, if directed by Owner; and

4. **Contractor responsibility for subcontractor warranties:** Be responsible to enforce any subcontractor’s, manufacturer’s, or supplier’s warranties should they extend beyond the period specified in the Contract Documents.

C. **Warranties beyond Final Acceptance:** The obligations under this section shall survive Final Acceptance.
5.22 **INDEMNIFICATION**

A. **Contractor to indemnify Owner:** Contractor shall defend, indemnify, and hold Owner and A/E harmless from and against all claims, demands, losses, damages, or costs, including but not limited to damages arising out of bodily injury or death to persons and damage to property, caused by or resulting from:

1. **Sole negligence of Contractor:** The sole negligence of Contractor or any of its Subcontractors;

2. **Concurrent negligence:** The concurrent negligence of Contractor, or any Subcontractor, but only to the extent of the negligence of Contractor or such Subcontractor; and

3. **Patent infringement:** The use of any design, process, or equipment which constitutes an infringement of any United States patent presently issued, or violates any other proprietary interest, including copyright, trademark, and trade secret.

B. **Employee action and RCW Title 51:** In any action against Owner and any other entity indemnified in accordance with this section, by any employee of Contractor, its Subcontractors, Sub-subcontractors, agents, or anyone directly or indirectly employed by any of them, the indemnification obligation of this section shall not be limited by a limit on the amount or type of damages, compensation, or benefits payable by or for Contractor or any Subcontractor under RCW Title 51, the Industrial Insurance Act, or any other employee benefit acts. In addition, Contractor waives immunity as to Owner and A/E only, in accordance with RCW Title 51.

**PART 6 – PAYMENTS AND COMPLETION**

6.01 **CONTRACT SUM**

Owner shall pay Contract Sum: Owner shall pay Contractor the Contract Sum plus state sales tax for performance of the Work, in accordance with the Contract Documents.

6.02 **SCHEDULE OF VALUES**

Contractor to submit Schedule of Values: Before submitting its first Application for Payment, Contractor shall submit to Owner for approval a breakdown allocating the total Contract Sum to each principal category of work, in such detail as requested by Owner (“Schedule of Values”). The approved Schedule of Values shall include appropriate amounts for demobilization, record drawings, O&M manuals, and any other requirements for Project closeout, and shall be used by Owner as the basis for progress payments. Payment for Work shall be made only for and in accordance with those items included in the Schedule of Values.

6.03 **APPLICATION FOR PAYMENT**

A. **Monthly Application for Payment with substantiation:** At monthly intervals, unless determined otherwise by Owner, Contractor shall submit to Owner an itemized Application for Payment for Work completed in accordance with the Contract Documents and the approved Schedule of Values. Each application shall be supported by such substantiating data as Owner may require.

B. **Contractor certifies Subcontractors paid:** By submitting an Application for Payment, Contractor is certifying that all Subcontractors have been paid, less earned retainage in accordance with RCW 60.28.011, as their interests appeared in the last preceding certificate of payment. By submitting an Application for Payment, Contractor is recertifying that the representations set forth in Section 1.03, are true and correct, to the best of Contractor’s knowledge, as of the date of the Application for Payment.
C. **Reconciliation of Work with Progress Schedule:** At the time it submits an Application for Payment, Contractor shall analyze and reconcile, to the satisfaction of Owner, the actual progress of the Work with the Progress Schedule.

D. **Payment for material delivered to site or stored off-site:** If authorized by Owner, the Application for Payment may include request for payment for material delivered to the Project site and suitably stored, or for completed preparatory work. Payment may similarly be requested for material stored off the Project site, provided Contractor complies with or furnishes satisfactory evidence of the following:

1. **Suitable facility or location:** The material will be placed in a facility or location that is structurally sound, dry, lighted and suitable for the materials to be stored;

2. **Facility or location within 10 miles of Project:** The facility or location is located within a 10-mile radius of the Project. Other locations may be utilized, if approved in writing, by Owner;

3. **Facility or location exclusive to Project’s materials:** Only materials for the Project are stored within the facility or location (or a secure portion of a facility or location set aside for the Project);

4. **Insurance provided on materials in facility or location:** Contractor furnishes Owner a certificate of insurance extending Contractor’s insurance coverage for damage, fire, and theft to cover the full value of all materials stored, or in transit;

5. **Facility or location locked and secure:** The facility or location (or secure portion thereof) is continuously under lock and key, and only Contractor’s authorized personnel shall have access;

6. **Owner right of access to facility or location:** Owner shall at all times have the right of access in company of Contractor;

7. **Contractor assumes total responsibility for stored materials:** Contractor and its surety assume total responsibility for the stored materials; and

8. **Contractor provides documentation and Notice when materials moved to site:** Contractor furnishes to Owner certified lists of materials stored, bills of lading, invoices, and other information as may be required, and shall also furnish Notice to Owner when materials are moved from storage to the Project site.

6.04 **PROGRESS PAYMENTS**

A. **Owner to pay within 30 Days:** Owner shall make progress payments, in such amounts as Owner determines are properly due, within 30 Days after receipt of a properly executed Application for Payment. Owner shall notify Contractor in accordance with chapter 39.76 RCW if the Application for Payment does not comply with the requirements of the Contract Documents.

B. **Withholding retainage; Options for retainage:** Owner shall retain 5% of the amount of each progress payment until 45 Days after Final Acceptance and receipt of all documents required by law or the Contract Documents, including, at Owner’s request, consent of surety to release of the retainage. In accordance with chapter 60.28 RCW, Contractor may request that monies reserved be retained in a fund by Owner, deposited by Owner in a bank or savings and loan, or placed in escrow with a bank or trust company to be converted into bonds and securities to be held in escrow with interest to be paid to Contractor. Owner may permit Contractor to provide an appropriate bond in lieu of the retained funds.
C. **Title passes to Owner upon payment:** Title to all Work and materials covered by a progress payment shall pass to Owner at the time of such payment free and clear of all liens, claims, security interests, and encumbrances. Passage of title shall not, however, relieve Contractor from any of its duties and responsibilities for the Work or materials, or waive any rights of Owner to insist on full compliance by Contractor with the Contract Documents.

D. **Interest on unpaid balances:** Payments due and unpaid in accordance with the Contract Documents shall bear interest as specified in chapter 39.76 RCW.

### 6.05 PAYMENTS WITHHELD

A. **Owner’s right to withhold payment:** Owner may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any payment to such extent as may be necessary to protect Owner from loss or damage for reasons including but not limited to:

1. **Non-compliant Work:** Work not in accordance with the Contract Documents;

2. **Remaining Work to cost more than unpaid balance:** Reasonable evidence that the Work required by the Contract Documents cannot be completed for the unpaid balance of the Contract Sum;

3. **Owner correction or completion Work:** Work by Owner to correct defective Work or complete the Work in accordance with Section 5.16;

4. **Contractor’s failure to perform:** Contractor’s failure to perform in accordance with the Contract Documents; or

5. **Contractor’s negligent acts or omissions:** Cost or liability that may occur to Owner as the result of Contractor’s fault or negligent acts or omissions.

B. **Owner to notify Contractor of withholding for unsatisfactory performance:** In any case where part or all of a payment is going to be withheld for unsatisfactory performance, Owner shall notify Contractor in accordance with chapter 39.76 RCW.

### 6.06 RETAINAGE AND BOND CLAIM RIGHTS

Chapters 39.08 RCW and 60.28 RCW incorporated by reference: Chapters 39.08 RCW and 60.28 RCW, concerning the rights and responsibilities of Contractor and Owner with regard to the performance and payment bonds and retainage, are made a part of the Contract Documents by reference as though fully set forth herein.

### 6.07 SUBSTANTIAL COMPLETION

**Substantial Completion defined:** Substantial Completion is the stage in the progress of the Work (or portion thereof designated and approved by Owner) when the construction is sufficiently complete, in accordance with the Contract Documents, so Owner has full and unrestricted use and benefit of the facilities (or portion thereof designated and approved by Owner) for the use for which it is intended. All Work other than incidental corrective or punch list work shall be completed. Substantial Completion shall not have been achieved if all systems and parts are not functional, if utilities are not connected and operating normally, if all required occupancy permits have not been issued, or if the Work is not accessible by normal vehicular and pedestrian traffic routes. The date Substantial Completion is achieved shall be established in writing by Owner. Contractor may request an early date of Substantial Completion which must be approved by Change Order. Owner’s occupancy of the Work or designated portion thereof does not necessarily indicate that Substantial Completion has been achieved.
6.08 **PRIOR OCCUPANCY**

A. **Prior Occupancy defined; Restrictions:** Owner may, upon written notice thereof to Contractor, take possession of or use any completed or partially completed portion of the Work ("Prior Occupancy") at any time prior to Substantial Completion. Unless otherwise agreed in writing, Prior Occupancy shall not: be deemed an acceptance of any portion of the Work; accelerate the time for any payment to Contractor; prejudice any rights of Owner provided by any insurance, bond, guaranty, or the Contract Documents; relieve Contractor of the risk of loss or any of the obligations established by the Contract Documents; establish a date for termination or partial termination of the assessment of liquidated damages; or constitute a waiver of claims.

B. **Damage; Duty to repair and warranties:** Notwithstanding anything in the preceding paragraph, Owner shall be responsible for loss of or damage to the Work resulting from Prior Occupancy. Contractor's one year duty to repair any system warranties shall begin on building systems activated and used by Owner as agreed in writing by Owner and Contractor.

6.09 **FINAL COMPLETION, ACCEPTANCE, AND PAYMENT**

A. **Final Completion defined:** Final Completion shall be achieved when the Work is fully and finally complete in accordance with the Contract Documents. The date Final Completion is achieved shall be established by Owner in writing, but in no case shall constitute Final Acceptance which is a subsequent, separate, and distinct action.

B. **Final Acceptance defined:** Final Acceptance shall be achieved when the Contractor has completed the requirements of the Contract Documents. The date Final Acceptance is achieved shall be established by Owner in writing. Prior to Final Acceptance, Contractor shall, in addition to all other requirements in the Contract Documents, submit to Owner a written notice of any outstanding disputes or claims between Contractor and any of its Subcontractors, including the amounts and other details thereof. Neither Final Acceptance, nor final payment, shall release Contractor or its sureties from any obligations of these Contract Documents or the payment and performance bonds, or constitute a waiver of any claims by Owner arising from Contractor's failure to perform the Work in accordance with the Contract Documents.

C. **Final payment waives Claim rights:** Acceptance of final payment by Contractor, or any Subcontractor, shall constitute a waiver and release to Owner of all claims by Contractor, or any such Subcontractor, for an increase in the Contract Sum or the Contract Time, and for every act or omission of Owner relating to or arising out of the Work, except for those Claims made in accordance with the procedures, including the time limits, set forth in Part 8.

PART 7 – CHANGES

7.01 **CHANGE IN THE WORK**

A. **Changes in Work, Contract Sum, and Contract Time by Change Order:** Owner may, at any time and without notice to Contractor's surety, order additions, deletions, revisions, or other changes in the Work. These changes in the Work shall be incorporated into the Contract Documents through the execution of Change Orders. If any change in the Work ordered by Owner causes an increase or decrease in the Contract Sum or the Contract Time, an equitable adjustment shall be made as provided in Section 7.02 or 7.03, respectively, and such adjustment(s) shall be incorporated into a Change Order.

B. **Owner may request COP from Contractor:** If Owner desires to order a change in the Work, it may request a written Change Order Proposal (COP) from Contractor. Contractor shall submit a Change Order Proposal within 14 Days of the request from Owner, or within such other period as mutually agreed. Contractor's Change Order Proposal shall be full compensation for
implementing the proposed change in the Work, including any adjustment in the Contract Sum or Contract Time, and including compensation for all delays in connection with such change in the Work and for any expense or inconvenience, disruption of schedule, or loss of efficiency or productivity occasioned by the change in the Work.

C. COP negotiations: Upon receipt of the Change Order Proposal, or a request for equitable adjustment in the Contract Sum or Contract Time, or both, as provided in Sections 7.02 and 7.03, Owner may accept or reject the proposal, request further documentation, or negotiate acceptable terms with Contractor. Pending agreement on the terms of the Change Order, Owner may direct Contractor to proceed immediately with the Change Order Work. Contractor shall not proceed with any change in the Work until it has obtained Owner’s approval. All Work done pursuant to any Owner-directed change in the Work shall be executed in accordance with the Contract Documents.

D. Change Order as full payment and final settlement: If Owner and Contractor reach agreement on the terms of any change in the Work, including any adjustment in the Contract Sum or Contract Time, such agreement shall be incorporated in a Change Order. The Change Order shall constitute full payment and final settlement of all claims for time and for direct, indirect, and consequential costs, including costs of delays, inconvenience, disruption of schedule, or loss of efficiency or productivity, related to any Work either covered or affected by the Change Order, or related to the events giving rise to the request for equitable adjustment.

E. Failure to agree upon terms of Change Order; Final offer and Claims: If Owner and Contractor are unable to reach agreement on the terms of any change in the Work, including any adjustment in the Contract Sum or Contract Time, Contractor may at any time in writing, request a final offer from Owner. Owner shall provide Contractor with its written response within 30 Days of Contractor’s request. Owner may also provide Contractor with a final offer at any time. If Contractor rejects Owner’s final offer, or the parties are otherwise unable to reach agreement, Contractor’s only remedy shall be to file a Claim as provided in Part 8.

F. Field Authorizations: The Owner may direct the Contractor to proceed with a change in the work through a written Field Authorization (also referred to as a Field Order) when the time required to price and execute a Change Order would impact the Project.

The Field Authorization shall describe and include the following:

1. The scope of work
2. An agreed upon maximum not-to-exceed amount
3. Any estimated change to the Contract Time
4. The method of final cost determination in accordance with the requirements of Part 7 of the General Conditions
5. The supporting cost data to be submitted in accordance with the requirements of Part 7 of the General Conditions

Upon satisfactory submittal by the Contractor and approval by the Owner of supporting cost data, a Change Order will be executed. The Owner will not make payment to the Contractor for Field Authorization work until that work has been incorporated into an executed Change Order.
7.02 CHANGE IN THE CONTRACT SUM

A. General Application

1. **Contract Sum changes only by Change Order:** The Contract Sum shall only be changed by a Change Order. Contractor shall include any request for a change in the Contract Sum in its Change Order Proposal.

2. **Owner fault or negligence as basis for change in Contract Sum:** If the cost of Contractor's performance is changed due to the fault or negligence of Owner, or anyone for whose acts Owner is responsible, Contractor shall be entitled to make a request for an equitable adjustment in the Contract Sum in accordance with the following procedure. No change in the Contract Sum shall be allowed to the extent: Contractor's changed cost of performance is due to the fault or negligence of Contractor, or anyone for whose acts Contractor is responsible; the change is concurrently caused by Contractor and Owner; or the change is caused by an act of Force Majeure as defined in Section 3.05.

   (a) **Notice and record keeping for equitable adjustment:** A request for an equitable adjustment in the Contract Sum shall be based on written notice delivered to Owner within 7 Days of the occurrence of the event giving rise to the request. For purposes of this part, “occurrence” means when Contractor knew, or in its diligent prosecution of the Work should have known, of the event giving rise to the request. If Contractor believes it is entitled to an adjustment in the Contract Sum, Contractor shall immediately notify Owner and begin to keep and maintain complete, accurate, and specific daily records. Contractor shall give Owner access to any such records and, if requested shall promptly furnish copies of such records to Owner.

   (b) **Content of notice for equitable adjustment; Failure to comply:** Contractor shall not be entitled to any adjustment in the Contract Sum for any occurrence of events or costs that occurred more than 7 Days before Contractor’s written notice to Owner. The written notice shall set forth, at a minimum, a description of: the event giving rise to the request for an equitable adjustment in the Contract Sum; the nature of the impacts to Contractor and its Subcontractors of any tier, if any; and to the extent possible the amount of the adjustment in Contract Sum requested. Failure to properly give such written notice shall, to the extent Owner's interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.

   (c) **Contractor to provide supplemental information:** Within 30 Days of the occurrence of the event giving rise to the request, unless Owner agrees in writing to allow an additional period of time to ascertain more accurate data, Contractor shall supplement the written notice provided in accordance with subparagraph a. above with additional supporting data. Such additional data shall include, at a minimum: the amount of compensation requested, itemized in accordance with the procedure set forth herein; specific facts, circumstances, and analysis that confirms not only that Contractor suffered the damages claimed, but that the damages claimed were actually a result of the act, event, or condition complained of and that the Contract Documents provide entitlement to an equitable adjustment to Contractor for such act, event, or condition; and documentation sufficiently detailed to permit an informed analysis of the request by Owner. When the request for compensation relates to a delay, or other change in Contract Time, Contractor shall demonstrate the impact on the critical path, in accordance with Section 7.03C. Failure to provide such additional information and documentation within the time allowed or within the format required shall, to the extent Owner's interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.
(d) **Contractor to proceed with Work as directed:** Pending final resolution of any request made in accordance with this paragraph, unless otherwise agreed in writing, Contractor shall proceed diligently with performance of the Work.

(e) **Contractor to combine requests for same event together:** Any requests by Contractor for an equitable adjustment in the Contract Sum and in the Contract Time that arise out of the same event(s) shall be submitted together.

3. **Methods for calculating Change Order amount:** The value of any Work covered by a Change Order, or of any request for an equitable adjustment in the Contract Sum, shall be determined by one of the following methods:

   a. **Fixed Price:** On the basis of a fixed price as determined in paragraph 7.02B.

   b. **Unit Prices:** By application of unit prices to the quantities of the items involved as determined in paragraph 7.02C.

   c. **Time and Materials:** On the basis of time and material as determined in paragraph 7.02D.

4. **Fixed price method is default; Owner may direct otherwise:** When Owner has requested Contractor to submit a Change Order Proposal, Owner may direct Contractor as to which method in subparagraph 3 above to use when submitting its proposal. Otherwise, Contractor shall determine the value of the Work, or of a request for an equitable adjustment, on the basis of the fixed price method.

B. **Change Order Pricing – Fixed Price**

Procedures: When the fixed price method is used to determine the value of any Work covered by a Change Order, or of a request for an equitable adjustment in the Contract Sum, the following procedures shall apply:

1. **Breakdown and itemization of details on COP:** Contractor’s Change Order Proposal, or request for adjustment in the Contract Sum, shall be accompanied by a complete itemization of the costs, including labor, material, subcontractor costs, and overhead and profit. The costs shall be itemized in the manner set forth below, and shall be submitted on breakdown sheets in a form approved by Owner.

2. **Use of industry standards in calculating costs:** All costs shall be calculated based upon appropriate industry standard methods of calculating labor, material quantities, and equipment costs.

3. **Costs contingent on Owner’s actions:** If any of Contractor’s pricing assumptions are contingent upon anticipated actions of Owner, Contractor shall clearly state them in the proposal or request for an equitable adjustment.

4. **Markups on additive and deductive Work:** The cost of any additive or deductive changes in the Work shall be calculated as set forth below, except that overhead and profit shall not be included on deductive changes in the Work. Where a change in the Work involves additive and deductive work by the same Contractor or Subcontractor, small tools, overhead, profit, bond and insurance markups will apply to the net difference.

5. **Breakdown not required if change less than $1,000:** If the total cost of the change in the Work or request for equitable adjustment does not exceed $1,000, Contractor shall not be required to submit a breakdown if the description of the change in the Work or request for equitable adjustment is sufficiently definitive for Owner to determine fair value.
6. **Breakdown required if change between $1,000 and $2,500:** If the total cost of the change in the Work or request for equitable adjustment is between $1,000 and $2,500, Contractor may submit a breakdown in the following level of detail if the description of the change in the Work or if the request for equitable adjustment is sufficiently definitive to permit the Owner to determine fair value:

   a. lump sum labor;
   b. lump sum material;
   c. lump sum equipment usage;
   d. overhead and profit as set forth below; and
   e. insurance and bond costs as set forth below.

7. **Components of increased cost:** Any request for adjustment of Contract Sum based upon the fixed price method shall include only the following items:

   a. **Craft labor costs:** These are the labor costs determined by multiplying the estimated or actual additional number of craft hours needed to perform the change in the Work by the hourly labor costs. Craft hours should cover direct labor, as well as indirect labor due to trade inefficiencies. The hourly costs shall be based on the following:

      (1) **Basic wages and benefits:** Hourly rates and benefits as stated on the Department of Labor and Industries approved “statement of intent to pay prevailing wages” or a higher amount if approved by the Owner. Direct supervision shall be a reasonable percentage not to exceed 15% of the cost of direct labor. No supervision markup shall be allowed for a working supervisor's hours.

      (2) **Worker's insurance:** Direct contributions to the state of Washington for industrial insurance; medical aid; and supplemental pension, by the class and rates established by the Department of Labor and Industries.

      (3) **Federal insurance:** Direct contributions required by the Federal Insurance Compensation Act; Federal Unemployment Tax Act; and the State Unemployment Compensation Act.

      (4) **Travel allowance:** Travel allowance and/or subsistence, if applicable, not exceeding those allowances established by regional labor union agreements, which are itemized and identified separately.

      (5) **Safety:** Cost incurred due to the Washington Industrial Safety and Health Act, which shall be a reasonable percentage not to exceed 2% of the sum of the amounts calculated in (1), (2), and (3) above.

   b. **Material costs:** This is an itemization of the quantity and cost of materials needed to perform the change in the Work. Material costs shall be developed first from actual known costs, second from supplier quotations or if these are not available, from standard industry pricing guides. Material costs shall consider all available discounts. Freight costs, express charges, or special delivery charges, shall be itemized.
c. **Equipment costs:** This is an itemization of the type of equipment and the estimated or actual length of time the construction equipment appropriate for the Work is or will be used on the change in the Work. Costs will be allowed for construction equipment only if used solely for the changed Work, or for additional rental costs actually incurred by the Contractor. Equipment charges shall be computed on the basis of actual invoice costs or if owned, from the current edition of one of the following sources:

(1) Associated General Contractors Washington State Department of Transportation (AGC WSDOT) Equipment Rental Agreement current edition, on the Contract execution date.

(2) The National Electrical Contractors Association for equipment used on electrical work.

(3) The Mechanical Contractors Association of America for equipment used on mechanical work.

The EquipmentWatch Rental Rate Blue Book shall be used as a basis for establishing rental rates of equipment not listed in the above sources. The maximum rate for standby equipment shall not exceed that shown in the AGC WSDOT Equipment Rental Agreement, current edition on the Contract execution date.

d. **Allowance for small tools, expendables & consumable supplies:** Small tools consist of tools which cost $250 or less and are normally furnished by the performing contractor. The maximum rate for small tools shall not exceed the following:

(1) **3% for Contractor:** For Contractor, 3% of direct labor costs.

(2) **5% for Subcontractors:** For Subcontractors, 5% of direct labor costs.

Expendables and consumables supplies directly associated with the change in Work must be itemized.

e. **Subcontractor costs:** This is defined as payments Contractor makes to Subcontractors for changed Work performed by Subcontractors of any tier. The Subcontractors’ cost of Work shall be calculated and itemized in the same manner as prescribed herein for Contractor.

f. **Allowance for overhead:** This is defined as costs of any kind attributable to direct and indirect delay, acceleration, or impact, added to the total cost to Owner of any change in the Contract Sum. If the Contractor is compensated under Section 7.03D, the amount of such compensation shall be reduced by the amount Contractor is otherwise entitled to under this subsection (f). This allowance shall compensate Contractor for all noncraft labor, temporary construction facilities, field engineering, schedule updating, as-built drawings, home office cost, B&O taxes, office engineering, estimating costs, additional overhead because of extended time, and any other cost incidental to the change in the Work. It shall be strictly limited in all cases to a reasonable amount, mutually acceptable, or if none can be agreed upon to an amount not to exceed the rates below:

(1) **Projects less than $3 million:** For projects where the Contract Award Amount is under $3 million, the following shall apply:
(a) **Contractor markup on Contractor Work:** For Contractor, for any Work actually performed by Contractor’s own forces, 16% of the first $50,000 of the cost, and 4% of the remaining cost, if any.

(b) **Subcontractor markup for Subcontractor Work:** For each Subcontractor (including lower tier subcontractors), for any Work actually performed by its own forces, 16% of the first $50,000 of the cost, and 4% of the remaining cost, if any.

(c) **Contractor markup for Subcontractor Work:** For Contractor, for any work performed by its Subcontractor(s) 6% of the first $50,000 of the amount due each Subcontractor, and 4% of the remaining amount if any.

(d) **Subcontractor markup for lower tier Subcontractor Work:** For each Subcontractor, for any Work performed by its Subcontractor(s) of any lower tier, 4% of the first $50,000 of the amount due the sub-Subcontractor, and 2% of the remaining amount if any.

(e) **Basis of cost applicable for markup:** The cost to which overhead is to be applied shall be developed in accordance with Section 7.02B 7a. – e.

(2). **Projects more than $3 million:** For projects where the Contract Award Amount is equal to or exceeds $3 million, the following shall apply:

(a) **Contractor markup on Contractor Work:** For Contractor, for any Work actually performed by Contractor’s own forces, 12% of the first $50,000 of the cost, and 4% of the remaining cost, if any.

(b) **Subcontractor markup for Subcontractor Work:** For each Subcontractor (including lower tier subcontractors), for any Work actually performed by its own forces, 12% of the first $50,000 of the cost, and 4% of the remaining cost, if any.

(c) **Contractor markup for Subcontractor Work:** For Contractor, for any Work performed by its Subcontractor(s), 4% of the first $50,000 of the amount due each Subcontractor, and 2% of the remaining amount if any.

(d) **Subcontractor markup for lower tier Subcontractor Work:** For each Subcontractor, for any Work performed by its Subcontractor(s) of any lower tier, 4% of the first $50,000 of the amount due the sub-Subcontractor, and 2% of the remaining amount if any.

(e) **Basis of cost applicable for markup:** The cost to which overhead is to be applied shall be developed in accordance with Section 7.02B 7a. – e.

g. **Allowance for profit:** Allowance for profit is an amount to be added to the cost of any change in contract sum, but not to the cost of change in Contract Time for which contractor has been compensated pursuant to the conditions set forth in Section 7.03. It shall be limited to a reasonable amount, mutually acceptable, or if none can be agreed upon, to an amount not to exceed the rates below:

(1) **Contractor / Subcontractor markup for self-performed Work:** For Contractor or Subcontractor of any tier for work performed by their forces, 6% of the cost developed in accordance with Section 7.02B 7a. – e.
(2) Contractor / Subcontractor markup for Work performed at lower tier: For Contractor or Subcontractor of any tier for work performed by a subcontractor of a lower tier, 4% of the subcontract cost developed in accordance with Section 7.02B 7a. – h.

h. Insurance and bond premiums: Cost of change in insurance or bond premium: This is defined as:

(1) Contractor’s liability insurance: The cost of any changes in Contractor’s liability insurance arising directly from execution of the Change Order; and

(2) Payment and Performance Bond: The cost of the additional premium for Contractor’s bond arising directly from the changed Work.

The cost of any change in insurance or bond premium shall be added after overhead and allowance for profit are calculated in accordance with subparagraph f. and g above.

C. Change Order Pricing – Unit Prices

1. Content of Owner authorization: Whenever Owner authorizes Contractor to perform Work on a unit-price basis, Owner’s authorization shall clearly state:

   a. Scope: Scope of work to be performed;

   b. Reimbursement basis: Type of reimbursement including pre-agreed rates for material quantities; and

   c. Reimbursement limit: Cost limit of reimbursement.

2. Contractor responsibilities: Contractor shall:

   a. Cooperate with Owner and assist in monitoring the Work being performed. As requested by Owner, Contractor shall identify workers assigned to the Change Order Work and areas in which they are working;

   b. Leave access as appropriate for quantity measurement; and

   c. Not exceed any cost limit(s) without Owner’s prior written approval.

3. Cost breakdown consistent with Fixed Price requirements: Contractor shall submit costs in accordance with paragraph 7.02B and satisfy the following requirements:

   a. Unit prices must include overhead, profit, bond and insurance premiums: Unit prices shall include reimbursement for all direct and indirect costs of the Work, including overhead, profit, bond, and insurance costs; and

   b. Owner verification of quantities: Quantities must be supported by field measurement statements signed by Owner.

D. Change Order Pricing – Time-and-Material Prices

1. Content of Owner authorization: Whenever Owner authorizes Contractor to perform Work on a time-and-material basis, Owner’s authorization shall clearly state:

   a. Scope: Scope of Work to be performed;
b. **Reimbursement basis:** Type of reimbursement including pre-agreed rates, if any, for material quantities or labor; and

c. **Reimbursement limit:** Cost limit of reimbursement.

2. **Contractor responsibilities:** Contractor shall:

   a. **Identify workers assigned:** Cooperate with Owner and assist in monitoring the Work being performed. As requested by Owner, identify workers assigned to the Change Order Work and areas in which they are working;

   b. **Provide daily timesheets:** Identify on daily time sheets all labor performed in accordance with this authorization. Submit copies of daily time sheets within 2 working days for Owner’s review.

   c. **Allow Owner to measure quantities:** Leave access as appropriate for quantity measurement;

   d. **Perform Work efficiently:** Perform all Work in accordance with this section as efficiently as possible; and

   e. **Not exceed Owner’s cost limit:** Not exceed any cost limit(s) without Owner’s prior written approval.

3. **Cost breakdown consistent with Fixed Price requirements:** Contractor shall submit costs in accordance with paragraph 7.02B and additional verification supported by:

   a. **Timesheets:** Labor detailed on daily time sheets; and

   b. **Invoices:** Invoices for material.

### 7.03 CHANGE IN THE CONTRACT TIME

A. **COP requests for Contract Time:** The Contract Time shall only be changed by a Change Order. Contractor shall include any request for a change in the Contract Time in its Change Order Proposal.

B. **Time extension permitted if not Contractor’s fault:** If the time of Contractor’s performance is changed due to an act of Force Majeure, or due to the fault or negligence of Owner or anyone for whose acts Owner is responsible, Contractor shall be entitled to make a request for an equitable adjustment in the Contract Time in accordance with the following procedure. No adjustment in the Contract Time shall be allowed to the extent Contractor’s changed time of performance is due to the fault or negligence of Contractor, or anyone for whose acts Contractor is responsible.

1. **Notice and record keeping for Contract Time request:** A request for an equitable adjustment in the Contract Time shall be based on written notice delivered within 7 Days of the occurrence of the event giving rise to the request. If Contractor believes it is entitled to adjustment of Contract Time, Contractor shall immediately notify Owner and begin to keep and maintain complete, accurate, and specific daily records. Contractor shall give Owner access to any such record and if requested, shall promptly furnish copies of such record to Owner.

2. **Timing and content of Contractor’s Notice:** Contractor shall not be entitled to an adjustment in the Contract Time for any events that occurred more than 7 Days before Contractor’s written notice to Owner. The written notice shall set forth, at a minimum, a description of: the event giving rise to the request for an equitable adjustment in the
Contract Time; the nature of the impacts to Contractor and its Subcontractors of any tier, if any; and to the extent possible the amount of the adjustment in Contract Time requested. Failure to properly give such written notice shall, to the extent Owner’s interests are prejudiced, constitute a waiver of Contractor’s right to an equitable adjustment.

3. **Contractor to provide supplemental information:** Within 30 Days of the occurrence of the event giving rise to the request, unless Owner agrees in writing to allow an additional period of time to ascertain more accurate data, Contractor shall supplement the written notice provided in accordance with subparagraph 7.03B.2 with additional supporting data. Such additional data shall include, at a minimum: the amount of delay claimed, itemized in accordance with the procedure set forth herein; specific facts, circumstances, and analysis that confirms not only that Contractor suffered the delay claimed, but that the delay claimed was actually a result of the act, event, or condition complained of, and that the Contract Documents provide entitlement to an equitable adjustment in Contract Time for such act, event, or condition; and supporting documentation sufficiently detailed to permit an informed analysis of the request by Owner. Failure to provide such additional information and documentation within the time allowed or within the format required shall, to the extent Owner’s interests are prejudiced, constitute a waiver of Contractor’s right to an equitable adjustment.

4. **Contractor to proceed with Work as directed:** Pending final resolution of any request in accordance with this paragraph, unless otherwise agreed in writing, Contractor shall proceed diligently with performance of the Work.

C. **Contractor to demonstrate impact on critical path of schedule:** Any change in the Contract Time covered by a Change Order, or based on a request for an equitable adjustment in the Contract Time, shall be limited to the change in the critical path of Contractor’s schedule attributable to the change of Work or event(s) giving rise to the request for equitable adjustment. Any Change Order Proposal or request for an adjustment in the Contract Time shall demonstrate the impact on the critical path of the schedule. Contractor shall be responsible for showing clearly on the Progress Schedule that the change or event: had a specific impact on the critical path, and except in case of concurrent delay, was the sole cause of such impact; and could not have been avoided by resequencing of the Work or other reasonable alternatives.

D. **Cost of change in Contract Time:** Contractor may request compensation for the cost of a change in Contract Time in accordance with this paragraph, 7.03D, subject to the following conditions:

1. **Must be solely fault of Owner or A/E:** The change in Contract Time shall solely be caused by the fault or negligence of Owner or A/E;

2. **Procedures:** Contractor shall follow the procedure set forth in paragraph 7.03B;

3. **Demonstrate impact on critical path:** Contractor shall establish the extent of the change in Contract Time in accordance with paragraph 7.03C; and

4. **Limitations on daily costs:** The daily cost of any change in Contract Time shall be limited to the items below, less the amount of any change in the Contract Sum the Contractor may otherwise be entitled to pursuant to Section 7.02B.7f for any change in the Work that contributed to this change in Contract Time:

   a. **Non-productive supervision or labor:** cost of nonproductive field supervision or labor extended because of delay;

   b. **Weekly meetings and indirect activities:** cost of weekly meetings or similar indirect activities extended because of the delay;
c. **Temporary facilities or equipment rental:** cost of temporary facilities or equipment rental extended because of the delay;

d. **Insurance premiums:** cost of insurance extended because of the delay;

e. **Overhead:** general and administrative overhead in an amount to be agreed upon, but not to exceed 3% of the Contract Award Amount divided by the originally specified Contract Time for each Day of the delay.

**PART 8 – CLAIMS AND DISPUTE RESOLUTION**

**8.01 CLAIMS PROCEDURE**

A. **Claim is Contractor's remedy:** If the parties fail to reach agreement on the terms of any Change Order for Owner-directed Work as provided in Section 7.01, or on the resolution of any request for an equitable adjustment in the Contract Sum as provided in Section 7.02 or the Contract Time as provided in Section 7.03, Contractor's only remedy shall be to file a Claim with Owner as provided in this section.

B. **Claim filing deadline for Contractor:** Contractor shall file its Claim within 120 Days from Owner's final offer made in accordance with paragraph 7.01E, or by the date of Final Acceptance, whichever occurs first.

C. **Claim must cover all costs and be documented:** The Claim shall be deemed to cover all changes in cost and time (including direct, indirect, impact, and consequential) to which Contractor may be entitled. It shall be fully substantiated and documented. At a minimum, the Claim shall contain the following information:

1. **Factual statement of Claim:** A detailed factual statement of the Claim for additional compensation and time, if any, providing all necessary dates, locations, and items of Work affected by the Claim;

2. **Dates:** The date on which facts arose which gave rise to the Claim;

3. **Owner and A/E employee’s knowledgeable about Claim:** The name of each employee of Owner or A/E knowledgeable about the Claim;

4. **Support from Contract Documents:** The specific provisions of the Contract Documents which support the Claim;

5. **Identification of other supporting information:** The identification of any documents and the substance of any oral communications that support the Claim;

6. **Copies of supporting documentation:** Copies of any identified documents, other than the Contract Documents, that support the Claim;

7. **Details on Claim for Contract Time:** If an adjustment in the Contract Time is sought: the specific days and dates for which it is sought; the specific reasons Contractor believes an extension in the Contract Time should be granted; and Contractor's analysis of its Progress Schedule to demonstrate the reason for the extension in Contract Time;

8. **Details on Claim for adjustment of Contract Sum:** If an adjustment in the Contract Sum is sought, the exact amount sought and a breakdown of that amount into the categories set forth in, and in the detail as required by Section 7.02; and
9. **Statement certifying Claim:** A statement certifying, under penalty of perjury, that the Claim is made in good faith, that the supporting cost and pricing data are true and accurate to the best of Contractor’s knowledge and belief, that the Claim is fully supported by the accompanying data, and that the amount requested accurately reflects the adjustment in the Contract Sum or Contract Time for which Contractor believes Owner is liable.

D. **Owner’s response to Claim filed:** After Contractor has submitted a fully documented Claim that complies with all applicable provisions of Parts 7 and 8, Owner shall respond, in writing, to Contractor as follows:

1. **Response time for Claim less than $50,000:** If the Claim amount is less than $50,000, with a decision within 60 Days from the date the Claim is received; or

2. **Response time for Claim of $50,000 or more:** If the Claim amount is $50,000 or more, with a decision within 60 Days from the date the Claim is received, or with notice to Contractor of the date by which it will render its decision. Owner will then respond with a written decision in such additional time.

E. **Owner’s review of Claim and finality of decision:** To assist in the review of Contractor’s Claim, Owner may visit the Project site, or request additional information, in order to fully evaluate the issues raised by the Claim. Contractor shall proceed with performance of the Work pending final resolution of any Claim. Owner’s written decision as set forth above shall be final and conclusive as to all matters set forth in the Claim, unless Contractor follows the procedure set forth in Section 8.02.

F. **Waiver of Contractor rights for failure to comply with this Section:** Any Claim of the Contractor against the Owner for damages, additional compensation, or additional time, shall be conclusively deemed to have been waived by the Contractor unless made in accordance with the requirements of this Section.

8.02 **ARBITRATION**

A. **Timing of Contractor’s demand for arbitration:** If Contractor disagrees with Owner’s decision rendered in accordance with paragraph 8.01D, Contractor shall provide Owner with a written demand for arbitration. No demand for arbitration of any such Claim shall be made later than 30 Days after the date of Owner’s decision on such Claim; failure to demand arbitration within said 30 Day period shall result in Owner’s decision being final and binding upon Contractor and its Subcontractors.

B. **Filing of Notice for arbitration:** Notice of the demand for arbitration shall be filed with the American Arbitration Association (AAA), with a copy provided to Owner. The parties shall negotiate or mediate under the Voluntary Construction Mediation Rules of the AAA, or mutually acceptable service, before seeking arbitration in accordance with the Construction Industry Arbitration Rules of AAA as follows:

1. **Claims less than $30,000:** Disputes involving $30,000 or less shall be conducted in accordance with the Northwest Region Expedited Commercial Arbitration Rules; or

2. **Claims greater than $30,000:** Disputes over $30,000 shall be conducted in accordance with the Construction Industry Arbitration Rules of the AAA, unless the parties agree to use the expedited rules.

C. **Arbitration is forum for resolving Claims:** All Claims arising out of the Work shall be resolved by arbitration. The judgment upon the arbitration award may be entered, or review of the award may
occur, in the superior court having jurisdiction thereof. No independent legal action relating to or arising from the Work shall be maintained.

D. **Owner may combine Claims into same arbitration:** Claims between Owner and Contractor, Contractor and its Subcontractors, Contractor and A/E, and Owner and A/E shall, upon demand by Owner, be submitted in the same arbitration or mediation.

E. **Settlement outside of arbitration to be documented in Change Order:** If the parties resolve the Claim prior to arbitration judgment, the terms of the resolution shall be incorporated in a Change Order. The Change Order shall constitute full payment and final settlement of the Claim, including all claims for time and for direct, indirect, or consequential costs, including costs of delays, inconvenience, disruption of schedule, or loss of efficiency or productivity.

8.03 **CLAIMS AUDITS**

A. **Owner may audit Claims:** All Claims filed against Owner shall be subject to audit at any time following the filing of the Claim. Failure of Contractor, or Subcontractors of any tier, to maintain and retain sufficient records to allow Owner to verify all or a portion of the Claim or to permit Owner access to the books and records of Contractor, or Subcontractors of any tier, shall constitute a waiver of the Claim and shall bar any recovery.

B. **Contractor to make documents available:** In support of Owner audit of any Claim, Contractor shall, upon request, promptly make available to Owner the following documents:

1. Daily time sheets and supervisor’s daily reports;
2. Collective bargaining agreements;
3. Insurance, welfare, and benefits records;
4. Payroll registers;
5. Earnings records;
6. Payroll tax forms;
7. Material invoices, requisitions, and delivery confirmations;
8. Material cost distribution worksheet;
9. Equipment records (list of company equipment, rates, etc.);
11. Contracts between Contractor and each of its Subcontractors, and all lower-tier Subcontractor contracts and supplier contracts;
12. Subcontractors’ and agents’ payment certificates;
13. Cancelled checks (payroll and vendors);
14. Job cost report, including monthly totals;
15. Job payroll ledger;
16. Planned resource loading schedules and summaries;
17. General ledger;
18. Cash disbursements journal;
19. Financial statements for all years reflecting the operations on the Work. In addition, the Owner may require, if it deems it appropriate, additional financial statements for 3 years preceding execution of the Work;
20. Depreciation records on all company equipment whether these records are maintained by the company involved, its accountant, or others;
21. If a source other than depreciation records is used to develop costs for Contractor’s internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents;
22. All nonprivileged documents which relate to each and every Claim together with all documents which support the amount of any adjustment in Contract Sum or Contract Time sought by each Claim;
23. Work sheets or software used to prepare the Claim establishing the cost components for items of the Claim including but not limited to labor, benefits and insurance, materials, equipment, Subcontractors, all documents which establish the time periods, individuals involved, the hours for the individuals, and the rates for the individuals; and
24. Work sheets, software, and all other documents used by Contractor to prepare its bid.

C. Contractor to provide facilities for audit and shall cooperate: The audit may be performed by employees of Owner or a representative of Owner. Contractor, and its Subcontractors, shall provide adequate facilities acceptable to Owner, for the audit during normal business hours. Contractor, and all Subcontractors, shall make a good faith effort to cooperate with Owner’s auditors.

PART 9 – TERMINATION OF THE WORK

9.01 TERMINATION BY OWNER FOR CAUSE

A. 7 Day Notice to Terminate for Cause: Owner may, upon 7 Days written notice to Contractor and to its surety, terminate (without prejudice to any right or remedy of Owner) the Work, or any part of it, for cause upon the occurrence of any one or more of the following events:

1. Contractor fails to prosecute Work: Contractor fails to prosecute the Work or any portion thereof with sufficient diligence to ensure Substantial Completion of the Work within the Contract Time;
2. Contractor bankrupt: Contractor is adjudged bankrupt, makes a general assignment for the benefit of its creditors, or a receiver is appointed on account of its insolvency;
3. Contractor fails to correct Work: Contractor fails in a material way to replace or correct Work not in conformance with the Contract Documents;
4. Contractor fails to supply workers or materials: Contractor repeatedly fails to supply skilled workers or proper materials or equipment;
5. Contractor failure to pay Subcontractors or labor: Contractor repeatedly fails to make prompt payment due to Subcontractors or for labor;

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6. **Contractor violates laws:** Contractor materially disregards or fails to comply with laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction; or

7. **Contractor in material breach of Contract:** Contractor is otherwise in material breach of any provision of the Contract Documents.

B. **Owner's actions upon termination:** Upon termination, Owner may at its option:

1. **Take possession of Project site:** Take possession of the Project site and take possession of or use all materials, equipment, tools, and construction equipment and machinery thereon owned by Contractor to maintain the orderly progress of, and to finish, the Work;

2. **Accept assignment of Subcontracts:** Accept assignment of subcontracts pursuant to Section 5.20; and

3. **Finish the Work:** Finish the Work by whatever other reasonable method it deems expedient.

C. **Surety's role:** Owner's rights and duties upon termination are subject to the prior rights and duties of the surety, if any, obligated under any bond provided in accordance with the Contract Documents.

D. **Contractor’s required actions:** When Owner terminates the Work in accordance with this section, Contractor shall take the actions set forth in paragraph 9.02B, and shall not be entitled to receive further payment until the Work is accepted.

E. **Contractor to pay for unfinished Work:** If the unpaid balance of the Contract Sum exceeds the cost of finishing the Work, including compensation for A/E’s services and expenses made necessary thereby and any other extra costs or damages incurred by Owner in completing the Work, or as a result of Contractor's actions, such excess shall be paid to Contractor. If such costs exceed the unpaid balance, Contractor shall pay the difference to Owner. These obligations for payment shall survive termination.

F. **Contractor and Surety still responsible for Work performed:** Termination of the Work in accordance with this section shall not relieve Contractor or its surety of any responsibilities for Work performed.

G. **Conversion of “Termination for Cause” to “Termination for Convenience”:** If Owner terminates Contractor for cause and it is later determined that none of the circumstances set forth in paragraph 9.01A exist, then such termination shall be deemed a termination for convenience pursuant to Section 9.02.

9.02 **TERMINATION BY OWNER FOR CONVENIENCE**

A. **Owner Notice of Termination for Convenience:** Owner may, upon written notice, terminate (without prejudice to any right or remedy of Owner) the Work, or any part of it, for the convenience of Owner.

B. **Contractor response to termination Notice:** Unless Owner directs otherwise, after receipt of a written notice of termination for either cause or convenience, Contractor shall promptly:

1. **Cease Work:** Stop performing Work on the date and as specified in the notice of termination;
2. No further orders or Subcontracts: Place no further orders or subcontracts for materials, equipment, services or facilities, except as may be necessary for completion of such portion of the Work as is not terminated;

3. Cancel orders and Subcontracts: Cancel all orders and subcontracts, upon terms acceptable to Owner, to the extent that they relate to the performance of Work terminated;

4. Assign orders and Subcontracts to Owner: Assign to Owner all of the right, title, and interest of Contractor in all orders and subcontracts;

5. Take action to protect the Work: Take such action as may be necessary or as directed by Owner to preserve and protect the Work, Project site, and any other property related to this Project in the possession of Contractor in which Owner has an interest; and

6. Continue performance not terminated: Continue performance only to the extent not terminated

C. Terms of adjustment in Contract Sum if Contract terminated: If Owner terminates the Work or any portion thereof for convenience, Contractor shall be entitled to make a request for an equitable adjustment for its reasonable direct costs incurred prior to the effective date of the termination, plus reasonable allowance for overhead and profit on Work performed prior to termination, plus the reasonable administrative costs of the termination, but shall not be entitled to any other costs or damages, whatsoever, provided however, the total sum payable upon termination shall not exceed the Contract Sum reduced by prior payments. Contractor shall be required to make its request in accordance with the provisions of Part 7.

D. Owner to determine whether to adjust Contract Time: If Owner terminates the Work or any portion thereof for convenience, the Contract Time shall be adjusted as determined by Owner.

PART 10 – MISCELLANEOUS PROVISIONS

10.01 GOVERNING LAW

Applicable law and venue: The Contract Documents and the rights of the parties herein shall be governed by the laws of the state of Washington. Venue shall be in the county in which Owner’s principal place of business is located, unless otherwise specified.

10.02 SUCCESSORS AND ASSIGNS

Bound to successors; Assignment of Contract: Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to the other party hereto and to partners, successors, assigns, and legal representatives of such other party in respect to covenants, agreements, and obligations contained in the Contract Documents. Neither party shall assign the Work without written consent of the other, except that Contractor may assign the Work for security purposes, to a bank or lending institution authorized to do business in the state of Washington. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations set forth in the Contract Documents.

10.03 MEANING OF WORDS

Meaning of words used in Specifications: Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Reference to standard specifications, manuals, or codes of any technical society, organization, or association, or to the code of any governmental authority,
whether such reference be specific or by implication, shall be to the latest standard specification, manual, or code in effect on the date for submission of bids, except as may be otherwise specifically stated. Wherever in these Drawings and Specifications an article, device, or piece of equipment is referred to in the singular manner, such reference shall apply to as many such articles as are shown on the drawings, or required to complete the installation.

10.04 RIGHTS AND REMEDIES

No waiver of rights: No action or failure to act by Owner or A/E shall constitute a waiver of a right or duty afforded them under the Contract Documents, nor shall action or failure to act constitute approval or an acquiescence in a breach therein, except as may be specifically agreed in writing.

10.05 CONTRACTOR REGISTRATION

Contractor must be registered or licensed: Pursuant to RCW 39.06, Contractor shall be registered or licensed as required by the laws of the State of Washington, including but not limited to RCW 18.27.

10.06 TIME COMPUTATIONS

Computing time: When computing any period of time, the day of the event from which the period of time begins shall not be counted. The last day is counted unless it falls on a weekend or legal holiday, in which event the period runs until the end of the next day that is not a weekend or holiday. When the period of time allowed is less than 7 days, intermediate Saturdays, Sundays, and legal holidays are excluded from the computation.

10.07 RECORDS RETENTION

Six year records retention period: The wage, payroll, and cost records of Contractor, and its Subcontractors, and all records subject to audit in accordance with Section 8.03, shall be retained for a period of not less than 6 years after the date of Final Acceptance.

10.08 THIRD-PARTY AGREEMENTS

No third party relationships created: The Contract Documents shall not be construed to create a contractual relationship of any kind between: A/E and Contractor; Owner and any Subcontractor; or any persons other than Owner and Contractor.

10.09 ANTITRUST ASSIGNMENT

Contractor assigns overcharge amounts to Owner: Owner and Contractor recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by the purchaser. Therefore, Contractor hereby assigns to Owner any and all claims for such overcharges as to goods, materials, and equipment purchased in connection with the Work performed in accordance with the Contract Documents, except as to overcharges which result from antitrust violations commencing after the Contract Sum is established and which are not passed on to Owner under a Change Order. Contractor shall put a similar clause in its Subcontracts, and require a similar clause in its sub-Subcontracts, such that all claims for such overcharges on the Work are passed to Owner by Contractor.

10.10 HEADINGS AND CAPTIONS

Headings for convenience only: All headings and captions used in these General Conditions are only for convenience of reference, and shall not be used in any way in connection with the meaning, effect, interpretation, construction, or enforcement of the General Conditions, and do not define the limit or describe the scope or intent of any provision of these General Conditions.
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These University of Washington Modifications to the General Conditions form a part of, and are incorporated in the Contract Documents and modify, delete, add, and replace provisions of the General Conditions. Provisions not altered remain in effect. All terms defined elsewhere in the Contract Documents shall have the same meaning here.

PART 1 – GENERAL PROVISIONS

1.01 DEFINITIONS

Add the following definitions:

Certified Business Enterprise (CBE): Any business enterprise certified with the Washington State Office of Minority and Women’s Business Enterprises (OMWBE), Northwest Mountain Minority Supplier Diversity Council (NWMMSDC), or Women’s Business Enterprise Council (WBEC).

Lesbian/Gay/Bisexual/Transgender Business Enterprise (LGBTBE): More than 50% owned and controlled by at least one person who is a member of the LGBT community.

Minority Business Enterprise (MBE): More than 50% owned and controlled by at least one person who is a member of one or more of the following minority groups:
- Asian Pacific American
- Black American
- Hispanic American
- Native American
- Subcontinent Asian American

Minority Women’s Business Enterprise (MWBE): More than 50% owned and controlled by at least one woman who is a member of one or more of the above minority groups.

Small Business Enterprise (SBE): A business entity that:
- Can attest that it is owned and operated independently from all other businesses and
- Conforms to the U.S. Small Business Administration Size Standards of the North American Industry Classification System (NAICS) Codes in which it is to be engaged at the UW; or
- Is certified with the OMWBE.

Veteran’s Business Enterprise (VBE): Certified with the Washington State Department of Veteran’s Affairs (DVA)

Women’s Business Enterprise (WBE): More than 50% owned and controlled by one or more women.

PART 2 – INSURANCE AND BONDS

2.01 Contractor’s Liability Insurance
• Add the following language to the end of the first paragraph of section 2.01:

“The certificate holder shall be:
UW Facilities, Project Delivery Group
University of Washington
Box 352205
Seattle, WA 98195”

A policy for Commercial General Liability Insurance which includes coverage for bodily injury, property damage, premises operations, independent contracts, and broad-form contractual liability, and Stop Gap, unless as Employer Liability under Part B of Worker’s Compensation Insurance Policy.

Products Completed Operations Additional Insured. The Contractor’s CGL insurance must include the Owner as an additional insured status on ISO CG 20 10 11 85 or CG 20 37 endorsement, or by an equivalent policy or endorsement provisions. The Product Completed Operations additional insured status for the Owner must remain in effect for not less than 3 years following Final Completion.

• Delete subparagraph 2.01A2 and replace it with the following language:

“Automobile Liability Insurance:
Commercial Automobile Liability with a combined single limited of not less than $1,000,000 for each accident. Coverage shall include Bodily Injury and Property Damage Liability for all owned, non-owned, leased, and hired automobiles and contain a Waiver of Subrogation in favor of the Owner. If pollutants are to be transported, MCS 90 and CA 99 48 endorsements are required on the Automobile Liability policy unless the transportation pollution risk covered under a Pollution Liability insurance policy carried by the Contractor.

• Delete paragraph 2.01D and replace it with the following language:

“Owner as Additional Insured: All insurance coverages shall name the Board of Regents of the University of Washington as an additional insured with respect to liability arising out of work performed by Contractor, and an additional insured endorsement to the policy must be provided to the Owner. All insurance coverages shall be endorsed to be primary and non-contributory with any insurance maintained by the University of Washington, provide a waiver of any rights of subrogation against the University of Washington, and contain a severability of interest provision in favor of the University of Washington, and all insurance certificates shall evidence full compliance with the enumerated requirements. If the contract amount, including alternates, is less than $5 million, the primary and non-contributory endorsement is not mandatory.”

The Contractor must provide a Pollution Liability policy for pollutants that are or may be remediated on or off site covering claims, including investigation, defense, or settlement costs and expenses that involve bodily injury and property damage (including natural resources damages and loss of use of tangible property that has not been physically injured) covering:

Pollution conditions caused or made worse by the Contractor, including clean-up costs for a newly caused condition or a historical condition that is made worse the vicarious liability of subcontractors of any tier.

The Pollution Liability insurance must provide a minimum limit of liability of $1,000,000 each claim with a minimum aggregate limit of 200% of the each claim limit. There is no requirement for a dedicated project aggregate limit provided that the Contractor (1) submits to the Owner before the Notice to Proceed Date with its insurance certification a written statement from its authorized insurance representative that the full minimum aggregate limit is available and has...
not been impaired by any claims reserved on another project, and (2) thereafter, until the completion of the Work, provides notice in writing to the City within 10 Days of Contractor’s constructive knowledge of any pending or actual impairment of the aggregate limit. If in-Transit Pollution Liability is required but is not provided under the Automobile Liability, the Contractor must provide evidence of transportation coverage under the Contractor’s Pollution Liability policy.

2.04 Payment and Performance Bonds

- Delete the last sentence of section 2.04 and replace it with the following language:
  “No payment or performance bond is required if the Contract Sum is $150,000 or less and Contractor agrees that Owner may, in lieu of the bond, retain 10% of the Contract Sum for the period allowed by RCW 39.08.010.”

PART 5 - PERFORMANCE

5.01 Contractor Control and Supervision

Add a new paragraph 5.01G as follows:

“Work During Off Hours: When work is to be performed during other than normal working hours or on University of Washington holidays, Contractor shall give Owner prior notice so that Owner’s Police Department may be properly notified. Any construction activity between the hours of 10:00 p.m. to 6:00 a.m. is subject to approval of Owner.”

Add a new paragraph 5.01H as follows:

“Contractor to comply with University of Washington’s campus conduct code: Contractor shall ensure that its owner(s) and employees, and those of its Subcontractors, comply with the University’s conduct on campus code, WAC 478-124-020, which, among other things, prohibits the possession or use of firearms or other dangerous weapons or instrumentalities on the University campus, except for authorized University purposes. At the discretion of the University, Contractor shall remove from the University campus, at its sole cost and expense, any of its, or its Subcontractors’ employees, if they are in violation of this code.”

5.02 Permits, Fees and Notice

Add a new paragraph 5.02D as follows:

“For Work within the City of Seattle, Owner shall pay the City of Seattle directly for the cost of the Master Use and Building Permit. Prior to Final Acceptance, the building permit and City-approved drawings, signed inspection card(s), and any appropriate occupancy permits shall be submitted to Owner.”

5.07 Safety Precautions

- Add a new paragraph 5.07I as follows:
  “In order to receive a Notice to Proceed, the Contractor must submit the following to Owner:

  1. A copy of its company Safety Program. The Safety Program shall contain, at a minimum, the following:
    a. Organization, including names of individuals who will perform safety duties, titles, work assignments, authority and reporting relationships.”

Last Revised: November 27, 2019
b. Training Program. Who, how and when training is provided; method of employee training concerning safety rules and procedures; training in use of protective equipment.

c. Protective Equipment. List of personal protective equipment to be provided to employees.

d. Accident Prevention and Loss Control Plan. Work site inspection and hazard correction procedures; disciplinary procedures for safety infractions; accident response, investigation and reporting procedures.

e. Regular Safety Meetings. On-site weekly or other frequency as appropriate, safety meetings mandatory for all employees."

- Add a new paragraph 5.07J as follows:

  "Prior to commencing any Work on-site, Contractor shall submit an appropriate site specific safety plan for Owner’s acceptance. The plan must be tailored to the needs of the particular project and to the types of hazards involved, and be in compliance with WISHA requirements. Contractor shall not begin any on-site Work until the site specific safety plan has been accepted by Owner."

- Add a new paragraph 5.07K

  "With its monthly Application for Payment, the Contractor shall submit the Monthly Safety report on the form in Appendix A.

5.10 Unforeseen Physical Conditions

Add a new paragraph 5.10C as follows:

  "If Contractor encounters mold in the course of its work it shall notify Owner to evaluate what action might be necessary. Contractor shall ensure that all building materials used during the work are dry prior to incorporation into the Work. If Contractor encounters water intrusion from any source it shall take immediate steps to ensure that any effected material is dry according to generally accepted industry standards."

5.13 Material and Equipment

Add the following new sentence after the last sentence of paragraph 5.13A:

  "Contractor shall ensure that all equipment, materials and articles incorporated into the Work shall be asbestos free."

5.20 Subcontractors and Suppliers

Add the following new subparagraph 5.20A6 as follows:

  "For contracts entered into between September 1, 2010 and December 31, 2013, not have violated the reporting requirements of RCW 39.04.370 more than one time, as determined by the Department of Labor and Industries."

5.23 Contractor Performance Evaluation

Add a new section 5.23 as follows:
"CONTRACTOR PERFORMANCE EVALUATION"

Owner shall evaluate Contractor for the performance categories as set forth in the “Contractor Performance Evaluation Report” in Appendix A. Section 00 73 20, Contractor Performance Evaluation Program, describes the evaluation process.

PART 6 – PAYMENTS AND COMPLETION

6.07 Substantial Completion

Delete the second sentence of paragraph 6.07 and replace it with the following language:

“All Work other than incidental corrective and incidental punch list work shall be completed.”

PART 7 – CHANGES

7.02 Change in the Contract Sum

- Add the following new sentence after the second sentence of subparagraph 7.02B7a:

  “When estimating labor hours for electrical work, such hours shall be no greater than the Labor Units for specific items included in the “Normal” project conditions column of the NECA Manual of Labor Units, most recent edition. When estimating labor hours for mechanical work, such hours shall be no greater than 75% of the Labor Units for specific items included in the MCAA Web-Based Estimating Manual (WebLEM), subject to the assumptions and notes in the WebLEM, except that the Labor Units for “Hangers, Sleeves, & Inserts” shall be no greater than 50% of the WebLEM Labor Units. Special exceptions for electrical and mechanical work may be made for work having to be performed under extraordinary conditions. Such exceptions shall be identified and explained in any applicable pricing proposals and shall be subject to approval by Owner.”

- Delete the last sentence of subparagraph 7.02B7a(1) and replace it with the following:

  “No supervision markup shall be allowed in a Change Order that contains direct labor costs for a working supervisor’s hours (including any category of foreman).”

- Replace subparagraph 7.02B7b in its entirety with the following:

  “Material costs: This is an itemization of the quantity and cost of materials needed to perform the change in the Work. Material costs shall be developed first from actual known costs, including, but not limited to, Contractors’ supplier(s)’ actual cost(s) available from the standard industry pricing guide “Trade Service”, second from supplier quotations, or, if these are not available, and third from other standard industry pricing guides.

  Material costs shall include all available discounts. Freight costs, express charges, or special delivery charges, shall be itemized.”

- Add the following new language after the second sentence of subparagraph 7.02B7c:
“The Contractor's cost for utility vehicles and other items such as pickup trucks, vans, flatbed trucks, storage trailers, containers, etc., that are already in use or planned for use on the Project will not be compensated in Change Order work except for the time that, in the opinion of the Owner, such items: (1) are directly and necessarily used for the performance of the change work; and (2) the cost of using such items has not been included within the Contractor's total project overhead costs.”

- Add the following new language after the last sentence of subparagraph 7.02B7c(2):

  “Equipment pricing shall be no greater than 75% of NECA monthly rates.”

- Delete the first sentence of subparagraph 7.02B7d and replace it with the following language:

  “Small tools consist of tools which cost $1,000 or less and are normally furnished by the performing contractor.”

PART 8 - CLAIMS AND DISPUTE RESOLUTION

8.02 Replace section 8.02 in its entirety with the following:

“LITIGATION

A. If Contractor disagrees with Owner's decision rendered in accordance with paragraph 8.01D, Contractor shall serve and file a lawsuit in an appropriate court within 120 days of Owner's decision. This requirement cannot be waived except by an explicit waiver signed by Owner. The failure to file a lawsuit within said 120-day period shall result in Owner's decision rendered in accordance with paragraph 8.01D being final and binding on Contractor and all of its Subcontractors.

B. At any time, either before or after a lawsuit has been commenced by Contractor in accordance with paragraph 8.02A, Owner may require Contractor to participate in further mediation or arbitration, or both, in any forum or format as determined by Owner.

C. Claims between Owner and Contractor, Contractor and its Subcontractors, Contractor and A/E, and Owner and A/E shall, upon demand by Owner, be submitted in a single forum, or Owner may consolidate such Claims or join any of the above-named parties in the same forum.”

PART 10 - MISCELLANEOUS PROVISIONS

10.11 Add a new section 10.11 as follows:

“Business Equity Requirements

A. General Requirements

Contractor shall conduct business in an equitable and inclusive manner. The University of Washington welcomes the participation of all Business Equity Enterprises (BEE), irrespective of gross revenues, including those that are self-designated and those that are state (OMWBE) certified. Participation may be on a direct basis in response to this invitation to bid, or as a subcontractor or supplier. The University of Washington has set an overall aspirational goal of 20% BEE utilization, inclusive of 15% minority and women-owned business utilization across our public works program."
Contractor shall comply with the following requirements:
In accordance with Chapter 39.19 RCW, it is the policy of the State of Washington to provide the maximum practicable opportunity for increased participation by minority and women-owned and controlled businesses (MWBE) in public works.

The Washington State Office of Minority and Women's Business Enterprises (OMWBE) certifies firms that are owned and controlled by minorities or women, and can provide information regarding the certification process. Information about the certification status of a particular firm is available at the following OMWBE website address: http://www.omwbe.wa.gov/biznetwas/, or by contacting OMWBE at (360) 753-9693, 406 South Water, P.O. Box 41160, Olympia, Washington 98504-4611.

B. Inclusion Efforts

1. The identified lowest responsive bidder shall submit, as provided by the Owner, a BEE Contribution Form, along with their Schedule of Values for review. The BEE Contribution Form shall include a project specific BEE inclusion goal and capture the efforts and business practices the Contractor used to ensure that BEEs have the maximum practicable opportunity to participate and be included in the project. The BEE Contribution Form shall be complete and the information in each section shall demonstrate the Contractor's approach to providing these opportunities and the inclusion of BEE. The BEE Contribution Form is subject to review and approval by the Owner. The Owner may request clarification and/or corrections, however, non-responsive or incomplete Forms may be grounds for rejecting the Bidder as not responsible.

2. Contractors shall:
   a. Advertise opportunities for subcontractors or suppliers in a manner reasonably designed to provide BEEs capable of performing the work with timely notice of such opportunities, and all advertisements shall include a provision encouraging participation by BEE firms. Advertising may be done through general advertisements (e.g., newspapers, journals, etc.) or by soliciting bids/proposals directly from BEEs.
   b. Provide BEEs that express interest with adequate and timely information about plans, specifications, schedules, and requirements of the Contract.

3. Contractors are further encouraged to:
   a. Break down work into tasks or quantities that are appropriately sized for the intended subcontractor and/or BEE, in order to permit maximum participation by BEEs and other small businesses.
   b. Establish delivery schedules, where the requirements of this contract permit, that encourage participation by BEEs and other small businesses.
   c. Reduce bonding requirements where practicable.
   d. Utilize the services of available minority community organizations, minority contractor groups, local minority assistance offices and organizations that provide assistance in the recruitment and placement of BEEs and other small businesses.

C. Reporting Requirements
1. With the application for Progress Payment, Contractor shall submit a list of all BEE subcontractors/suppliers paid during the payment period along with any certification or Self-Declaration information. The Owner has provided a BEE Declaration Form, which is to be completed by every subcontractor, supplier, and materialman or similar on the project.

2. Prior to Final Acceptance, Contractor shall submit a report of total dollar amounts paid to BEEs.

D. Non-Discrimination

Contractors shall not create barriers to open and fair opportunities to all businesses including BEEs to participate in University contracts and to obtain or compete for contracts and subcontracts as sources of supplies, equipment, construction and services. In considering offers from and doing business with subcontractors and suppliers, the Contractor shall not discriminate on the basis of race, color, creed, religion, sex, age, nationality, marital status, or the presence of any mental or physical disability in an otherwise qualified disabled person.

E. Sanctions

Failure to comply with any of the mandatory requirements of this part of the contract may subject the Contractor to sanctions or damages as provided for by RCW 39.19.090, or by other applicable laws."

END OF SECTION
These Supplemental Conditions form a part of, and are incorporated in, the Contract Documents and modify, delete, add, and replace provisions of the General Conditions. Provisions not altered remain in effect. All terms defined elsewhere in the Contract Documents shall have the same meaning in these Supplemental Conditions.

00 73 01 TIME OF COMPLETION AND LIQUIDATED DAMAGES

The Work shall be commenced on the effective date specified in the Notice to Proceed and shall be substantially complete within a period not to exceed:

(162) One Hundred Sixty-Two calendar days from Notice to Proceed for rooms 190, 191, 194, 196, 2295, 2297, 2299

(92) Ninety-Two calendar days from Notice to Proceed for Room 180, and 193.

Failure to achieve Substantial Completion of the Work within the time provided, Contractor shall pay Owner $1,000 for each calendar day from the date when Substantial Completion should have been achieved to the date Substantial Completion is actually achieved. The provisions of the General Conditions section 3.07, for liquidated damages, remain in effect.

00 73 02 CONTRACTOR'S LIABILITY INSURANCE

Delete paragraph 2.01D and replace it with the following language:

“Owner as Additional Insured: All insurance coverages shall name King County and the University of Washington, their boards, their officers, agents and employees, as an additional insured with respect to liability arising out of work performed by Contractor, and an additional insured endorsement to the policy must be provided to the Owner. All insurance coverages shall be endorsed to be primary and non-contributory with any insurance maintained by the University of Washington, provide a waiver of any rights of subrogation against the University of Washington, and contain a severability of interest provision in favor of the University of Washington, and all insurance certificates shall evidence full compliance with the enumerated requirements. If the contract amount, including alternates, is less than $5 million, the primary and non-contributory endorsement is not mandatory.”

Add new item E to Section 2.01 as follows:

Products Completed Operations Additional Insured. The Contractor’s CGL insurance must include the King County, and the University of Washington, their boards, their officers, agents, and employees as an additional insured status on ISO CG 20 10 11 85 or CG 20 37 endorsement, or by an equivalent policy or endorsement provisions. The Product Completed Operations additional insured status for the Owner must remain in effect for not less than 6 years following Final Completion.
SECTION 00 73 04 BUILDER’S RISK

Delete Section 2.06 A and B and replace with the following new Section 2.06 A:

Owner will purchase and maintain Builder’s Risk property insurance in the amount of the Contract Sum including all Change Orders for the entire Work on a replacement cost basis until Substantial Completion. Contractor shall be responsible for all losses up to the policy deductible amount of $10,000 per occurrence. A specimen policy is available for inspection. Contractor is not required to obtain Builder’s Risk property insurance. All other provisions of the General Conditions Section 2.06, Builder’s Risk, remain in effect except that Architects and Engineers (A/E’s) and A/E’s Subconsultants are deleted from paragraph C.

If the Contractor believes it has a loss that is covered by Builder’s Risk/Property Insurance, and it is likely to exceed the policy deductible, the Contractor shall notify the Owner within 48 hours.

Owner will purchase and maintain Builder’s Risk property insurance in the amount of the Contract Sum including all Change Orders for the entire Work on a replacement cost basis until Substantial Completion. Contractor shall be responsible for all losses up to the policy deductible amount of $250,000 per occurrence. A specimen policy is available for inspection. Contractor is not required to obtain Builder’s Risk property insurance. All other provisions of the General Conditions Section 2.06, Builder’s Risk, remain in effect except that Architects and Engineers (A/E’s) and A/E’s Subconsultants are deleted from paragraph C.

If the Contractor believes it has a loss that is covered by Builder’s Risk/Property Insurance, and it is likely to exceed the policy deductible, the Contractor shall notify the Owner within 48 hours.

Owner will purchase and maintain Builder’s Risk property insurance in the amount of the Contract Sum including all Change Orders for the entire Work on a replacement cost basis until Substantial Completion. Contractor shall be responsible for all losses up to the policy deductible amount of $5,000 per occurrence for projects valued at $500,000 or
less; and $10,000 per occurrence for projects valued at more than $500,000. A specimen policy is available for inspection. Contractor is not required to obtain Builder’s Risk property insurance. All other provisions of the General Conditions Section 2.06, Builder’s Risk, remain in effect except that Architects and Engineers (A/E’s) and A/E’s Subconsultants are deleted from paragraph C.

If the Contractor believes it has a loss that is covered by Builder’s Risk/Property Insurance, and it is likely to exceed the policy deductible, the Contractor shall notify the Owner within 48 hours.

In Section 2.06, delete the following from paragraph C: “A/E, A/E’s subconsultants” and renumber paragraph C as paragraph B.

00 73 05 PARTNERING
   A. Not used

00 73 06 CLAIMS AND DISPUTE RESOLUTION
   A. Not Used

00 73 07 PERMITS REQUIRED
   A. Not Used

00 73 08 ENVIRONMENTAL MITIGATION
   A. Not Used.

00 73 09 FINAL PAYMENT
   A. Not Used.

00 73 10 APPRENTICESHIP UTILIZATION REQUIREMENTS

   10.12  APPRENTICE UTILIZATION REQUIREMENTS

   A. The Contractor shall ensure that at least 15% of the total labor hours utilized on the project are performed by apprentices registered with the Washington State Apprenticeship and Training Council.

   1. Total labor hours include additional hours worked as a result of change orders.

   2. Total labor hours exclude hours worked by foremen, superintendents, supervisors, owners, and workers who are not subject to prevailing wage requirements. However, total labor hours shall include the hours worked by supervisors, foremen, and superintendents if it is determined they are subject to prevailing wage requirements pursuant to Washington Administrative Code (WAC) 296-127-015.
3. Total labor hours includes all hours worked by the Contractor and all subcontractors on the Project.

B. The Contractor shall meet or exceed the apprentice utilization requirements of the Contract Documents on all labor hours on the Project. The Owner has determined a monetary incentive of $\underline{500}$ for meeting the goals, and a monetary penalty of $\underline{200}$ for not meeting the goals.

C. The Contractor shall include the apprentice utilization requirements of Paragraph A, above, in all subcontracts executed for the Project.

D. If, during the term of the Contract, the Contractor determines that it will be unable to meet the percentage utilization requirement in Paragraph A, above, the Contractor may make a written request to the Owner to reduce the required percentage. The request shall include documentation of:

1. The demonstrated lack of availability of apprentices in specific geographic areas; and/or

2. A disproportionately high ratio of material costs to labor hours, which does not make feasible the required minimum levels of apprentice participation; and/or

3. Participating contractors have demonstrated a good faith effort to comply with the requirements of RCW 39.04.300 and 39.04.310.

E. The Owner shall evaluate the request, and if appropriate, a change order shall be prepared by the Owner reducing the utilization requirement.

F. With its monthly Application for Payment, the Contractor shall submit the Apprentice and Journey Level Worker Utilization Report on the form in Appendix A.

00 3 11 BEE REQUIREMENTS

A. Not Used.

END OF SECTION
I. POLICY

The University of Washington through its Capital Planning and Development service group (Owner), is charged with the responsibility of ensuring that all public works improvement projects are awarded to the responsible bidder submitting the lowest responsive bid, and are performed in compliance with the Contract Documents and applicable federal, state, and local laws and regulations. The Owner is responsible to the citizens of the State to oversee the expenditure of public funds, and to secure the best possible results for that expenditure. To assist the Owner in evaluating a Contractor's responsibility, as well as its performance on contracts of the Owner, the Contractor Performance Evaluation Program has been developed. The implementation of a mandatory, standardized system of evaluating Contractors' performance is expected to yield consistency, objectivity, fairness, and accountability.

II. PURPOSE

The purpose of the Contractor Performance Evaluation Program is to better assure that Contractors considered for contract award on public works projects either possess, or will likely possess at the time contract performance is set to begin, all qualifications necessary to successfully complete the project on time. Among other things, the Program is intended to:

° Assist the Owner in exercising its discretion to determine a Contractor's qualifications and abilities to successfully perform a particular contract.
° Provide the Owner with a rational basis for determining that a Contractor is or is not responsible.
° Provide Contractors with a means of enhancing their qualifications and reputation by receiving recognition for high standards of performance.
° Encourage better working relationships between the Owner and Contractors.
° Provide official, verifiable references for Contractors who may be under consideration for award of, or approval on, contracts to be awarded by other public owners.
° Provide a history and an assessment of a Contractor's performance on prior contracts of the Owner for use in suspension or debarment proceedings.

The Contractor Performance Evaluation Program is not intended to determine whether a Contractor has breached a contract with the Owner, or to determine the acceptability of any particular noncompliance with Contract requirements.

III. PERFORMANCE CATEGORY EVALUATION GUIDE

The Performance Category Evaluation Guide establishes criteria to be used in evaluating the Contractor's performance in connection with each Performance Category, and describes five Performance Levels, which range in ascending order of merit from "Inadequate" to "Superior".
The "Standard" Performance Level is considered a baseline; it characterizes the level of acceptable performance normally associated with a reasonably prudent, diligent, and skilled Contractor working on projects of the same general type and size. Both the "Superior" and "Good" Levels characterize performance levels that exceed the baseline; they respectively connote consistent and substantial positive contributions to the overall project. Both the "Deficient" and "Inadequate" Levels characterize levels of performance that fall below the baseline, and respectively connote substantial and serious detriment to the overall project. The "No Evaluation" Level is to be used only where the Contractor had no direct or indirect responsibility for performance.

The five Performance Levels are more specifically described as follows, and the criteria set forth for each shall be applied in evaluating the Contractor's performance in connection with each of the Performance Categories listed in Section III of the Contractor Performance Evaluation Report:

A. Superior  To merit an evaluation of "Superior" in any Performance Category, the Contractor must have consistently demonstrated:

   (1) Command or virtual mastery of the Contract Documents related to that Performance Category;

   (2) Performance of the work or activity being evaluated under that Performance Category that always exceeded or surpassed the material requirements of the Contract;

   (3) A highly cooperative attitude in dealing with Owner’s employees, consultants, and the public in connection with that Performance Category, which attitude made a substantial, positive contribution to the Project; and

   (4) Initiative in carrying out his or her duties in connection with that Performance Category in a responsive, thorough, and timely manner without prompting by the Owner’s Representative.

If the Contractor fails to satisfy any one of the Performance Level criteria set out above, then his or her performance will be re-evaluated under the "Good" Level by applying the criteria for that Level.

B. Good  To merit an evaluation of "Good" in any Performance Category, the Contractor must have demonstrated:

   (1) Thorough knowledge of Contract Documents related to that Performance Category;

   (2) Performance of the work or activity being evaluated under that Performance Category that always met, and often exceeded, the material requirements of the Contract;

   (3) A cooperative attitude in dealing with Owner’s employees, consultants, and the public in connection with that Performance Category, which attitude made a positive contribution to the project; and
(4) Initiative in carrying out his or her duties in connection with that Performance Category in a responsive, thorough, and timely manner with only minimal prompting by the Owner’s Representative.

If the Contractor fails to satisfy any one of the Performance Level criteria set out above, then his or her performance will be re-evaluated under the "Standard" Level by applying the criteria for that Level.

C. Standard To merit an evaluation of "Standard" in any Performance Category, the Contractor must have demonstrated:

   (1) Acceptable knowledge of the Contract Documents related to that Performance Category;

   (2) Performance of the work or activity being evaluated under that Performance Category that met all material Contract requirements;

   (3) A generally cooperative attitude toward Owner’s employees, consultants, and the public in connection with that Performance Category; and

   (4) Initiative in carrying out his or her duties in connection with that Performance Category in a responsive, thorough, and timely manner with only moderate prompting by the Owner’s Representative.

If the Contractor fails to satisfy any one of the Performance Level criteria set out above, then his or her performance will be re-evaluated under the "Deficient" and "Inadequate" Levels by applying the criteria for those Levels.

D. Deficient To merit an evaluation of "Deficient" in any Performance Category, the Contractor must have demonstrated:

   (1) Marginal knowledge of the Contract Documents related to that Performance Category;

   (2) Performance of the work or activity being evaluated under that Performance Category that did not always meet the material Contract requirements, and such failures were not excusable as the sole fault and responsibility of one or more other parties;

   (3) An occasionally uncooperative attitude toward Owner’s employees, consultants, or the public in connection with that Performance Category; or

   (4) Performance of his or her duties in connection with that Performance Category in a moderately unresponsive, inattentive, or dilatory manner, or after frequent or repeated prompting by the Owner’s Representative.

E. Inadequate To merit an evaluation of "Inadequate" in any Performance Category, the Contractor must have either: (a) failed to satisfy the criteria listed for the Performance Levels of "Superior", "Good", "Standard", and "Deficient" set out above and did not qualify for treatment under Section III.F below; or (b) must have demonstrated:
(1) Inadequate knowledge of the Contract Documents related to that Performance Category;

(2) Performance of the work or activity being evaluated under that Performance Category which seldom met the material Contract requirements, and such failures were not excusable as the sole fault and responsibility of one or more other parties;

(3) A seriously uncooperative attitude toward Owner’s employees, consultants, or the public in connection with that Performance Category; or

(4) Performance of his or her duties in connection with that Performance Category in a seriously unresponsive, inattentive, or dilatory manner, or only after frequent prompting by Owner’s Representative.

F. No Evaluation. This rating should only be used in those circumstances where the Contractor had no contractual responsibility, either directly or through its subcontractors, suppliers, or materialmen, for performance related to that Performance Category.

IV. OVERALL EVALUATION GUIDE

The Contractor's Overall Evaluation can be determined by placing the Overall Percentage Score calculated on the Contractor Performance Evaluation Report within the numerical ranges of the following narrative ratings in the Overall Evaluation Guide:

A. SUPERIOR (Overall Percentage Score of 90% or above)

The Contractor exceeded the Contract requirements and expectations in most or all of the areas evaluated. The Contractor was extremely or completely knowledgeable regarding Contract requirements and applicable laws and regulations. A consistently high level of cooperation, project management, and job site control appreciably contributed to an unusually good result. The Contractor is commended for excellent performance.

B. GOOD (Overall Percentage Score of 70% to 89%)

The Contractor met Contract requirements evaluated, and exceeded them in some areas. The Contractor was generally cooperative, and performed his/her work with a minimum of prompting. The results of the performance were very good.

C. STANDARD (Overall Percentage Score of 50% to 69%)

The Contractor generally satisfied the minimum requirements of the Contract as evaluated. The Contractor occasionally had to be prompted or reminded of Contract requirements, but overall management of the Project was good, producing a good result.

D. DEFICIENT (Overall Percentage Score of 30% to 49%)

Even though the Project may have been accepted, the Contractor's performance as evaluated was marginal overall. While the Contractor
performed some tasks satisfactorily, most elements evaluated reflected a less than satisfactory response to Contract requirements.

E. **INADEQUATE** (Overall Percentage Score of 29% or below)

The Contractor's performance as evaluated did not meet minimum Contract requirements, or so otherwise detracted from the Project as to seriously call it into jeopardy. While the Project may have been accepted by the Owner, the effort expended by the Owner’s Representative in prompting the Contractor to perform was excessive. The Contractor's poor or uncooperative performance created serious unnecessary or avoidable difficulties in achieving contract completion.

A Contractor's Overall Evaluation, being based upon an averaged rate on a discrete number of Performance Categories, should not be read or interpreted as a measure of whether the Contractor did or did not breach the contract in question.

V. **PERFORMANCE EVALUATION REPORTS**

Each Contractor Performance Evaluation Report shall be prepared by, or at the direction of, the Owner’s Representative who will include numerical ratings substantiated, when necessary, by one or more narratives which describe the Contractor's performance.

Every Contractor Performance Evaluation Report containing Performance Level evaluations of "Deficient" or "Inadequate", and all Overall Evaluations on projects the total cost of which is $500,000 or more, shall contain one or more narratives which provide details substantiating the evaluations. Narratives may be provided for other Performance Categories as the evaluator deems necessary.

Narratives provided with a Contractor Performance Evaluation Report shall be based upon documentation prepared during the life of the project, e.g., project diaries, inspectors' reports, and other pertinent documents. Such documentation shall constitute a major portion of the administrative record to be used for any review, appeal, or litigation that may arise from the evaluation process.

Every Contractor Performance Evaluation Report shall be signed by the Owner's Representative and the supervisor of the Owner's Representative before a copy of the Report shall be transmitted to the Contractor. The Report shall not be considered final until such time as the review/appeal periods described in Section VI herein have been completed.

Generally, only one Contractor Performance Evaluation Report shall be issued, following completion of the contract Work. However, in addition to a final Report, one or more interim Reports may be issued at the discretion of the Owner when:

- A contract is of long duration, particularly those in excess of one year.
- An individual charged with primary responsibility for administration of the Contract will cease his or her involvement with the Project prior to completion of the Work.
- Contractor's performance at 50% completion is deficient or inadequate.
Interim Contractor Performance Evaluation Reports shall be considered to be preliminary and shall be designated as such, and shall be processed administratively in the same manner as a Final Report. A Contractor may request review of an Interim Report by the applicable project Director in Capital Planning and Development; and appeal to the Owner’s Associate Vice President for Capital Planning and Development or his/her designee pursuant to the provisions of Section VI below. All Interim Reports shall be attached to, and considered when preparing, the Final Report.

If a Contractor Performance Evaluation Report is an Interim Report, the Report should indicate on its face that it is Interim, and shall contain the following language:

This Performance Evaluation Report is not the final report on this Contractor on this Project. The Contractor may dispute the Report or any part thereof, and need not seek review or appeal until completion and acceptance of the Project.

VI. NOTICE, REVIEW, AND APPEAL

A. Notice. Contractors shall be mailed a copy of their Contractor Performance Evaluation Report within a reasonable time after completion of the Report. A Contractor who is given an Overall Evaluation of "Deficient" or "Inadequate" in connection with a project shall be provided with a copy of the Contractor Performance Evaluation Report via certified mail (return receipt requested).

B. Review. A Contractor who disputes, or is otherwise dissatisfied with, his or her Contractor Performance Evaluation Report may request review of the Report by the applicable project Director in Capital Planning and Development. The request must be submitted in writing within thirty (30) calendar days of receipt by the Contractor of the Final Contractor Performance Evaluation Report. The request must also state, with specificity, all bases for the requested review.

The applicable project Director shall, upon receipt of a proper and timely request, review the Contractor Performance Evaluation Report and any documentation submitted by the Contractor with his or her request. The applicable project Director shall, on the basis of his or her review, issue findings which may affirm, correct, or modify all or any part of the Report. A copy of the findings shall be mailed to the Contractor via certified mail, return receipt requested.

C. Appeal. Within ten (10) calendar days of receipt by the Contractor of the applicable project Director's findings on review, the Contractor may appeal therefrom to the Owner’s Associate Vice President for Capital Planning and Development or his/her designee. Any such appeal shall be in writing, and shall state with specificity the bases or grounds for the appeal.

The Associate Vice President for Capital Planning and Development or his/her designee shall review and consider the objectivity, accuracy, completeness, and fairness of the Contractor Performance Evaluation Report, together with the applicable project Director's findings, engineers' diaries, job records and other documentation, including such documentation as the Contractor may provide with the appeal.

Upon hearing and review of the applicable Director’s findings, the Associate Vice President for Capital Planning and Development or his/her designee shall issue a determination and findings which may affirm or modify the Contractor's Contractor Performance Evaluation Report. The
Associate Vice President for Capital Planning and Development or his/her designee shall notify the Contractor of its determination and findings by certified mail (return receipt requested).

VII. NOT RESPONSIBLE DETERMINATION FOR WORK ON SPECIFIC PROJECT

The Owner’s Associate Vice President for Capital Planning and Development may determine, from Contractor Performance Evaluation Reports and other public documents relating to the project in question, that a Contractor who has received one or more Overall Evaluations of "Deficient" or "Inadequate" is not a responsible bidder and not able to successfully perform a specific project of the Owner for which the Contractor submitted a bid, and is therefore ineligible for award of that contract.

When, on that basis, the Owner’s Associate Vice President for Capital Planning and Development believes that the low bidder is not a responsible bidder and not able to successfully perform a project, the Owner shall notify the low bidder in writing of its determination that the bidder is not a responsible bidder. The bidder may appeal the determination within the time period specified in the Instructions to Bidders by presenting additional information to the Owner. The Owner shall consider the additional information before issuing its final determination. In evaluating the additional information, the Owner may or may not meet with the bidder to hear additional information. If the final determination affirms that the bidder is not responsible, the Owner will not execute a contract with any other bidder until two business days after the bidder determined to be not responsible has received the final determination.

VIII. DEBARMENT OF CONTRACTOR

The Owner’s Associate Vice President for Capital Planning and Development or his/her designee, after conducting a hearing with the Contractor and evaluating the evidence, may debar a Contractor from contracting with the Owner for a period of up to two years if a Contractor has received overall evaluations of their performance of "Deficient" or "Inadequate" on three or more projects of the Owner physically completed during the preceding five (5) year period.

IX. RELEASE OF INFORMATION

Contractor Performance Evaluation Reports are public documents subject to disclosure to other governments and to the public. Because the Reports and the Overall Evaluations they contain may be used as a basis for contract award and may reflect upon the Contractor’s reputation, care must be taken to assure that only accurate, complete, and current information is released.

A. Final Reports. Contractor Performance Evaluation Reports may be released when:

(1) The Report becomes final as set forth in Section V herein; or

(2) The Owner has relied upon the Report for the purpose of taking further action with respect to the Contractor; or

(3) A court has ordered release of the Report.

B. Interim Reports. Interim Contractor Performance Evaluation Reports may only be released when:

(1) The Contractor has consented in writing to the release; or
(2) The Contractor has requested and received final administrative review of an Interim Report; or

(3) The Owner has used or relied upon the Interim Report to take action with respect to the Contractor; or

(4) A court has ordered release of the Report.

C. Termination for Cause and Pending Litigation. In the event that the Contract is terminated by Owner for cause, this fact shall be noted on the Contractor's Contractor Performance Evaluation Report. In the event that a Contractor commences suit against the Owner, that Contractor's Performance Evaluation Report shall not be released without approval from the Washington State Attorney General's Office.

D. Intergovernmental Cooperation. All requests for Contractor references from agencies of foreign, federal, state, or local governments shall be referred to the Owner's applicable project Director or his/her designee. If such a request is honored, the requesting agency shall be provided with copies of all Contractor Performance Evaluation Reports on the Contractor, together with any written objections or refutations filed with the Owner by the Contractor in connection therewith.

X. INSTRUCTIONS FOR COMPLETING EVALUATION FORMS

The Owner's Representative shall complete Sections I (Contractor Data) and II (Project Data), and then evaluate the Contractor's performance in each of the Performance Categories listed in Section III (Performance Data) of the Contractor Performance Evaluation Report, and shall assign points for each category based on the Performance Level applicable for the Contractor's performance.

The descriptions provided on the Contractor Performance Evaluation Report form for each Performance Category will not necessarily match precisely with the Contractor's actual performance of the task(s) on a given portion of the project.

The Owner's Representative should consider the general character of the Contractor's performance for each Performance Category evaluated and select the Performance Level that most closely matches the actual performance.

If the Contractor was not responsible for any performance in connection with a given Performance Category, then the Contractor's evaluation in that Category should be "No Evaluation," and no points should be assigned.

When rating a Contractor, the Owner's Representative should consider all the work performed by the Contractor as well as work performed by all subcontractors, since the Contractor is contractually responsible to the Owner for all of the work under the Contract, whether or not the Contractor actually performs the work. Interim Reports, if issued, shall be attached to the Final Report.

Comments are always encouraged, and may be written on the Contractor Performance Evaluation Report or on an attachment to the Report.

However, for each Performance Category evaluated as "Deficient" or "Inadequate", the Owner's Representative must prepare a written narrative substantiating the facts and circumstances giving rise to the evaluation.
After evaluating the Contractor on Performance Categories listed in Section III of the Contractor Performance Evaluation Report, the Owner’s Representative shall total all of the points assigned and divide that into the total points possible (excluding those Performance Categories evaluated as "No Evaluation"). The evaluator will enter the resulting Overall Percentage Score on the Report, and will enter the appropriate Overall Evaluation on the basis of the following ranges:

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Overall Percentage Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior</td>
<td>90% or above</td>
</tr>
<tr>
<td>Good</td>
<td>70% to 89%</td>
</tr>
<tr>
<td>Standard</td>
<td>50% to 69%</td>
</tr>
<tr>
<td>Deficient</td>
<td>30% to 49%</td>
</tr>
<tr>
<td>Inadequate</td>
<td>29% or below</td>
</tr>
</tbody>
</table>

The Owner’s Representative shall sign the Report and forward it to his or her supervisor for concurrence signature and submission to the Owner’s Contracts Department. The Contracts Department staff shall then forward signed copies of the completed Report to the Contractor.

END OF SECTION 00 73 20
PART 1 - GENERAL

1.1 PROJECT DESCRIPTION

A. The Work of the Contract Documents can be summarized as follows:

Interior and Exterior renovations of existing lab and support spaces in rooms 193, 194, 2299, 2297, and 2295, 180, 198, 190, 191, and 196 in the Roosevelt building located at 4245 Roosevelt Way NE. Interior work in these areas includes, but is not limited to, updating finishes and ceilings, reconfiguration and/or replacement of lighting, electrical and mechanical systems, low voltage pathways, lab gas distribution piping, partial removal and/or replacement of laboratory casework, replacement of or installation of fume hoods (some to be Owner Furnished or existing to be reconnected per plan), installation of partitions to create auxiliary spaces in the labs. Work in the garage (room 180) includes installation of a fenced enclosure, concrete pads and infill, and the construction of movable storage racks for lab gases. Work in rooms 190 and 198 includes reconfiguration of equipment and electrical modifications, and installation of seismic restraints for owner-furnished equipment and refrigerators. Work in room 191 and 196 includes finish updates and installation of equipment and movable storage racks. Exterior work includes, but is not limited to, installation of a dedicated exhaust fan on the fourth floor, with associated electrical connections, roof curb and roof membrane repair, and exterior wall mounted duct installation to connect to the fourth floor fan to a proposed roof penetration on the second floor terrace. The primary work area is 2,565 sf on the first floor and 2,800 sf on the second floor. Site access is primarily through the existing garage and loading dock accessed via 9th Ave NE. Refer to the site access diagram provided on the Drawings. Rooftop equipment placement will require crane support and access (and street permits) for Roosevelt Way NE. Existing building construction is a combination of pre- and post-tensioned concrete slab systems. All core drilling activity will require radar imaging and pre-planning to avoid negative impacts to structural elements. Room 193 is a high-priority space. Owner has requested that work in that room be expedited for early completion target date and possible Temporary Certificate of Occupancy (TCO).

1.2 GENERAL INFORMATION

A. Title of Contract Documents:
1. University of Washington
   SPH Environmental Toxicology Labs
   Project Number: 206825

B. Owner and A/E Defined:
1. Owner:
   University of Washington
   Project Delivery Group
   Seattle, Washington 98195-2205

   Project Manager: Reginald Hampton
   E-mail: regihamp@uw.edu
   Phone: 206 685 6389
   Fax: 206 543 3959

   Owner’s Representative: The Owner shall designate, in writing, the Owner’s Representative for this Project during construction.
2. A/E:
   MITHUN
   Pier 56, 1201 Alaskan Way #200
   Seattle, WA, 98101

   Representative: Evan Bourquard, AIA
   E-mail: evanb@mithun.com
   Phone: 206 623 3344
   Fax: n/a

3. The Owner, the A/E, and various consultants hereinafter or otherwise listed shall be
   given access to the Work insofar as their interests are concerned.

C. A/E’s Sub-Consultants: The sub-consultants under contract with the A/E in preparation of the
   Contract Documents are:
   1. Mechanical, Electrical, Plumbing and Telecom Engineering:
      Integrity Energy Services Company
      14405 SE 36th Street, Suite 210
      Bellevue, WA, 98006

      Representative: Mark Foster
      E-mail: markf@iesinnovates.com
      Phone: 206 965 0529
      Fax: n/a

2. Lab Planner:
   The Estime Group
   PO Box 11712
   Bainbridge Island, WA, 98110-5712

   Representative: Roz Estime
   E-mail: restime@estimegroup.com
   Phone: 206 428 3777
   Fax: n/a

3. Structural Engineering:
   Lund Opsahl
   1201 First Avenue South, Suite 310
   Seattle, WA, 98134

   Representative: Marjorie Lund
   E-mail: mlund@lundopsahl.com
   Phone: 206 402 5156
   Fax: n/a

4. Envelope Consulting:
   Wetherholt and Associates, Inc
   14715 NE 95th Street, Suite 100
   Redmond, WA, 98052

   Representative: Don Davis
   E-mail: dond@wetherholt.com
   Phone: 425 822 8397
   Fax: n/a
D. Owner’s Consultants: The consultants under contract with the Owner in preparation of the Contract Documents are:

1. Hazardous Materials Consulting:
   PBS Environmental
   214 East Galer Street, Suite 300
   Seattle, WA, 98102
   
   Representative: Willem Mager
   E-mail: willem.mager@pbsusa.com
   Phone: 206 233 9639
   Fax: n/a

2. Roosevelt Building Manager:
   Kidder Matthews
   500 108th Ave NE, Suite 2400
   Bellevue, WA, 98004
   
   Representative: Gary LaRoque
   E-mail: gary.laroque@kidder.com
   Phone: 425 829 0345
   Fax: n/a

1.3 SPECIAL CONDITIONS

A. Description of special conditions of the Work:
   1. No dedicated contractor parking is provided.
   2. Room 193 (and required support spaces and services) is a high-priority for completion. Owner has requested that work in that room be expedited for possible early completion and Temporary Certificate of Occupancy (TCO) to allow use as soon as possible. A separate target substantial completion date has been established for this room and must be included in the Construction Schedule.
   3. Vibration, impacts, and excessive noise that may affect adjacent occupied spaces must be limited to the greatest extent possible by the Contractor. This may affect hours of work, as well as methods of installation. Contractor will be required to complete test installations of potentially impactful work in coordination with the Owner to establish noise and vibration criteria that are acceptable to adjacent occupied spaces and processes.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
SECTION 011101 - SUMMARY OF WORK – REGULATED MATERIALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Regulated materials requiring special handling or abatement or protection during construction include hazardous materials and dangerous wastes. The Owner has investigated the Project Site and determined that the following regulated materials could be encountered during construction and may be impacted by the Work:
   1. Silica containing materials
   2. Lab P Traps

B. Related Sections: This Section and the following related Construction Documents were prepared by the Owner’s environmental consultant:
   1. Section 02 80 00 “Facility Remediation”
   2. Section 02 83 50 “Lab P-Trap Decommission”

C. Owner’s Environmental Consultant: The Owner’s environmental consultant and the AHERA-certified designer for this Project is:
   Firm Name: PBS Engineering & Environmental
   Project Designer: Willem Mager
   Certification number: 177530
   Expiration date: 3/5/2021

D. Survey: The Owner has included in Appendix C of the Specifications a Regulated Materials “Good Faith” Survey report of the Project site area to be impacted by the Work. The Contractor shall ensure that a copy of this report is provided to all bidders and Subcontractors. A copy of this Survey must be retained and available for review on the Project site at all times throughout the duration of the Project.

1.2 GENERAL REQUIREMENTS

A. Laws, Regulations, Codes and Ordinances: The Contractor shall comply with all applicable laws, regulations, codes, and ordinances concerning the impact, removal, handling, storage, disposal, monitoring and employee protection against exposure or environmental protection against pollution, related to regulated materials requiring special handling or abatement or protection during construction.

B. Supervisory Authority: The Contractor is solely and completely responsible related to the Contractor’s supervisory authority over Subcontractors and personnel performing work of this Section.

C. Asbestos Awareness Training: The Contractor shall provide asbestos awareness training for its onsite employees and the onsite employees of the Contractor’s Subcontractors (of any tier), in accordance with WAC 296-62-07722(6).

D. Access Restrictions: Access to various construction work areas by the general public, Subcontractors, and other individuals is restricted during certain hazardous materials work.
sequences, as specified in the Contract Documents. The Contractor shall coordinate the Work to facilitate access by Subcontractors while enforcing work area restrictions, and shall minimize disruption to building occupants and services.

E. Hazwoper Training: The Contractor shall provide the appropriate level of HAZWOPER training for its onsite employees and the onsite employees of the Subcontractors (of any Tier) when working on a federal or state-listed contaminated site in accordance with WAC 296-843-100.

F. Working Hours: No hazardous materials work shall occur when building users have access to work areas. All hazardous materials work shall be scheduled to occur in accordance with schedule requirements outlined elsewhere in the Contract Documents, and when work areas have been vacated by building users.

G. Emergency Contacts: Designated qualified representatives of the Contractor and specific hazardous materials Subcontractors are to be available on a 24-hour emergency basis for the duration of the Work. Contact information shall be provided to the Owner's Representative for inclusion in the Project emergency contact list.

H. Submittals: Contractor shall review the scope of work requirements outlined in the Contract Documents and shall submit, and require all Subcontractors performing the work of handling or disposing of any regulated materials to submit, pertinent information required by the Contract Documents.

I. Regulated, Hazardous, and Dangerous Waste Disposal:
   1. The Owner's Environmental Consultant will conduct all testing required to designate the waste streams. The Contractor shall not remove any suspect wastes from the site until the test data has been reviewed by the UW EHS, Environmental Programs and they have made a determination on the waste designation.
   2. Transportation and disposal of all hazardous materials and dangerous wastes will be managed by, and the costs will be borne by, the Owner through the Owner's Environmental Programs Office. The Contractor shall be responsible for packaging and staging hazardous materials and dangerous wastes onsite, and for scheduling pickup through the Owner's Representative.
   3. Transportation and disposal of PCB-containing ballasts (2 parts per million or greater) and TSCA-Regulated PCB Waste (50 parts per million or greater) will be managed by, and the costs will be borne by, the Owner through the Owner's UW EH&S Environmental Programs. The Contractor shall be responsible for packaging (in Owner-provided containers) and staging TSCA-Regulated wastes onsite, and for scheduling drop-off of containers and pick up through the Owner's Representative.
   4. All other regulated waste materials (including asbestos-containing materials) must be disposed of by the Contractor at an Owner audited and approved disposal facility. Approved facilities can be viewed online at http://www.ehs.washington.edu/epowaste/disposalfacclist.pdf.
      a. Lead-containing materials and materials with lead-containing coatings, which are not designated as hazardous or dangerous waste, must be handled and disposed of as a regulated waste and cannot be recycled.
         1) Exception for metal items which contain lead: Metal items which contain lead (e.g., lead flashings, vent caps, lead painted metal) may be recycled at a scrap facility which is permitted to accept and process such materials.
2) Building materials coated with lead-containing paints (including concrete) shall not be recycled.

3) Brick and mortar waste streams that do not designate as a dangerous or hazardous waste may be recycled at a facility which is permitted to accept and process such materials.

J. Regulated Materials - Waste Manifests: Prior to Final Completion, the Contractor shall submit to the Owner copies of all transportation and disposal manifests, including signed landfill receipts and chain-of-custody, for all regulated wastes disposed of by the Contractor during the course of the Project.

1.3 SPECIAL CONDITIONS

A. The following are special conditions which will impact the Work performed under this and related Project Specifications:
   1. All construction operations must comply with the most current COVID-19 mitigation related rules and guidance from the Governor’s Office including the “Stay Home, Stay Healthy” addendum, dated April 24, 2020, and additional guidance issued April 29, 2020 (and amendments).
      All activities must also comply with all related and applicable COVID-19 mitigation requirements issued by the Washington State Department of Labor and Industries and Public Health Agencies having jurisdiction (and associated amendments).
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor’s selection for products for use in the Work, and administrative procedures for handling requests for substitutions made before and after receipt of bid.

B. Owner’s forms referenced in this Section include (see Appendix A):
   1. Substitution Request Form

1.2 DEFINITIONS

A. Definitions used in this Section are not intended to negate the meaning of other terms used in the Contract Documents.
   1. “Products” are items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the Project or taken from previously purchased stock.
   2. “Named Products” are products identified by use of the manufacturer’s name for a product, including such items as a make or model designation, as recorded in the most recent published product literature as of the date of the Contract Documents.
   3. “Materials” are products that must be cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
   4. “Equipment” is a product with operational parts, whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

1.3 QUALITY ASSURANCE

A. Source Limitations: Provide products of same kind, to fullest extent possible, from a single source.

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

C. Nameplates: Except for labels required by Authorities Having Jurisdiction (AHJ), do not attach or imprint manufacturer’s or producer’s nameplates, trademarks or operating data on surfaces exposed to view in occupied spaces or on the building exterior.
   1. Labels: Locate required product labels and stamps on a concealed surface, or where required by AHJ for observation after installation, on an accessible surface that is not conspicuous.

1.4 PRODUCT SELECTION

A. General Product Requirements: Unless otherwise indicated, provide products that comply with the Contract Documents and that are undamaged and unused at the time of installation.
   1. Provide products complete with all accessories, trim, finish, safety guards and other devices and with details needed for a complete installation for the intended use and effect.
   2. Where available, provide standard products of a type and manufacturer used successfully in similar situations on other projects.

B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations. Procedures governing product selection include the following:
1. Performance Specifications: Performance specifications may be one of the following:
   a. One or more named reference(s) with no accompanying conditioning language such as “or approved equal” or “no substitutions”; or
   b. No named reference is specified, and requirements are specified by means of any of the following:
      1) Descriptive requirements
      2) Design requirements
      3) Performance requirements
      4) Regulatory requirements and/or industry standards

2. References to equipment, material, articles or patented processes by trade name, manufacturer, make or catalog number, are presumed to set a standard of quality so as to encourage competition. The term “equal” is presumed and need not be repeated in the Specifications. Where Specifications set a standard of quality, provide product options complying with or exceeding the provisions of the Contract Documents, and which are recommended by a manufacturer for the applications indicated. No Substitution Request is required. However, Owner may request, and Contractor shall provide, documentation of the manufacturer’s recommendations for a particular product application.

3. Closed Proprietary Specifications: Products by one or more manufacturers are specified, and the specification section includes the term “no substitution(s),” “no other(s),” or “no exceptions.” No other product options will be accepted. Provide products and work as specified.

4. Open Proprietary Specifications: Products by one or more manufacturers are specified, and the specification section includes the term “or approved equal,” or “other acceptable.” Submit the Substitution Request Form for other products to Owner under the provisions of this Section.

5. Visual Matching: Where matching an established sample is required, the Owner’s decision will be final on whether a proposed product matches satisfactorily.
   a. Where there is no product available within the specified product category which matches satisfactorily and also complies with other specified requirements, the contractor shall comply with the provisions of the Contract Documents concerning substitutions for the selection of a matching product in another product category.

6. Visual Selection: Where specified product requirements include the phrase “...as selected from the manufacturer’s standard colors, patterns, textures...” or similar phrases, select a product and manufacturer that complies with other specified requirements. Owner will select the color, patterns and texture from the product line selected.

1.5 PRODUCT SUBSTITUTION

A. General:
   1. No substitution request will be considered unless submitted in accordance with the requirements of this Section.
   2. If a bidder or Contractor desires approval of some material or product other than that specified by the Contract Documents, it must submit a written request for approval of the proposed substitute item to the Owner in accordance with the following requirements:
      a. All requests must be made on the Owner’s Substitution Request Form
      b. After receipt of bid, substitution requests shall be prepared, transmitted, and processed in accordance with Section 01 33 00 “Submittal Procedures.”
   3. Final decision as to whether an item is an equal or acceptable substitution rests solely with the Owner.

B. Substitution Requests: Every substitution request must state whether the item offered is equal or superior to the specified product. The substitute material or product must be accompanied by its reference in the Contract Documents and complete catalog, technical and other information. If applicable, include samples showing comparison of physical and other pertinent
characteristics as required to establish equivalence of acceptability for the proposed application. Where specific test results are required by the Contract Documents, the comparison data for the proposed item shall be based upon the same test methods as those specified, or they shall be correlated to clearly demonstrate comparability. The same warranty of the Work described for the specified product is required for the substitution.

C. During Bid Period:
   1. Submit Substitution Request Form prior to the date identified in Section 00 21 00 “Instructions to Bidders.”
   2. Bidders will be notified by addendum of products accepted in addition to those specified. NO OTHER FORM OF APPROVAL, INCLUDING VERBAL OR IMPLIED, IS ACCEPTABLE AS AN INDICATOR OF ACCEPTED SUBSTITUTION REQUESTS.

D. After Receipt of Bid: Contractor shall indicate one or more reasons why a product substitution is required with a Substitution Request Form. Owner will notify Contractor in writing of decision to accept or reject the Substitution Request. Substitution Requests will not be considered except for the following reasons, which must be substantiated by the Contractor:
   1. Unavailability: Specified item has been discontinued or is unavailable in time to meet Construction Schedule through no fault of the Contractor or Subcontractor.
   2. Unsuitability: Subsequent information discloses the specified item as unsuitable, inappropriate, or unable to perform properly or fit the designated space.
   3. Regulatory Requirements: A substitution is required to comply with code interpretations by AHJ or insurance regulations.
   4. Warranty: A manufacturer or fabricator declares the specified item to be unsuitable for the use intended or refuses to certify or warrant the performance of the specified item for the Project.
   5. Owner’s Benefit: In the judgment of Contractor, acceptance of the proposed substitution is clearly in Owner’s best interest because of cost, quality, or other consideration.

E. Coordination: In making a Substitution Request, the Contractor certifies that it will coordinate all Subcontractor work required by the substitution and waives all claims for additional costs and/or time which subsequently become apparent as a consequence of the substitution.

F. Re-design: At the Owner's sole discretion, the Contractor shall bear all Owner costs related to the substitution, including costs of A/E's services for investigation, evaluation and re-design, if necessary.

G. Owner will not consider:
   1. Substitutions, if they are indicated or implied on Shop Drawings or other Project data submittals;
   2. Substitutions which, if accepted, will require substantial revisions of Contract Documents; or
   3. Substitution Request Forms which do not provide adequate or clearly defined information for complete and timely appraisal.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the administrative and procedural requirements for executing a change in the Work as herein specified and further described in Part 7 of the General Conditions.

B. Owner's forms references in this Section include (see Appendix A):
   1. Change Order Proposal;
   2. Change Order Transmittal;
   3. COP General Contractor Breakdown Summary;
   4. COP Subcontractor Breakdown Summary;
   5. COP Cost Breakdown;
   6. COP Wage Rates; and
   7. COP Equipment Rates.

1.2 PRELIMINARY REQUIREMENTS:

A. Prior to submitting the Contractor’s first Change Order Request (COR), or responding to the first Change Order Proposal (COP), the Contractor shall submit a breakdown of journeyman and apprentice, where applicable, wage rates using the Owner’s COP Wage Rates form. The breakdown shall show:
   1. Basic wage rate (based on L&I Intent to Pay Prevailing Wages or union agreement);
   2. Fringe Package (based on L&I Intent to Pay Prevailing Wages or union agreement);
   3. FUI (Federal Unemployment Insurance);
   4. FICA (Federal Insurance Compensation Act);
   5. Medicare;
   6. SUI (State Unemployment Compensation Act);
   7. WC (Workers Compensation).

B. Contractor shall submit verification of the above rates, if requested by Owner's Representative.

C. Prior to submitting Contractor’s first COR or responding to Owner’s first COP that involves equipment owned by the Contractor, the Contractor shall submit a list of all equipment anticipated to be used on the Project. Contractor shall provide the hourly rate based on the Equipment Watch Rental Rate Blue Book and as modified by the current AGC/WSDOT Agreement or other sources as referenced in the General Conditions. The Contractor shall use the Owner’s COP Equipment Rates form to compute the equipment rate.

1.3 CHANGE ORDER PROCEDURES

A. Owner Change Order Proposal (COP): Changes may be initiated by Owner through a Publics Work Change Order Proposal form submitted to the Contractor. Such a request is for information and pricing only and is not an instruction to execute changes or to stop work in progress, unless issued as a Field Order.
   1. The COP will include:
      a. A detailed description of changes, products, and location of modification in Project and a statement as to whether overtime work is authorized; and
      b. Supplementary or revised Drawings or Specifications.
   2. An updated Construction Progress Schedule may be requested if the COP impacts the existing Construction Progress Schedule.
B. Contractor Change Order Request (COR): The Contractor shall initiate changes by submitting written correspondence, in letter format, signed and dated to the Owner's Representative requesting a Change Order Proposal. The letter shall include:
1. Description of proposed changes;
2. Reason for making changes;
3. A specific period of time during which requested price will be considered valid;
4. Actions required by Owner;
5. Effect on Contract Sum and Contract Time;
6. Documentation consistent with the requirements of Part 7.02 and/or 7.03 of the General Conditions supporting any change in Contract Sum or Contract Time, as appropriate;
7. Statement of why proposed change is not covered in Contract Documents; and
8. Date the Work is to be completed.

C. Field Order: In situations where time is of the essence or an emergency condition exists, the Owner's Representative may directly order a change to the Work by a written Field Order signed by Owner's Representative. Field Orders will only be issued on an agreed upon not-to-exceed cost basis, either lump sum or time and materials.

D. Change Order Pricing:
1. The cost of the change shall be marked-up in accordance with General Conditions and Modifications to the General Conditions. NO ADDITIONAL MARK-UPS SHALL BE ALLOWED.
2. Contractor shall provide all backup pricing documentation for a change on the following forms (THESE FORMS SHALL ALSO BE THE ONLY ACCEPTABLE DOCUMENTATION FOR ALL SUBCONTRACTORS):
   a. COP General Contractor Breakdown Summary
   b. COP Subcontractor Breakdown Summary
   c. COP Cost Breakdown
3. Owner's Representative may require Contractor to provide certified payroll.
4. Provide all other supporting documentation as required to substantiate the requested costs such as invoices for rental equipment and freight cost. Total cost and time shall be brought forward to the COP form and signed and dated by Contractor.

E. Change Order Authorization:
1. A/E recommendation of COP acceptance to Owner is indicated by A/E's signature.
2. Upon signature and execution by Owner, the Change Order Proposal becomes a Change Order altering the Contract Sum and/or Contract Time, as indicated.
3. Contractor may only request payment for changes in the Work against an approved Change Order.
4. If Owner disapproves the Change Order Proposal, the reason for disapproval will be stated. A request for a revised proposal or cancellation of the proposal will be shown and returned to the Contractor.

F. Correlation with Contractor's Submittals:
1. Application of Payment forms shall record each Change Order as a separate item of work (see Section 01 29 76, "Progress Payment Procedures").
2. Revise Construction Progress Schedule to reflect changes in Contract Time.
3. Upon completion of Change Order work, record pertinent modifications in the Project Record documents.

G. Distribution:
1. Upon authorization of a Change Order, Owner will transmit one (1) signed copy to Contractor.
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the administrative and procedural requirements for Contractor progress payment and release of retainage as herein specified and further described in Part 6 of the General Conditions.

B. Owner’s forms referenced in this Section include (see Appendix A):
   1. Application and Certificate for Payment on Contract (Application for Payment)
   2. Construction Invoice Voucher
   3. Retainage Invoice Voucher
   4. Monthly Subcontractors List and Certifications
   5. Certificate of Payment of Labor and Materials
   7. Apprentice and Journey Level Worker Utilization Report

1.2 PREREQUISITES FOR FIRST APPLICATION FOR PAYMENT

A. Progress Schedule: Submit and receive approval of the "preliminary" Progress Schedule.

B. Prevailing Wage Forms: Submit Statement of Intent to Pay Prevailing Wages form, approved by the Department of Labor and Industries, prior to commencing the Work (see Part 5.04B of the General Conditions). The Owner will not make payment on an Application for Payment until the Contractor has filed with the Owner an approved copy of the form for the Contractor and every Subcontractor of every tier that performed work during the payment period and are included in an Application for Payment. The form shall list every classification of laborer, worker, or mechanic employed by the Contractor and its Subcontractors. THERE ARE NO EXCEPTIONS TO THIS REQUIREMENT.
   1. The website address link to the prevailing wage forms is included in Appendix A.
   2. The website address link to the “Washington State Prevailing Wage Rates for Public Works Contracts” is included in Appendix B.

C. Schedule of Values: Before submitting the first Application for Payment, submit and receive approval of the Schedule of Values allocating the detail of the Contract Award Amount, in a breakdown acceptable to the Owner, which shall be documented on the Application for Payment. The approved Schedule of Values will be used by the Owner as the basis for progress payments. PAYMENT FOR WORK WILL ONLY BE MADE FOR, AND IN ACCORDANCE WITH, THOSE ITEMS INCLUDED IN THE APPROVED SCHEDULE OF VALUES.
   1. Format: On 8-1/2” x 11” paper
   2. Content: Include as a minimum the following:
      a. Individual Items of Work.
      b. Major cost items, which are not directly a cost of actual work-in-place, shall be shown as separate items in the Schedule of Values, and shall include the following items:
         1) General Conditions, mobilization, and distinct temporary facilities shall not exceed 3% of the Contract Award Amount.
         2) Section 01 77 00 “Closeout Procedures” shall not be less than 4% of the Contract Award Amount.
         3) Preparation and submittal to Owner of Construction Baseline Schedule and Submittal Schedule shall not be less than 1/4% of the Contract Award Amount.
4) Preparation of monthly Progress Schedule updates shall not be less than 1/4% of the Contract Award Amount, with the value of each update apportioned equally.

c. For items on which progress payments will be requested for materials or equipment purchased/fabricated/delivered, but not yet installed, show "initial value" for payment request and "value added" for subsequent stage(s) of completion on that unit of work.

d. For each line item of installed value exceeding 10% of Contract Award Amount, show breakdown by major products or operations under each item.

e. Breakdown major work efforts by floor or phases or systems as appropriate for ease of review and confirmation of Work completed.

f. Breakdown mechanical and electrical systems or phases with material and labor as separate items.

3. Round figures to nearest dollar amount.

4. Make sum of total scheduled costs equal to the Contract Award Amount. Do not include State of Washington sales tax.

5. Coordinate items of the Schedule of Values so that there is a corresponding item in the Progress Schedule.

6. Revise as requested by Owner.

D. Subcontractors List: Submit a list of all Subcontractors and major material suppliers consistent with Part 5.20B of the General Conditions.

E. Retainage: Submit instructions for the disposition of retainage funds.

1. In accordance with Part 6.04B of the General Conditions and Chapter 60.28 RCW, the Owner shall reserve a Contract retainage in an amount not-to-exceed 5% of the moneys earned by the Contractor as a trust fund for the protection and payment of:

   a. The claims of any person arising under the Contract Documents;

   b. The State of Washington with respect to taxes imposed pursuant to Titles 50, 51, and 82 RCW which may be due from the Contractor, and;

   c. The Owner for claims it may have against the Contractor.

2. Contractor's written instructions should be addressed to the University of Washington, UW Facilities, Project Delivery Group, Accounting Department, Box 352205, Seattle, Washington 98195 - 2205.

3. At the option of the Contractor, the moneys reserved by the Owner shall be:

   a. Retained in a fund by the Owner; or

   b. Bonded by the Contractor (if approved by Owner) for all of the Contract retainage in a form acceptable to the Owner; or

   c. Deposited by the Owner in an Owner's interest bearing account in a bank, mutual savings bank, or savings and loan association; or

   d. Placed in escrow with a bank or trust company by the Owner.

   1) Escrow Agent: If the retained funds are to be placed in escrow, Contractor will select the escrow agent, subject to approval by the Owner. The selected agent must be a bank or trust company in the State of Washington.

   2) Escrow Agreement: Pursuant to electing the escrow option, an escrow agreement shall be executed by Contractor, Owner, and bank. A completed and signed escrow agreement in a form acceptable to the Owner must be on file with the Owner for payment before the Contractor's first Application for Payment is processed.

   3) Escrow Payments: As each progress estimate is presented for payment, Contractor shall make a voucher request for the retained funds that are to be placed in escrow. Such requests should be prepared on the Owner's Retainage Invoice Voucher form and submitted with the related Application for Payment. Upon receiving a retainage invoice, the Owner will issue a check payable to the
Contractor and the bank jointly. Such checks will be mailed to the bank and the Contractor will receive copies of check transmittal letters.

4) Escrow Investments: The bank shall invest the retained funds in bonds and other securities selected by the Contractor from the following list approved by the Owner:
   a) Bills, certificates, notes or bonds of the United States;
   b) Other obligations of the United States or its agencies;
   c) Obligations of any corporation wholly owned by the government of the United States;
   d) Indebtedness of the Federal National Mortgage Association;
   e) Time deposits in commercial banks, mutual savings banks, and savings and loan associations in the State of Washington;
   f) Deposits in savings accounts in commercial banks, mutual savings banks, and savings and loan associations in the State of Washington.

5) The investments selected must mature on or prior to the date set for Substantial Completion, including extensions thereof or no later than forty-five (45) days following the Final Acceptance of the Work. Interest on such investments shall be paid to the Contractor by the escrow agent as it accrues.

6) Escrow Costs and Fees: All escrow costs and fees shall be paid by the Contractor, in accordance with the escrow agreement.

1.3 DRAFT APPLICATION FOR PAYMENT

A. Submit a draft Application for Payment for Owner’s review and comment. The cutoff date shall be five (5) days prior to actual application or as otherwise agreed. Include projected costs to the end of the month in the pay request. Provide the following documents (draft documents may be marked by hand):
      a. Mechanical and electrical Subcontractor’s draft monthly payment requests shall be submitted, for review and comment, prior to the A/E’s and Owner’s review of the Contractor’s draft monthly Application for Payment.
      b. List Change Orders approved prior to the submission date individually (last on the form). Use Owner’s Change Order designation and description (similar to an original component item of work). DO NOT BILL FOR CHANGE ORDER PROPOSALS UNTIL AN APPROVED CHANGE ORDER HAS BEEN RECEIVED FROM THE OWNER INCORPORATING THE PROPOSAL.
   3. Stored Materials: The Contractor is solely responsible for the stored materials. Requests for payment on materials stored shall be for materials properly stored on the Project site. In addition to the requirements of the General Conditions, payment for materials stored off-site shall be at the sole option of the Owner and comply with conditions stipulated by the Owner. These conditions may include, but are not limited to:
      a. Provide supplier invoice
      b. Provide insurance or a bond to cover the total loss of material and time impact to Project
   5. Monthly Safety Report

B. The A/E and/or Owner and the Contractor shall review the Project Record for completeness and accuracy.
1.4 APPLICATION FOR PAYMENT

A. The Contractor shall submit an electronic copy of the Application for Payment to the Owner after responding to the Owner’s comments to the draft application.

B. The Contractor is cautioned to carefully check all extensions, totals, and required information for accuracy before submittal.

C. Applications are to be signed by a responsible officer of the Contractor.

D. The Application for Payment shall include the following Owner forms and documents:
   1. Application and Certificate for Payment on Contract
   2. Construction Invoice Voucher (for the total amount due)
   3. Retainage Invoice Voucher (for the retainage amount)
   4. Monthly Subcontractors List and Certifications
   5. Invoices for materials stored off-site
   7. Apprentice and Journey Level Worker Utilization Report

E. Contractor, subcontractor, or employer shall file a copy of its certified payroll records directly with the Department of Labor and Industries online system at least once per month.

F. When the Owner’s Representative and A/E find the Application for Payment properly completed and correct, they will sign and transmit all copies of the Application for Payment to the Owner’s accounting office for processing.

G. If the A/E or Owner’s Representative find the Application for Payment improperly or incorrectly executed, an annotated copy will be returned for a new submittal.

H. Only minor corrections are allowed on the original, with approval of Owner.

1.5 PRIOR TO FINAL APPLICATION FOR PAYMENT

A. The final Application for Payment request will be accepted for processing only after providing satisfactory completion of the following:
   1. Application and Certificate for Payment on Contract
   2. Construction Invoice Voucher (for the total amount due)
   3. Retainage Invoice Voucher (for the retainage amount)
   4. Monthly Subcontractors List and Certifications
   5. Invoices for materials stored off-site
   6. Final Completion procedures per Section 01 77 00 "Closeout Procedures"
   7. Final Schedule of Values "Contract Sum"
   8. Monthly Safety Report
   9. Apprentice and Journey Level Worker Utilization Report

1.6 RELEASE OF RETAINAGE

A. Pursuant to the completion of Work performed in accordance with the Public Works Contract and Final Acceptance by the Owner, the following requirements must be satisfied prior to the release of retained Contract funds.
   1. “Notice of Completion of Public Works Contract (REV 31 0020)”: This Department of Revenue form will be completed by the Owner, establishing the date of Final Acceptance. A copy of the notice will be e-mailed to the Department of Revenue, the Employment
Security Department, the Department of Labor and Industries, and a copy will be transmitted to the Contractor.

2. “Certificate of Payment of State Excise Taxes by Public Works Contractor (REV 31 0028)”: Following receipt of the Owner’s Notice of Completion of Public Works Contract form and after determining that all taxes, interest and penalties due from Contractor have been paid, the Department of Revenue will issue this certificate to Owner, thereby notifying the Owner that it has no objection to the release of retainage to the Contractor.

3. “Certificate of Payment of Contributions, Penalties and Interest on Public Work Contract (EMS 8449 760)”: Upon receiving a copy of the Owner’s Notice of Completion of Public Works Contract form from the Department of Revenue and determining that the Contractor is in compliance with the provisions of the Employment Security Act, the Employment Security Department will issue this certificate to Owner, thereby notifying the Owner that it has no objection to the release of retainage to the Contractor.

4. Upon receiving a copy of the Owner’s Notice of Completion of Public Works Contract form and determining that the Contractor is in compliance with the provisions of Chapter 51 RCW for payment of industrial insurance premiums, the Department of Labor and Industries will issue a certificate for the Owner, thereby notifying the Owner that it has no objection to the release of retainage to the Contractor.

5. “Affidavit of Wages Paid on Public Works Contract” (F700-007-000): An Affidavit of Wages Paid, for the Contractor, each Subcontractor, and each sub-tier Subcontractor, approved by the Industrial Statistician of the Department of Labor and Industries, must be submitted by the Contractor to the Owner. Contractors and Subcontractors may file the Affidavit of Wages Paid either on-line at the website link provided in Appendix A or by completing the forms manually.

6. “Certificate of Payment of Labor and Materials”: This Owner’s form shall be completed by the Contractor and returned to the Owner. If the only exception to full payment to all Subcontractors is retainage owed to Subcontractors, the appropriate box on the form should be checked.

7. Invoice Voucher: If the retained funds are on deposit in Owner accounts, the Contractor shall prepare a Retainage Invoice Voucher for the total amount retained and submit to the Owner for payment. If these funds have been placed in escrow at the direction of Contractor, no further invoice is required.

B. Retainage will be paid by the Owner to the Contractor sixty (60) days following the published date of Final Acceptance, contingent upon the Contractor’s compliance with provisions of public works statutes and as stated above. If there are either unpaid taxes or unsatisfied claims of lien against the retained percentage, disbursement of retainage funds will be made in accordance with State of Washington law.

C. Address all transmittal of retainage documents to the Owner’s Representative at: University of Washington, UW Facilities, Project Delivery Group, Box 352205, Seattle, Washington, 98195 - 2205.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - TBDGENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for meetings during construction in addition to requirements specified elsewhere in the Contract Documents.

B. Contractor and Subcontractor representatives attending meetings must be qualified and authorized to act on behalf of their firms.

C. The Owner will utilize an internet-based construction management system (CMS) for communications and documents controls with the Contractor and A/E on this Project (see Section 01 35 00 “Electronic Communications”).
   1. Meeting minutes, Contractor construction activity data and work plans, A/E field reports and other such communications shall be distributed electronically by e-mail.

D. Related Sections:
   1. Section 01 32 16 “Construction Progress Schedule”

1.2 PRECONSTRUCTION MEETING

A. The Owner will schedule a preconstruction meeting to be held prior to the Contractor mobilizing and beginning any Work. This meeting will review Contract administration requirements and mobilization procedures.

B. Meeting location: To be determined

C. Participants shall include:
   1. Contractor’s Project Manager, Superintendent, CQC Representative, Safety and Health Officer, and for projects with LEED requirements, LEED Coordinator;
   2. Owner’s Representative, Project Manager, and for projects with LEED requirements, the Owner’s Sustainability Manager;
   3. A/E and the A/E’s sub-consultants, as appropriate;
   4. Owner’s consultants, as appropriate; and
   5. Others, including the Contractor’s major Subcontractors as appropriate.

D. Owner’s Representative will: Administer the meeting

E. A/E will: Record and distribute copies of the minutes within seven (7) days of the meeting to all meeting participants.

F. Agenda:
   1. The Work including, but not limited to:
      a. Schedule and phasing requirements
      b. Contractor’s use of premises
      c. Special conditions and coordination
   2. Communications including, but not limited to:
      a. Chain and persons authorized to direct changes
      b. Requests for Information (RFI), field decisions, and clarifications
      c. Non-Conformance Reports
      d. Hazard communication
      e. Project meetings
   3. Contractor’s “Site Specific Safety Plan”
4. Administrative and procedural requirements including, but not limited to:
   a. Contract modification
   b. Progress payment
   c. Submittals - including Contractor’s Progress Schedule
   d. Electronic communications
5. Project LEED requirements and documentation, if any
6. Testing and inspection
7. Contractor quality control
8. Temporary facilities and controls including, but not limited to:
   a. Deliveries and storage
   b. Temporary utilities and enclosures
   c. Security procedures
   d. Noise and vibration control
   e. Cutting, patching, and field engineering
   f. Utility shutdowns
   g. Contractor parking
   h. Housekeeping and waste management
   i. Infection control - for medical facilities projects
9. Closeout procedures - including Project Record requirements
10. Other information as appropriate

G. Contractor shall conduct a like meeting, covering the same body of information, with each Subcontractor’s project manager and foreman supervising the Work prior to the performance of any work on-site by that Subcontractor.

1. Provide Owner copies of meeting minutes prepared by the Contractor with each Subcontractor, when requested by Owner.

1.3 CONSTRUCTION PROGRESS MEETINGS

A. Progress meetings shall occur as needed, but no more than weekly, until Substantial Completion has been achieved.

B. Meeting location: To be determined

C. Participants shall include:
   1. Contractor’s Project Manager, Superintendent, CQC Representative, and Safety and Health Officer as appropriate;
   2. Owner’s Representative and Project Manager;
   3. A/E and the A/E’s sub-consultants, as appropriate; and
   4. Others, including the Owner’s consultants, as appropriate.

D. Owner’s Representative will: Administer the meeting

E. Contractor shall: Provide schedules, logs and other construction activity data to support the issues discussed at the meeting.

F. A/E will: Record and distribute copies of the minutes prior to the next progress meeting to all meeting participants and provide copies at each meeting.

G. Agenda:
   1. Review and approve the minutes of the previous meeting noting exceptions, if any
   2. Review the progress of the Work since the previous meeting
   3. Review the Short Interval Schedule and work plans for progress during the period
a. Identify pending meetings
b. Discuss safety activities and job hazards analysis

4. Discuss field observations, problems, and conflicts
   a. Identify problems impeding the construction Progress Schedule

5. Review Quality Control
   a. Non-Conformance Reports - discuss corrective Work actions
   b. Infection control – for medical center projects

6. Review the Submittal Schedule and RFIs - present methods to expedite as required
7. Review off-site fabrication and delivery schedules
8. Review proposed changes in the Work and substitution requests for:
   a. Timely processing
   b. Effect on the Progress Schedule and Substantial Completion
   c. Effect on any other contracts of the Project
9. Review any other business

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation meetings shall be held prior to the Contractor or Subcontractors beginning work on each definable feature of the Work identified in the Contract Documents to require a pre-installation meeting and/or as required by the Owner’s Representative. Notify Owner’s Representative at least ten (10) working days in advance of each pre-installation meeting.

1. At the Owner’s discretion, the Owner may conduct this meeting as part of the Construction Progress Meeting.

B. Meeting examples include, but not by way of limitation:
   1. Site clearing and excavation
   2. Demolition and regulated materials remediation
   3. Site utilities
   4. Landscaping and site restoration
   5. Concrete
   6. Masonry
   7. Structural steel
   8. Exterior cladding systems
   9. Water and damp proofing and roofing
   10. Doors, including frames and hardware
   11. Millwork
   12. Finishes
   13. Equipment, including elevators
   14. Mechanical and Electrical systems, such as high voltage, fire alarm, and communications
   15. Specialty items

C. Meeting location: To be determined

D. Participants shall include:
   1. Contractor’s Superintendent, CQC Representative, and Safety and Health Officer as appropriate;
   2. Subcontractor’s project manager or foreman supervising the Work, as appropriate;
   3. Owner’s Representative;
   4. A/E and the A/E sub-consultants, as appropriate;
   5. Owner’s consultants as appropriate; and
   6. Others as appropriate.

E. Agenda:
   1. Review of the pre-installation CQC Work Plan and Contract requirements
2. Materials - available and ready for use  
3. Submittals  
4. Persons responsible for performing the work  
5. Tests - required tests, criteria for performance, who samples and how often  
6. Safety procedures and requirements  
7. Substrate - criteria for substrate  
8. Other items as appropriate  

F. Contractor shall: Administer the meeting, and record and distribute copies of the minutes within seven (7) days of each meeting to all meeting participants.  

1.5 CHANGE ORDER MEETINGS  
A. Change order meetings shall be held to review and resolve any Change Order Proposals, change order requests, or other change order issues pertaining to Contract Modification. Meetings shall be held monthly until all Change Order Proposals are resolved.  
1. At the Owner’s discretion, the Owner may conduct this meeting as part of the Construction Progress Meeting.  

B. Meeting Location: To be determined  

C. Participants shall include:  
1. Contractor’s Project Manager, or cost engineer as appropriate;  
2. Owner’s Representative;  
3. A/E and the A/E’s sub-consultants, as appropriate;  
4. Others, including the Owner’s consultants as appropriate.  

D. Owner’s Representative will: Administer the meeting  

E. Agenda: Review Change Order Proposals for scope and estimated costs, and negotiate Change Order Proposal prices.  

1.6 DRAFT APPLICATION FOR PAYMENT REVIEW MEETINGS  
A. Draft Application for Payment review meetings shall occur monthly.  
1. At the Owner’s discretion, the Owner may conduct this meeting as part of the Construction Progress Meeting.  

B. Meeting location: To be determined  

C. Participants shall include:  
1. Contractor’s Project Manager;  
2. Owner’s Representative;  
3. A/E and A/E’s sub-consultants, as appropriate; and  
4. Owner’s consultants as appropriate.  

D. Owner’s Representative will: Administer the meeting  

E. Contractor shall: Present the draft monthly Application for Payment together with the required back up information for review and comment by the Owner and A/E.  

F. Agenda - Discussion will pertain to items such as:  
1. Percentage of work complete  
2. Off-site storage
3. Bill of quantities
4. Percentage of subcontract payment allocations
5. Apprentice Utilization and Journey Level Report

1.7 SPECIAL MEETINGS

A. Special meetings may be called at the discretion of the Owner or Contractor for the purpose of coordinating specific information or resolving special issues related to the Project.

B. Contractor shall record and distribute minutes within three (3) days of the meeting to all meeting participants.

1.8 COMMISSIONING MEETINGS DURING CONSTRUCTION

A. Commissioning meetings shall occur weekly during the start-up and commissioning phase of the Work.
   1. At the Owner’s discretion, the Owner may conduct this meeting as part of the Construction Progress Meeting.

B. Meeting location: To be determined

C. Participants shall include:
   1. Contractor’s Test Engineer, and Superintendent as appropriate;
   2. Subcontractor representative(s) as appropriate;
   3. Owner’s Representative;
   4. Owner’s Commissioning Authority; and
   5. A/E and the A/E’s sub-consultants, as appropriate.

D. Commissioning Authority will: Administer the meeting

E. Contractor shall: Record and distribute copies of the minutes prior to the next meeting to all participants and provide copies at each meeting.

F. Agenda - Discussion will pertain to items such as:
   1. Coordination of Work of applicable trades, such as balancing, electrical, controls, communications wiring connectivity;
   2. Scheduling of systems shutdown and switch over;
   3. Start-up and functional performance tests acceptance criteria; and

1.9 LEED MEETINGS

A. LEED meetings shall occur monthly until Final Completion is achieved or until LEED documentation is complete, submitted on-line to the Green Building Certification Institute (GBCI), and is acceptable to the Owner, whichever occurs first.

B. Meeting location: To be determined.

C. Participants shall include:
   1. Contractor’s LEED Coordinator and Project Manager, as appropriate.
   2. Owner’s Sustainability Manager and Owner’s Representative, as appropriate.
   3. A/E and the A/E’s sub-consultants, as appropriate.
D. Contractor shall: Administer the meeting and record and distribute copies of the minutes prior to the next meeting to all participants and provide copies at each meeting.

E. Agenda - Contractor shall review:
   1. The Contractor and Owner shall review the LEED Site and Field Binder documentation for completeness and accuracy.
   2. LEED construction procedures and management plans, and the preparation of GBCI online forms.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements, in addition to those defined in the General Conditions, for Baseline Progress Schedule preparation, monthly Progress Schedule updates, change in Contract Time analysis, submittal schedules, and short interval schedules.

B. Related Sections:
   1. 01 26 00, “Contract Modification Procedures”
   2. 01 29 76, “Progress Payment Procedures”
   3. 01 50 00, “Temporary Facilities and Controls”
   4. 01 77 00, “Closeout Procedures”

C. Owner’s forms included by reference for this Section include (see Appendix A):
   1. Short Interval Schedule

D. Total Float is defined as the amount of time between the earliest start date and the latest start date, or between the earliest finish date and the latest finish date of an activity on the Progress Schedule. Float is not for the exclusive use of either the Contractor or the Owner unless otherwise identified in the Contract Documents.
   1. Extensions of time for Contract performance will be granted only to the extent that equitable time adjustments to the affected activity or activities exceed the total float time along the affected paths of the current Progress Schedule at the time a Field Order, or Change Order, was issued for the change.

E. All Progress Schedule submittals, including monthly Progress Schedule updates, will be reviewed jointly by the Owner’s Representative and the Contractor. Such review of the Contractor’s schedules shall not constitute an approval or acceptance of the Contractor’s construction means, methods, or sequencing, or its ability to complete the Work in a timely manner.

F. As used in this Section, “Progress Schedule” refers collectively to “Baseline Progress Schedule” and “monthly Progress Schedule updates.”

1.2 PROGRESS SCHEDULE

A. Within fourteen (14) calendar days after Notice-to-Proceed, the Contractor shall prepare and submit to the Owner, for review and comment, three (3) copies of a preliminary Progress Schedule utilizing a Critical Path Method (CPM) logic based on the Contract Documents. The Owner will review the preliminary schedule for conformance with the Contract Documents and provide comments within fourteen (14) calendar days of receipt from the Contractor. The Contractor shall respond to all comments and provide the Owner a Baseline Progress Schedule within fourteen (14) calendar days of receipt of the Owner’s comments.

B. Once the Baseline Progress Schedule is submitted to the Owner, the Progress Schedule shall be formally established as the baseline file within the Contractor’s scheduling software. This baseline file shall not be modified without the Owner’s written approval.
   1. The amount specified in Section 01 29 76 shall be withheld from the Contractor’s monthly Application for Payment if the Baseline Progress Schedule and Submittal Schedule, referenced in 1.5 of this Section, are past due and such amount may, at the Owner’s sole
judgment and discretion, be reduced from the Contract Sum by unilateral Change Order (see Section 01 29 76, "Progress Payment Procedures").

C. The Baseline Progress Schedule shall be the basis that the Contractor shall use to: plan, organize, and execute the Work; record and report actual performance and progress through updates, and; show how the Contractor plans to complete all remaining Work. The Baseline Progress Schedule and monthly Progress Schedule updates shall be the basis for consideration and analysis of requests for time extensions as specified below. The schedule shall be in the form of an activity based precedence diagram.

D. The Baseline Progress Schedule and monthly Progress Schedule updates shall be constructed to show the order in which the Contractor proposes to carry out the Work, and to indicate the restrictions of access to and availability of the work area, and availability and use of manpower, materials, equipment, and all activities of trade contractors, equipment vendors, and suppliers. The Progress Schedule shall incorporate contractually specified limitations and restrictions, and contractually specified milestones. Construction activities shall match or be correlated with the pay items in the approved Schedule of Values. The Progress Schedule shall be prepared in sufficient detail with the assignment and coding of all activities by the Contractor and Subcontractors in consideration of, but not limited to, the following Work activities:
   1. Access and availability to the Project Site, including road closures;
   2. Identification of interfaces and dependencies with preceding, concurrent, and succeeding contractors, if applicable;
   3. The type of work to be performed and labor trades involved;
   4. All procurement, manufacturing, fabrication (both on-site and off-site), and delivery activities for all major materials and equipment;
   5. Shutdowns of existing Owner’s equipment and utility services;
   6. Required delivery dates of OFCI equipment and materials;
   7. Testing, air balancing, and commissioning activities, including submission and approval of test results;
   8. Approvals by regulatory agencies or other third parties, including obtaining an Occupancy Permit;
   9. Coordination for Owner’s occupancy including Owner’s cleaning, OFOI equipment and furnishings installations;
   10. Planning for phased occupancy by the Owner, with intermediate completion dates;
   11. Contractor’s preliminary cleaning and final cleaning operations;
   12. Contractor’s Final Punch List Report, Owner’s Final Inspection (Punch List), Contractor’s corrections, and Owner’s re-inspection;
   13. Substantial Completion and Final Completion activities and milestones, and Final Acceptance.

E. The activities defined in the Progress Schedule shall represent the planned durations in anticipation of normal man-power and equipment utilization in durations of whole working days. No activity durations shall exceed twenty two (22) working days. If approved by the Owner, longer durations may be allowed for non-construction activities such as procurement, delivery, or submittal activities. All durations shall be determined based upon resource planning under contractually defined on-site work conditions. In calculating activity durations, normal inclement weather shall be considered. The Contractor shall schedule the Work to minimize the effect of adverse weather. The Contractor shall also protect the work site from the effects of adverse weather or take other necessary measures such that the Work can be completed within the time established in the Contract Documents and include these provisions in the schedule as appropriate.

F. Schedule activity identification codes shall not be alphanumeric unless approved by Owner.
1. Activity Description: Provide adequate information to readily identify each activity up to 48 characters in the general descriptive format: action, item, location (such as Install Steel Studs 3rd Floor).

2. The Critical Path shall be clearly indicated on all diagrams submitted. An activity is critical when it is part of the longest duration pathway(s) through the CPM network or when total float is less than or equal to zero.

3. Clearly identify activities that are planned to use overtime, double shifts, work on weekdays or holidays.

4. Include a listing of activities with open ends and out-of-sequence progress.

G. Certification: When requested by Owner, submit certification that each Subcontractor and major equipment supplier has participated in, reviewed, and concurs with the Progress Schedule as it relates to their Work.

1.3 MONTHLY PROGRESS SCHEDULE UPDATES

A. The Contractor is required to prepare and submit monthly Progress Schedule updates and to participate in monthly schedule update meetings with the Owner as described below.

1. Timely submission of updates is of significant and crucial importance to the management of this Project. Lack of, or late receipt of, updates diminishes their value to the Owner. If a monthly Progress Schedule update is not submitted to and reviewed with the Owner prior to the Contractor submitting its monthly Application for Payment, the monthly Schedule of Values amount for Progress Schedule updates may, at the Owner’s sole judgment and discretion, be reduced from the Contract Sum by unilateral Change Order (see Section 01 29 76, “Progress Payment Procedures”).

B. The Contractor shall prepare a monthly Progress Schedule update to reflect work progress achieved since the previous update. Historical performance data and/or records shall not be changed without the approval of the Owner.

C. The Contractor shall use and maintain a fixed end date when generating the required reports and diagrams for the Owner as specified by this Section. The fixed end date shall be the Substantial Completion date. The fixed end date will be adjusted in subsequent updates only to reflect approved time extensions incorporated by Change Order.

D. The Project shall be rescheduled each reporting period with:
   1. An updated data date.
   2. Actual start/finish dates.
   3. Percent complete.
   4. Remaining durations (for each activity) in the “status” or “current” file.

E. Show changes occurring since the previous schedule submission, such as:
   1. Any major changes in scope.
   2. Activities modified since previous submission including, but not limited to, logic changes.
   3. Revised projections for progress and completion, as applicable.
   4. Any other identifiable changes.

F. The Contractor shall account for all rain days, for major events, and similar excusable non-compensable delays, during which little or no work is progressed and that are acknowledged by the Owner, in the period within which the events occur.

G. The Construction Progress Meeting shall be held prior to Owner’s review and comment of the Contractors draft Application for Payment, unless otherwise approved by Owner.

1. The Contractor shall provide copies of two tabular reports:
a. A total float report clearly indicating the current critical path through Substantial Completion.
b. A report of activities sorted by early start dates commencing with the previous monthly progress update and including all updated activities during the previous month. Actual progress of the previous month will be recorded and incorporated into the update.

2. The Contractor shall provide copies of a narrative report to include:
   a. A description of the Work that has progressed.
   b. An explanation of the Work that had been scheduled to be performed in the previous period but was not performed, and why it was not performed.
   c. Anticipated delay and impact on the schedule.
   d. Corrective action recommended and its effect.
   e. A discussion of the Work scheduled for the upcoming period noting any issues or events that could impact this Work.
   f. If the Contractor intends to make a logic or original activity duration change(s), the report shall include such changes.

3. The Contractor and Owner shall review these reports and discuss any differences or issues raised.

1.4 CHANGE IN CONTRACT TIME ANALYSIS

A. It is the Owner’s desire and intent to resolve all issues affecting the Substantial Completion date in a timely, efficient, and effective manner. To achieve this goal, the Owner and Contractor shall participate in an analysis of all delays and advances of the schedule.

B. Assessment of impacts due to changes or other events must be performed on the most recent update of the Progress Schedule. Further impacts due to changes or other events shall be assessed utilizing the Progress Schedule update that represents the data date closest to, and just prior to, the date of the impacting event.

C. The logic and planning elements of the Progress Schedule are the Contractor’s responsibility.

1. No Contract Time shall be modified unless directed by an approved Change Order.

D. Submission of a valid monthly Progress Schedule update and the completion of a delay analysis impacting the critical path are conditions precedent to the review and approval of any request for an extension in the Contract Time. Failure to complete monthly Progress Schedule updates and to participate in the analysis will defer consideration of any time extensions by the Owner until the Work is completed and all as-built progress can be analyzed by the Owner. Further, the Owner will assess liquidated damages, if any, regardless of the status of any requests for time extensions pending, until any such requests are resolved.

1.5 SUBMITTAL SCHEDULE

A. General: Within ten (10) calendar days following Owner’s receipt of the Baseline Progress Schedule, the Contractor shall prepare and submit to the Owner a complete schedule of work-related submittals based on the Progress Schedule, as required by the Contract Documents ("Submittal Schedule"). Correlate Submittal Schedule with the listing of principal Subcontractors.

B. Form: Prepare Submittal Schedule in chronological sequence of submittals. Show category of submittal, name of Subcontractor, generic description of work covered, related Specification Section numbers, activity or event code on the Progress Schedule baseline file, scheduled date for first submission, and blank columns for actual date of submittal, re-submittal, and final
release or acceptance by the A/E. The Submittal Schedule shall be prepared in sufficient
detail and in consideration of, but not limited to, the following:
1. Preparation and submission of shop drawings, layout drawings, product data, material
samples, and mock-ups.

C. Update the Submittal Schedule monthly and submit to Owner.

1.6 SHORT INTERVAL SCHEDULE

A. Short Interval Schedule: Prepare and update weekly a four (4) week Short Interval Schedule.
Show previous week of actual progress (planned vs. actual performance). Forecast three (3)
weeks of start and completion dates for each activity, task, or event in comparison to the
Contractor’s Construction Progress Schedule.
1. Activities in the Short Interval Schedule shall relate directly to activities in the Progress
Schedule.

B. Format for the Short Interval Schedule should be similar to the Owner’s form. The Contractor
may submit an alternative format that must first be approved by the Owner. The format shall
include comment annotation as necessary.

C. Copies of the Short Interval Schedule shall be provided at the Construction Progress Meetings
and will be used as the basis for discussion of progress and planned work at the meetings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. This Section specifies general administrative and procedural requirements for submittals required by the Contract Documents.

1.2 SUBMITTAL PROCEDURES
A. The Owner intends to utilize an internet-based construction management system (CMS) for submittals (see Section 01 35 00 “Electronic Communications”).

1. The electronic submittal process is not intended to be used for color samples, color charts, or material samples.

B. Coordination: Contractor shall review submittals for completeness, accuracy, and compliance with the Contract Documents, and shall coordinate the transmittal of submittals to ensure there is no delay in the construction Progress Schedule. Submittal sequencing should coincide with the Contractor’s Submittal Schedule.

1. Allow fourteen (14) calendar days turnaround for each submittal, from time of receipt by the Owner. For complex submittals or submittals requiring coordination with subsequent submittals, plan additional turnaround time.
a. Provide a "Priority List" when submitting several submittals within a short time.
2. A/E reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
3. Submittals received from sources other than Contractor will be returned without action.

C. Submittal Preparation: Contractor shall place a label on each submittal for processing. Include the following information on the label:
1. Date
2. Owner’s Project name
3. Name of Contractor and submittal number
4. Name of the entity that prepared the submittal
5. Specification reference number
6. For Shop Drawing submittals, Contractor’s certification that the submittal has been coordinated and reviewed for compliance with the requirements of the Contract Documents, and is approved for A/E’s action

D. Submittal Transmittal: Contractor shall include a transmittal with each submittal package.
1. Address no more than one topic, or related topics, on a single transmittal (i.e., mechanical items shall not be submitted with electrical items; miscellaneous specialties shall not be grouped; shoring shall be submitted separate from foundations).
2. Record relevant information including, but not limited to: the requested review return date (in order to maintain the construction Progress Schedule) and for Shop Drawings, variations from the requirements of the Contract Documents.
3. Provide the minimum number of each required submittal as noted in the Contract Documents and/or as follows:
a. Shop Drawings: one (1) PDF
b. Product data: one (1) PDF
c. Samples: five (5) samples
d. Mock-ups: As required by the Contract Documents
e. Reference the Contract Documents for additional submittal requirements
4. Material and Color Samples: Submit samples of actual materials and colors.
a. Where variation in color, pattern, texture or other characteristics are inherent in the material, submit no less than four (4) variations of each sample to show approximate limits of the variations.

E. Portable Document Format (PDF) Requirements:
1. All documents are to be created as PDF files from the original source files, unless approved otherwise in writing by Owner.
2. The CAD printer shall be Autodesk DWG to PDF.pc3 print configuration.
   a. Layer information shall not be included.
3. All documents are to be created with a resolution of not less than 300 dpi.
4. All fonts are to be embedded in the PDF.
5. When compression is used, the algorithm must be LZW, CITT Group 4, or PackBits.
6. The PDF document size must be the same as the original document size if the document were printed (e.g., a 24”x36” print should have a PDF sheet size of 24x36).
7. Each document must be submitted as a single file.
   a. A single O&M product reference is one file.
   b. A single drawing is one file.
   c. A document larger than 11”x17” is defined as single document and is one file.

F. A/E’s Action: Except for submittals provided for the Owner’s information, the A/E will: review each submittal, mark each submittal with a uniform self-explanatory action stamp indicating action taken, and return promptly. Typically action stamps indicate:
1. Accepted without exception;
2. Subject to noted corrections;
3. Returned for re-submittal after correction; and
4. Rejected as non-compliant with the Contract Documents.

G. Compliance with Contract Documents requirements is the Contractor’s responsibility.
1. A/E’s approval of submittals does not relieve the Contractor from responsibility for a proper installation, compliance with applicable codes, or coordination of the Work.
2. All submittals required by the Contract Documents will be reviewed by the Owner for CAD drafting compliance, PDF compliance, and to determine completeness of the documents provided.

1.3 SHOP DRAWINGS

A. General: Shop Drawing submittals are defined in the General Conditions and include, but are not limited to, product data, samples and mock-ups, and layout drawings.
   1. Do not reproduce Contract Documents as Shop Drawings.
   2. For CAD Shop Drawing submittals, see 01 77 00 “Closeout Procedures.”

B. Product Data: Product data includes manufacturer’s printed installation instructions, catalog cuts, standard color charts, rough-in diagrams and templates, standard wiring diagrams, and performance curves.
   1. Submittal of standard product data is acceptable only when specific reference to the requirements of the Contract Documents is included. Submit specially prepared manufacturer’s product data when standard product data is insufficient.
   2. Mark each product data submittal and show the following information:
      a. Compliance with specified product requirements, including LEED requirements
      b. Compliance with any specified industry standards and testing agency standards, with testing agency labels and seals
      c. Manufacturer’s printed recommendations
      d. Applicable choices and options
      e. Notation of coordination requirements
f. Notation of dimensions established by field measurement, as appropriate

C. Samples and Mock-ups: Samples include, but are not limited to, actual colors, materials and products to be provided. Mock-ups include field installations and partial assemblies of components.
   1. Prepare samples to facilitate review. Provide the following information:
      a. Generic description of the sample
      b. Source of the sample
      c. Confirmation of availability and delivery time
   2. Where samples are for selection of appearance characteristics from a range of standard choices, submit a full set of choices for the material or products.
   3. Maintain sets of approved samples and mock-ups at the Project site for quality comparisons throughout the course of construction.

D. Layout Drawings: Drawings include, but are not limited to, fabrication and installation drawings, layouts, schematics, diagrams, schedules, patterns, and templates.
   1. Submit drawings drawn to accurate scale. Indicate, at a minimum, the following information:
      a. Dimensions
      b. Identification of products and materials included
      c. Compliance with product installation requirements and/or industry standards
      d. Notation of coordination requirements
      e. Notation of dimensions established by field measurement

E. Coordinated Shop Drawings:
   1. Contractor shall coordinate the Work and require the Subcontractors to prepare and submit CAD (Computer Aided Drafting) composite coordinated Shop Drawings at a scale not less than 1/4" = 1'-0". The coordinated Shop Drawings shall clearly show: how the Work is to be installed in relation to the work of the other Subcontractors including, but not limited to, the structural and the suspended ceiling Subcontractors; all systems routings, sizes and components; space for disassembly and/or removal of major equipment requiring maintenance; access to products and equipment that require periodic maintenance including, but not limited to, cable trays, pull boxes, valves, dampers, switches, motors, filters, control components; and that maintenance access is adequate and in accordance with the requirements of Authorities Having Jurisdiction. The requirements of this Section E shall apply to all mechanical and electrical rooms and tunnels.
      a. Contractor, working through the Contractor’s mechanical Subcontractor, shall:
         coordinate the mechanical systems and equipment in relationship with other Subcontractor systems and equipment and the building components; and determine if the scheduling sequence and coordination of installations and movement and positioning of large equipment into the building are important to the efficient flow of the Work. The mechanical Subcontractor will at a minimum prepare drawings indicating the following:
            1) Planned piping layout showing valve locations and valve-stem movement
            2) Clearances for installing and maintaining insulation
            3) Access doors
            4) Equipment and accessory service connections and support details
            5) Fire-rated wall and floor penetrations
            6) Accessories such as sizes and location of concrete pads and bases
            7) Penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations
            8) All equipment requiring maintenance access from ladders six feet or more in height, or from scaffolding
b. Contractor, working through the Contractor’s HVAC Subcontractor, shall prepare drawings indicating the location, size, and elevation of supply and exhaust systems ductwork and diffusers; fire and smoke dampers; ventilation equipment including terminal boxes, fans, and motors with VFD’s; seismic bracing; and access doors in ceilings. Coordinate equipment and dampers to avoid maintenance access conflicts with built-in work below (e.g., millwork and equipment).

c. Contractor working through the Contractor’s plumbing and piping Subcontractor shall prepare drawings indicating location, size, and elevation of piping, valves, controllers and headers, cleanouts, guides and rollers, expansion joints, seismic bracing, access doors in ceilings, and fixtures and equipment. Avoid routing plumbing through electrical and data/communications rooms.

d. Contractor, working through the Contractor’s sprinkler Subcontractor, shall prepare drawings indicating location, size, and elevation of the complete sprinkler system including supply and cross mains routing, valves, seismic bracing, and standpipes. Coordinate location of sprinkler heads on the ceiling layout plans.

e. Contractor working through the Contractor’s electrical Subcontractor and fire alarm Subcontractors, shall prepare drawings indicating the location, size, and elevation of primary distribution conduit runs, sleeves, pull boxes, junction boxes, CATV boxes, cable tray, seismic bracing, electrical equipment and panels(with working clearances), and fixtures including sound system speakers and terminal cabinets.

f. Electrical panels have been purposely located and have priority for indicated locations. Mechanical and plumbing installations provide shall provide all required offsets to ensure that electrical panels are installed in the indicated locations.

2. Contractor shall arrange meetings with its Subcontractors to resolve any apparent conflicts on the coordinated Shop Drawings.

3. For Owner’s information, submit a composite CAD Shop Drawing, showing the work of each participant Subcontractor at the conclusion of coordination of each logical component of the Work.

a. CAD backgrounds will be provided by the Owner, as reasonably required by Contractor.

F. Ceiling Layout Drawings: Contractor shall submit for Owner’s review detailed reflected ceiling layout drawings at a scale not less than 1/8” = 1’– 0” showing gypsum wallboard soffits and headers with heights, and locations of access doors, roof openings, HVAC diffusers, sprinkler heads, fire alarm devices, lights, and other ceiling mounted appurtenances.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for electronic communications and document control between the Owner, A/E and Contractor in supporting the Work of the Contract Documents.

B. The Owner will provide the Contractor and its Subcontractors access to the Owner’s internet-based integrated construction management system (CMS) which shall be used for communications and document control.
   1. Not all Project documents are tracked in the CMS. For most documents not in the system, the Owner provides electronic forms created with other industry standard software.
   2. Owner’s forms are included in Appendix A of these Specifications.

1.2 ADMINISTRATIVE REQUIREMENTS

A. System Access: The Owner will provide the required access codes necessary for the Contractor’s access to the Owner’s CMS website. The Owner will host the software and administer authority levels and classifications to users to control security access. Access levels will be provided to match only the level necessary to maintain and process electronic documents specified in this Section.
   1. Owner shall not be responsible for temporary or intermittent outages.

B. System Users: The Contractor shall provide a list of all parties from the Contractor’s and Subcontractors’ staffs and others that will be given access to the system. The Owner will provide the Contractor with access for a maximum of four (4) users, unless otherwise requested by the Contractor and approved by the Owner. The Contractor may, at its sole discretion, elect to enter all required data into the system including input from Subcontractors or may require the Subcontractors to enter their own data, but in either case the Contractor will be responsible for the accuracy of the data entered.

C. System Training: The Owner will provide initial training in the use of the CMS website at no cost to the Contractor commensurate with requirements for document control specified in this Section.
   1. The Owner will provide a training seminar for up to four (4) representatives from the Contractor’s organization at no cost to the Contractor. A training location and dates for the training will be provided after the award of the Contract. Training is anticipated to begin within two weeks of Contract execution.
   2. Additional training requested by the Contractor shall be subject to approval by the Owner.

D. Documents Requiring Signatures: All documents requiring signatures for approval shall be processed with the CMS to expedite preliminary concurrence of information only. Receipt of a “hard copy” signature on forms is required prior to implementing action or work as the conditions may require.

E. Equipment and Software Requirements: A computer with high speed internet access will be required in the Contractor’s home office and field office and in the offices of each of its Subcontractors using the CMS. Each computer must utilize Internet Explorer 8 or above and must be equipped to handle current versions of Microsoft Excel and Word documents, as well as pdf and tif files.
F. Information Input: The responsibility of the Owner, A/E, and Contractor to enter information and data into the Owner’s internet-based CMS shall correlate with the responsibilities of the same parties as specified in all other sections within these Contract Documents. Responsibilities include, but are not limited to:

1. The Owner will input Project and cost information from the Contract Award and maintain emergency contact lists, reports, logs, and enter all change documents.

2. The A/E will enter the Contract Documents and design clarifications with attached drawings and details, after Owner’s approval, and field reports.

3. The Contractor will enter all meeting minutes, submittals, utility shutdown requests, Requests for Information and other reports and documents required by the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies minimum requirements for safety on the construction site including:

1. Contractor responsibility (regarding safety)
2. Contractor safety program and plan submittals
3. Contractor safety requirements
4. Contractor safety reporting
5. Construction “fire safety” requirements
6. Chemical hazard communication
7. Chemicals of interest reporting
8. SARS-CoV-2/COVID-19 exposure control, mitigation, and response plan
   Note: Refer to the UW Project Delivery Group (PDG) website for information on current regulatory/agency guidelines and University requirements (https://facilities.uw.edu/unit/project-delivery)

B. Owner’s forms referenced in this Section include (see Appendix A):

1. Chemicals of Interest – Contractor Declaration and Reporting Form

C. For additional provisions related to safety precautions, refer to the General Conditions.

1.2 CONTRACTOR RESPONSIBILITY

A. The Contractor is solely and completely responsible for compliance with all applicable laws, codes and regulations regarding safety (whether noted in this Section or not) and for creating and maintaining a safe working environment, including safety of all persons and property on the jobsite (whether the requirements of this Section address a particular situation or not).

B. The Contractor shall maintain the jobsite and perform the Work in a manner which meets or exceeds statutory and regulatory requirements for the provision of a safe place to work and which minimizes safety risks to personnel of the Contractor, Subcontractors, Owner, general public or other parties. This obligation shall apply continuously and not be limited to normal working hours.

1. The Contractor shall ensure that all Contractor and Subcontractor personnel are provided sufficient training, and shall take such actions as are necessary to maintain a safe environment on the construction site. Such training and actions shall include, but not be limited to, ensuring that such employees are familiar with governing construction safety requirements and the requirements for compliance with applicable regulations.

2. The Contractor shall monitor the jobsite to ensure that employees do not create unsafe conditions for others, and to comply with the provisions of the Site Specific Safety Plan.

3. The Contractor shall establish and communicate clear expectations to its employees and Subcontractors of any tier (and their employees) of their obligation to notify the Contractor and any at risk party of any potential health or safety hazard affecting themselves or others.

4. The Contractor shall conduct on-site safety meetings weekly, or other frequency as appropriate, that shall be mandatory for all employees.

C. The Contractor shall designate a full-time on-site competent individual to be the “Safety and Health Officer” who is qualified and authorized to supervise and enforce compliance with the Contractor’s Site Specific Safety Plan during the performance of the Work. The Contractor is responsible to ensure that all necessary monitoring equipment, protective clothing, and other supplies and equipment are available to implement the Plan.
1. The Contractor shall require each Subcontractor to provide a fulltime on-site safety manager (competent individual) for the duration of work at the Project site. If the man-load is below fifty (50) field workers, the Subcontractor may designate its Superintendent as the safety manager. If the man-load is fifty (50) or above field workers on-site, the Subcontractor shall provide and designate a dedicated competent individual as safety manager whose sole responsibility is Project safety including, but not limited to: review pre-task plans, critical lift plans, rigging and installation means and methods, fall protection, trenching excavations, electrical safety, Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act of 1973 (WISHA) regulations compliance, and second tier Subcontractor safety monitoring and compliance.

D. Safety Violations: In the event of WISHA violations by the Contractor or any of its suppliers or Subcontractors of any tier for unsafe practices involving imminent danger to personnel of the Owner, Contractor, Subcontractors, or others, the Contractor shall immediately correct the hazardous situation which caused the violation prior to any work continuing in the affected area. If such violations exist and corrective actions have not been taken by the Contractor, the Owner may order the Contractor to stop work (to be followed up in writing the same day), until satisfactory corrective action has been taken per Article 3.04 of the General Conditions.

1.3 CONTRACTOR SAFETY PROGRAM AND PLAN SUBMITTALS

A. Company Safety Program: The Contractor shall submit a copy of its Company Safety Program to the Owner. The Company Safety Program shall contain, at a minimum, the following elements:

1. Organizational Structure: Include names of individuals who will perform safety duties, titles, work assignments, authority and reporting relationships.
2. Training Program: Who, how, and when training is provided; method of employee training concerning safety rules and procedures; and training in use of protective equipment.
3. Protective Equipment: List of personal protective equipment to be provided to employees.
4. Accident Prevention and Loss Control Plan: Work site inspection and hazard correction procedures; disciplinary procedures for safety infractions; and accident response (investigation and reporting procedures).

B. Site Specific Safety Plan: The Contractor and each of the Contractor’s Subcontractors shall review the Contract Documents, and the Contractor shall develop and submit a copy of a “Site Specific Safety Plan” to the Owner. The Site Specific Safety Plan shall be tailored to the unique issues of the Project and the specific types of hazards likely to be encountered throughout all phases of the Work, be in compliance with WISHA and all other regulatory requirements, and contain, at a minimum, the following elements:

1. Application of Company Safety Program: The Site Specific Safety Plan shall address how the elements listed in this Section 1.3A will be specifically applied and modified in addressing the unique issues related to the Project.
2. Specific Hazards: The Site Specific Safety Plan shall address, as applicable, the following, and other specific hazards for the Project:
   a. Odor notification
   b. Excavation and rescue plans
   c. Pedestrian safety (including on Husky Game and/or other special event days)
   d. Overhead hazards and flying objects
   e. Hot works
   f. Hazardous materials and chemical exposure
   g. Methane abatement
   h. Safety issues related to Owner’s “Prior Occupancy”
   i. Working over water
   j. Rigging - aerial lifts and forklifts
k. Electrical safety
l. Scaffolding and personnel lifts
m. Noise and dust
n. Lockout/Tagout and control of hazardous energy
o. Work in confined spaces
p. Housekeeping and safe access
q. Silica
r. Fall prevention
s. Steel erection activities
t. Crane safety
u. SARS-CoV-2/COVID-19 viruses

1.4 CONTRACTOR SAFETY REQUIREMENTS

A. Safety Training: Contractor shall provide construction site orientation for all employees (including Subcontractor employees) to become familiar with the Site Specific Safety Plan prior to commencing work. Contractor shall, on a weekly basis, perform safety training on hazards specific to the phase of work for all employees. These meetings shall be mandatory for all construction employees.
   1. Subjects should include site specific safety issues and procedures and discussion of corrections resulting from any violation in safety procedures. A log of subjects covered and a copy of the attendance records of each meeting shall be submitted to the Owner's Representative on the day the meeting occurs.

B. Respiratory Equipment: Any personnel performing work requiring the use of respiratory protective equipment shall be fully trained in the use of such equipment. Contractor must have a respiratory protection program and ensure that all workers wearing respirators have medical clearance and fit testing, as appropriate, for the type of respirators used.

C. Personal Protective Equipment: Contractor shall ensure all construction personnel are equipped with and utilize personal protective equipment in accordance with Labor and Industries standards. As a minimum requirement, all personnel working on the construction site shall be required to use approved hardhats, safety glasses, appropriate gloves, and substantially constructed work boots. In addition, high-visibility safety apparel shall be worn in accordance with the American National Standards Institute and the International Safety Equipment Association (ANSI/ISEA) standard 107-2004.

D. First Aid: The Contractor shall maintain at the Contractor's field office, or other well known place at the Project site, all materials (e.g., a first aid kit) necessary for giving first aid to the injured, and shall establish, publish, and make known to all employees procedures for ensuring immediate removal to a hospital or a doctor's care, persons (including personnel) who may have been injured on the construction site. Construction personnel shall not work on the construction site before the Contractor has established, and made known, procedures for removal of injured persons to a hospital or a doctor's care. If the Contractor and/or any Subcontractors work crew consist of five or more employees, the Contractor shall ensure that at least one of such employees has a valid and effective first aid card.

E. Safety Walkthrough: In addition to WISHA requirements, the Contractor shall conduct a safety walkthrough of the Project with the Owner's Representative a minimum of once a month during the course of construction. If a safety manager is required for any Subcontractor, the safety manager shall also attend the safety walkthrough. The Contractor shall:
   1. Document and maintain a written record of the hazards and unsafe practices noted during the walk-through and provide copies to the Owner as requested;
   2. Ensure that corrective action is promptly taken to eliminate the items recorded; and
3. Maintain copies of all inspections performed by other competent individuals on the construction site during the course of construction.

F. Job Hazards Analysis: The Contractor shall plan daily work, considering procedures with the potential for personnel injury and implement appropriate practices to avoid injuries with focus on engineering controls, personal protective equipment needs, and mitigation for exposure to cuts and lacerations. At each construction progress meeting, the Contractor shall present its plan for addressing hazards likely to be encountered in the next week.
   1. The Contractor shall develop and implement a program requiring task planning at the foreman level, including at the Subcontractor’s foreman level.

1.5 CONTRACTOR SAFETY REPORTING

A. Reporting Injuries and Incidents: Contractor shall immediately notify the Owner’s Representative of any injury or incident to persons, including personnel, on the construction site. Contractor shall conduct an immediate investigation with an emphasis on preventative actions and lessons learned. The Contractor and its Subcontractor shall document the investigation and submit a hard copy of the report on OSHA Form 301 “Injury and Illness Report,” or equivalent, to the Owner within 24 hours of the incident. The Contractor shall report on a monthly basis the total number of hours worked on-site by the Contractor’s employees and Subcontractors, and the total number of recordable incidents and lost time accidents. Contractor shall submit copies of the Project First Aid Log to the Owner’s Representative on a monthly basis.

B. Reporting Potentially Serious Hazards: Contractor shall immediately notify the Owner’s Representative of any potentially serious hazard to persons, including personnel, on the construction site. Contractor and its Subcontractor shall conduct an immediate investigation and submit a report to the Owner’s Representative within 24 hours of becoming aware of the potentially serious hazard. The report shall describe the potentially serious hazard, the results of the Contractor’s investigation, and any steps the Contractor has taken to prevent an injury or incident from occurring based on the potentially serious hazard.

C. Emergency Procedures:
   1. The Contractor is responsible for obtaining copies of and complying with all Harborview Medical Center emergency response protocols.
   2. For emergencies requiring an ambulance, fire department, or police assistance, the Contractor shall call emergency services (fire and police at 911).
   3. Should the Contractor find it necessary to call for non-emergency police assistance or protection in the exercise of the Contractor’s responsibilities on the Seattle Campus, the Contractor shall call the University Police Department at 206-543-9331.
   4. If an emergency incident occurs within the UW Medical Center (UWMC), the Contractor shall also contact UWMC staff by calling from internal UWMC phones.

1.6 CONSTRUCTION FIRE SAFETY REQUIREMENTS

A. Fire Safety During Construction and Demolition: The Contractor shall conform to Chapter 1, “Fire Safety During Construction and Demolition,” of the International Fire Code, as locally amended, and any additional provisions as outlined herein for precautions against fire, flammable and combustible liquids, flammable gases, explosive materials, fire protection, fire reporting, fire fighting access, means of egress, standpipes, fire sprinklers, and roofing operations.
   1. The Contractor shall provide adequate separation between Owner-occupied buildings and construction trailers and sheds.

B. Hot Work Procedures:
1. Contractor shall establish a system for documentation and control of "hot work" activities which include the use of portable gas, grinding, or arc welding equipment and conduct operations in a manner that is fire-safe for the work area and adjacent areas. Hot work permits are to be posted at the jobsite in an accessible and conspicuous location. Maintain the premise clear of rubbish, debris, or other materials constituting a potential fire hazard. The local fire code is incorporated herein by reference; adhere to all applicable provisions as determined by the local fire department. Contractor and Subcontractors shall obtain from the local Fire Department engineering inspection section a permit for all hot work activities prior to performing this Work.
   a. Whenever practical, the Contractor shall perform cutting and welding operations off-site.

2. Maintain copies of all hot work related permits for Owner’s review upon request, including, but not limited to:
   a. Cutting and welding;
   b. Roofing / hot-tar kettle; and
   c. Storage of flammable materials (e.g., propane, butane) and/or compressed gases.

3. Prior to conducting hot work activities, the Contractor shall ensure all of the following fire safety precautions have been taken:
   a. Cutting and/or welding equipment must be thoroughly inspected and found to be in good repair, free of damage or defects.
   b. A multi-purpose dry chemical, portable fire extinguisher must be located so that it is immediately available to the area of work and is fully charged and ready for use.
   c. At least one fire alarm pull station or means of contacting the fire department (i.e., site telephone) must be immediately available and accessible to person(s) conducting the cutting/welding operation.
   d. Floor areas under and at least 35 feet around the cutting/welding operation must be swept clean of combustible and flammable materials.
   e. All construction equipment fueling activities and fuel storage must be located at least 35 feet away from cutting/welding operations.
   f. Fire resistant shields (e.g., fire retardant plywood, flameproof tarpaulin, metal, etc.), must cover combustible floors.
   g. Combustible materials and finished surfaces, equipment, electrical cables, and personnel must be provided with protection to prevent damage or injury from molten metal, falling sparks, and welding arcs.
   h. Spark / slag catchers (e.g., fire retardant plywood, flameproof tarpaulin, metal, etc.) must be suspended below any elevated cutting/welding operation.
   i. All floor and wall openings must be covered to prevent sparks/slag from traveling to other unprotected area.
   j. Containers in or on which cutting/welding will take place must be purged of flammable vapors.

C. Fire Systems Shutdowns, Impairments, and Fire Watch
1. When it is necessary to shut down existing fire alarm systems or suppression systems for switch-over purposes, or any other reason that leaves the building unprotected, the Contractor shall provide a continuous Owner-approved “fire watch” in accordance AHJs and the following (unless the Contractor provides an Owner-approved temporary equivalent system or the Contractor is specifically excepted by the Owner):
   a. Person(s) assigned to a fire watch must be trained in the use of the portable fire extinguisher.
   b. Fire watch personnel must have an immediate means of providing notification to the fire department (e.g., cellular phone, land-line phone, two-way radio to a continuously staffed position) and the University Police.
   c. Continuous rounds to cover all areas of the building where the fire protection system is out-of-service are required every 15 minutes.
1) Exception for Building Code type “B occupancy” buildings: During the hours a B occupancy building is occupied, building occupants performing their duties, including construction personnel, may act as a fire watch in lieu of a designated fire watch, when approved in writing by Owner.
   a) A fire watch is required at all times in unoccupied areas.
   b) Other building code occupancy types may be allowed this exception when approved in writing by the Owner.
   d) A log of rounds shall be maintained to include the name of the person performing the fire watch, the hours worked (including start and stop times), and comprehensive notes.

2. Fourteen (14) calendar days written notification shall be provided to the Owner’s Representative requesting approval for fire protection system shutdown or functional impairment; receipt of written approval from the Owner’s Representative is required before any system shutdown or functional impairment.
   a. In occupied buildings, include a plan indicating a method to notify all occupants.
   b. Notify the local fire department. In Seattle, the number to report out-of-service systems and equipment is 206-233-7219.

3. The Contractor shall work in cooperation with the Owner to identify fire alarm initiating devices in and adjacent to the Project site that may activate from construction activities (i.e., work that creates dust, smoke, steam, heat, etc.) and develop a plan to temporarily cover, remove, or disable through programming these devices to eliminate the potential for false alarms.
   a. The Owner may authorize in writing some devices to be disabled for the duration of the Work or for a particular activity without requiring a continuous “fire watch” for one shift or several days depending on circumstance.
   b. ONLY OWNER PERSONNEL SHALL DEACTIVATE OR DISABLE EXISTING FIRE DETECTION AND SUPPRESSION SYSTEMS, unless the Contractor is specifically authorized in writing by the Owner to do so.
   c. If the fire alarm system has been deactivated at the request of the Contractor and the Contractor leaves the construction site without informing the Owner of the need to reactivate the fire alarm system, a charge of $500 shall be assessed for each event. The Contract Sum will be amended for such amount by Change Order.

D. Fire Alarm/Suppression Systems False Activation or Discharge: Most existing Owner buildings have active fire detection and suppression systems. If proper procedures as outlined in the Contract Documents and this Section 1.6C are not followed to ensure the unnecessary activation or deactivation of these systems, the Owner may at its sole discretion impose an emergency response charge of $350 per occurrence to the Contractor and require a fire watch at the Contractor’s cost. The Contract Sum will be amended for such amount by Change Order.

E. Fire Extinguishers Required for Construction: Provide multipurpose dry chemical portable fire extinguishers for the Work in accordance with the International Fire Code Chapter 14, as locally amended, and as required by WISHA and other applicable regulations. Existing building fire extinguishers or new fire extinguishers specified by the Contract Documents for the Project do not alleviate Contractor’s responsibility to provide temporary fire extinguishers for the Work.

F. Standpipes Required for Construction: In new multi-story construction (four or more stories in height) a Class I standpipe shall be provided in accordance with Chapter 14 of the International Fire Code, as locally amended, for use during construction. Fire Department connections at bottom of standpipe shall be clearly marked and accessible at all times for fire department personnel and equipment. This requirement shall be reviewed and approved by the Owner’s Representative.
G. Existing Fire Separations: Existing fire separations, including floor-to-floor separations, shall not be impaired by construction activities.

H. Occupant Egress in Existing Buildings: The Contractor shall not block active exits, exit hallways, exit corridors and the exit access to a public way.
   1. Exits are to remain free of construction materials, equipment, and rubbish at all times, unless approved by Owner.
   2. Work which blocks or restricts exit corridors shall only occur at night with prior approval of the Owner. If approved, work that blocks or restricts exit corridors must be cleared by 6:00 a.m. each day.

I. Emergency Access: Outdoor storage and staging operations and construction fencing shall not impede egress, restrict or narrow fire fighting access (including roads or lanes), or present a fire exposure to existing buildings.
   1. Access to emergency services including, but not limited to, fire hydrants, fire department connections, fire command centers, fire alarm panels, valves and similar equipment and systems for emergency vehicles and emergency response personnel must be kept free and unobstructed at all times, unless specifically approved by the Owner.
   2. Temporary obstruction of emergency access may be allowed for special cases (e.g., crane installations and hoisting) on a short-term basis. A written plan must be submitted to the Owner for approval at least two weeks prior to the scheduled date of obstruction.

1.7 CHEMICAL HAZARD COMMUNICATION

A. General: The Owner and the Contractor are responsible under the Washington Administrative Code 296-800-170 through 296-800-18020 (Employer Chemical Hazard Communication) to provide a safe and healthy environment for their employees.

B. Responsibilities:
   1. The Owner maintains a centralized collection of all Material Safety Data Sheets (MSDS) for Owner materials. These MSDS are available to the Contractor if an unknown chemical is discovered in the work area; a worker is concerned about exposure; and the Contractor suspects the material originates with the Owner.
      a. The Contractor shall coordinate with the Owner’s Representative to receive this information.
   2. The Contractor shall establish a Chemical Hazard Communication Program (WAC 296-155-180) which includes multiemployer workplaces (WAC 296-800-17007), and provide hazard communication information and training to its employees and the employees of the Contractor’s Subcontractors (of any tier).
      a. The information shall include: signage demarcating regulated areas and entrances; signage indicating the location of the Contractor’s binder containing all MSDS used for Construction; and prominently posted lists identifying all hazardous chemicals present in the workplace.
      b. In addition to MSDS training which is regulated by the Employer Chemical Hazard Communication standard, training shall include those MSDS that are available for any Owner’s chemical product present at the jobsite.
   3. The Contractor shall provide the Owner chemical hazard information (MSDS) for all chemical products the Contractor and the Contractor’s Subcontractor’s (of any tier) bring onto the jobsite for Owner’s information prior to application including, but not limited to, all paints, glues, mastics, epoxies and cleaning products.
      a. At the jobsite, the Contractor shall establish and maintain a binder(s) of all hazardous chemicals MSDS used for Construction and indicate where utilized.
         1) The MSDS shall be bound in a slant-D, 3-ring, view binder with clear vinyl overlay inserts on the front cover and spine. The binder shall have heavy duty nylon reinforced hinges.
2) The binder shall have a cover slip sheet and a spine sheet typed with “MSDS used for Construction,” University Project name, University Project number, University Facility number, A/E name, and Contractor name.

3) The MSDS shall be organized by specification division and section with tabbed dividers between the sections or, when presented in a logical format by Contractor and approved by Owner, between categories.

1.8 CHEMICALS OF INTEREST REPORTING

A. Prior to work being performed by the Contractor and/or the Contractor’s Subcontractors (of any tier), the Contractor shall submit to Owner a completed “Contractor Declaration and Reporting Form for Department of Homeland Security – Chemicals of Interest” for chemicals listed in 6 CFR (Code of Federal Regulations) Appendix A to Part 27 that will be used on the jobsite. Individual declarations shall be provided by the Contractor and the Contractor’s Subcontractors (see Appendix A of the Specifications for a copy of the form)

1.9 SARS-CoV-2/COVID-19

A. All construction operations must comply with the most current COVID-19 related rules and guidance from the Governor’s Office including the “Stay Home, Stay Healthy” addendum, dated April 24, 2020, and additional guidance issued April 29, 2020. All activities must also comply with all related and applicable requirements issued by the Washington State Department of Labor and Industries and Public Health Agencies having jurisdiction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. The Section further describes basic Contract definitions, specification format and content explanations, and industry standards in the Contract Documents.

1.2 DEFINITIONS

A. Accepted: The term "accepted" is used in conjunction with the A/E’s duties and responsibilities as stated in the conditions of the Contract.

B. Concealed: Spaces out-of-sight such as above ceilings, below floors, between double walls, furred-in areas, pipe and duct shafts, and similar spaces.

C. Directed: Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the A/E, requested by the A/E, and similar phrases.

D. Exposed: Open to view. For example, pipe installed in a walkway tunnel or pipe installed in a room and not covered by other construction.

E. Furnish: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.

F. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference.

G. Install: Operations at Project site to place in position for service or use including unloading, unpacking, assembly, erection, placing, anchoring, applying, working-to-dimension, finishing, curing, protection, cleaning, and similar requirements.

H. Installer: An installer is the contractor or another entity engaged by the Contractor, either as an employee, Subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installers shall be experienced in the operations they are engaged to perform.

I. Project site: Is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built. Certain construction activities may extend beyond the Project site.

J. Provide: Furnish and install, complete and ready for intended use.

K. Regulations: The term “regulations” includes laws, codes, ordinances, statutes, and lawful orders issued by authorities having jurisdiction (AHJ), as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

L. Trades: Using terms such as carpentry does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as
It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into divisions and sections based on the Construction Specification Institute’s (CSI) MasterFormat.
   1. Title: The Specifications are divided into division and section for the convenience of writing and using. The titles of these are not intended to imply a particular meaning or to fully describe the work of each division, subdivision, or section and are not an integral part of the text which specifies the requirements.
   2. Three Part Section: Each section of Specifications has been subdivided into three parts for uniformity and convenience (Part 1 – GENERAL, Part 2 - PRODUCTS, and Part 3 - EXECUTION). These do not imply a particular meaning and are not an integral part of the text which specifies requirements. Where text for one of the parts is lacking due to project requirements, the part title is included followed by the words “Not Used.”

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B. Specification Content: This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. The conventions are explained as follows:
   1. Abbreviated language: Abbreviated words and meanings used in the Contract Documents shall be interpreted as appropriate. Words implied, but not stated, shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicate.
   2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarify to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
      a. The words ‘shall be’ are implied wherever a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

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

B. Publication Dates: Comply with the industry standards in effect as of the Bid date of the Contract Documents.
C. Conflicting Requirements: Where compliance with two (2) or more standards are specified and where the standards may establish, different or conflicting requirements for minimum quantities or quality levels, the Contractor shall promptly report to the A/E, in writing, requesting a decision before proceeding with the Work.

1. Minimum quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum, within reasonable limits, to comply with these requirements. Indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements.

D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound within the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Acronyms or abbreviations, as referenced in Contract Documents are defined to mean the recognized name of the trade association. Names and addresses are subject to change and are believed, but not assured, to be accurate and up-to-date as of the date of the Contract Documents. Refer to the latest edition of the “Encyclopedia of Associations” published by Thomson Gale for a listing of associations and general standards abbreviations.

F. Federal Government Agencies: Names and titles of federal government standard - or Specification - producing agencies are often abbreviated. Acronyms or abbreviations referenced in the Contract Documents may indicate names of standard - or Specification-producing agencies of the federal government. Names are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. General Requirements: Comply with the quality control provisions specified in the Contract Documents and perform quality control testing and inspection, and the surveillance of the Work for quality, unless specifically designated to be performed by Owner.

B. Owner’s forms referenced in this Section include (see Appendix A):
   1. Contractor Quality Control Daily Report

C. Contractor Quality Control (CQC) shall consist of plans, procedures, and organization necessary to provide materials, equipment, workmanship, fabrication, construction, and operations that comply with the requirements of the Contract Documents. CQC shall cover construction operations keyed to the Progress Schedule including, but not limited to, fabrication on-site and off-site, and field and factory tested construction mock-ups.

D. Owner’s special inspection and Testing Agency services are specified in Section 01 45 23 “Testing and Inspecting Services” which may be required to ensure the Work is in accordance with the Contract Documents, except where those tests are specifically indicated to be performed by the Contractor in the Contract Documents. These services do not relieve the Contractor of responsibility for compliance with Contract Documents requirements.

1.2 CQC MEETINGS

A. General Work Plan Meeting: Contractor shall meet with Owner’s Representative and A/E to discuss CQC procedures for the Project. Items for discussion shall include, but not be limited to:
   1. Identification of the Contractor’s CQC Representative;
   2. Interrelationship of Contractor, AE and Owner’s Representative;
   3. CQC administrative procedures and pre-installation work plans;
   4. Submittals and persons responsible for Shop Drawing review;
   5. Forms for recording the CQC program;
   6. Testing, inspections and approvals records;
   7. On-site and off-site fabrication and installation procedures; and
   8. Field constructed mock-ups.

B. Pre-installation CQC Work Plan Meetings: Develop a “CQC Work Plan” for each definable feature of the Work. Complete the work plan and submit to Owner with each notification requesting a pre-installation meeting. The work plan shall serve as the basis for discussion and review of the Contract Documents requirements. The work plan will assist to assure that materials and equipment delivered and assembled for construction conform to Contract requirements, and that control testing and CQC procedures are documented.
   1. When requested by the Owner, the Contractor shall revise a CQC Work Plan and provide the Owner a final CQC work plan with changes addressing comments or clarifications from the A/E and/or Owner’s special inspection services or Commissioning Authority.

1.3 CONTRACTOR QUALITY CONTROL REQUIREMENTS

A. Contractor’s Quality Control Organization: Staff the CQC organization, as required, to perform the activities outlined in this Section and elsewhere in the Contract Documents.
   1. Identify a “CQC Representative” (who is not the superintendent) who shall be on the Project site during progress of the Work as required. The CQC Representative shall have
complete authority to take those actions necessary to ensure compliance with the Contract Documents.

2. Identify persons responsible for review and approval of Shop Drawings and other submittals required by the Contract Documents.

B. Qualifications of CQC Representative: The Contractor shall propose and Owner shall approve, in writing, the Contractor’s CQC Representative. The CQC Representative must have construction management experience including prior experience with projects of similar construction, size, and complexity.

1. During progress of the Work, the Owner will monitor and evaluate the performance of the CQC Representative based on the conformance of the Work with the Contract Documents and an assessment of the accuracy, timeliness and completeness of the daily QC Report. If the CQC Representative fails to perform to the sole satisfaction of the Owner, the Contractor shall propose a replacement CQC Representative for the Owner’s approval.

C. Daily Quality Control Reports: CQC Representative shall maintain daily Quality Control (QC) Reports. The QC Reports shall be factual records containing numerical data of the Work and quality control activities and observations, including examination of work areas to verify the substrate upon which new work is to be placed. Submit QC Reports on Owner’s form, or another Owner approved form, by the next workday following the day of the report.

1. CQC Representative shall verify and sign all reports. Verification shall contain the statement that all supplies and materials incorporated in the Work are in compliance with the Contract Documents.

D. Control of On-Site and Off-Site Construction: Contractor’s Quality Control procedures shall include the following phases of control and management for each definable feature of the Work:

1. Pre-installation Meeting: A pre-installation meeting shall be held prior to beginning work on each definable feature of the Work specified in the Contract Documents (see Section 01 31 19 "Project Meetings").

2. In-Progress Inspection Phase: In-progress quality control testing and inspection, and surveillance of the Work for quality shall be performed continuously to verify that quality standards are maintained throughout the Work. Adjustment to quality control procedures and CQC work plans may be required, based upon the results of the inspections and testing.

a. The Contractor shall:
   1) Discuss quality control procedures at construction progress meetings;
   2) Report the results of the inspections and any changes to quality control procedures in the daily QC Report; and
   3) Revise CQC work plans for Owner’s records, if changes are required.

3. Above-Ceiling Final Inspections: The Contractor shall provide to the Owner a minimum two (2) week notice prior to ceiling installations for the A/E to conduct above-ceiling final inspections.

a. The Contractor shall perform corrective work and provide reasonable time for the A/E to validate the work complete prior to covering from sight.

4. Contractor’s Final Punch List Report: The CQC Representative shall thoroughly inspect all aspects of the construction (including the Subcontractor’s Work) and produce a final punch list report of work requiring correction and/or incomplete work that shall be issued to the Subcontractors with instructions to complete prior to requesting the Owner’s final inspections. The Contractor’s written request for Owner’s final inspection shall certify that all features of the Work are installed and have been reviewed by the Contractor to determine compliance with the Contract Documents.
a. The Contractor’s final punch list report shall be prepared by the Contractor utilizing the Owner’s internet-based construction management system (CMS), in a format acceptable to the Owner.

1) The report shall include a comprehensive Project room number list and additional entry listings for site work, building enclosure, roofs, and other items not designated with a room number to document the entire Project.

2) The Owner’s final inspections items will be added to the Contractor’s final punch list report by the A/E.

3) The Owner will manage the consolidated listing of all open inspection items until all items are signed-off by the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. General Requirements: Comply with the testing and inspection, and correction of Non-Conforming Work provisions specified in this Section and elsewhere in the Contract Documents.

B. Owner’s Responsibilities:
   1. The Owner will select and employ an independent “Testing Agency” to conduct the tests and inspections in accordance with applicable standard methods of the American Society for Testing and Materials (ASTM) or other standards as a requirement of the building permit.
   2. The Owner may provide other special inspection services to inspect and verify that the Work installed is in accordance with the Contract Documents and construction industry standards.

C. Contractor’s Responsibilities:
   1. All other tests and inspections which are required to obtain regulatory approval by Authorities Having Jurisdiction (AHJ) shall be provided by and paid for by the Contractor.
   2. The Contractor shall provide other testing services where specified in the Contract Documents.

1.2 DESCRIPTION

A. Definition: For the purpose of this Section, all references made to Testing Agency, or waterproofing and roofing inspections, or geotechnical consulting firm shall be referred to as those tests or inspections which will be conducted by an inspector provided by the Owner.

B. Testing and Inspection: Materials to be tested and inspected are specified by the Contract Documents. In addition, testing and inspection of other materials maybe required by the building permit or as directed by the Owner or AHJ. Quantities and extent of tests and inspections shall be as specified and/or required by the Owner’s inspector or AHJ.

1.3 QUALITY ASSURANCE

A. Qualifications: The inspector for all work of this Section, except for geotechnical and waterproofing and roofing special inspectors, shall be a registered inspector employed by an approved inspection and/or Testing Agency as listed by the Washington Association of Building Officials (WABO) Special Inspection Registration Program. All inspection personnel used on this Project are subject to being disapproved from the Project at the sole discretion of the Owner’s Representative. Minimum levels of qualifications as stated in the WABO Special Inspection Registration Program for various portions of the required Testing Agency inspections and testing must be complied with.
   1. The special Inspector for waterproofing and roofing must have the required technical knowledge and experience for the product being installed.
   2. The Owner may select a Testing Agency, other than the agency employed by the Contractor, to perform tests required by the building permit.
   3. Geotechnical inspection will be performed by a licensed geotechnical consulting firm.
1.4 DUTIES OF OWNER’S TESTING AGENCY

A. General: The Testing Agency shall conduct testing and inspection services, interpret them, evaluate the results for compliance with the building permit and the Contract Documents, and report the findings to the Owner’s Representative, A/E, Contractor, and AHJ. Testing and inspection services shall be in accordance with applicable standard methods of ASTM or other standards specified by AHJ, the Contract Documents, and construction industry standards. The Testing Agency shall reasonably support overtime, second shift, and out-of-area activity if requested by the Contractor and approved at the Owner’s sole discretion.

B. Non-Conforming Work: The Owner’s inspectors will document and immediately notify the Contractor and the Owner’s Representative of any Work found defective or not in accordance with the requirements of the Contract Documents.

C. The Owner’s inspectors are not authorized to:
   1. Release, revoke, alter, or enlarge on the requirements of Contract Documents;
   2. Approve or accept any portion of the Work, except as allowed by the special inspection duties delegated by AHJ for building permit inspections and testing;
   3. Perform any duties of the Contractor; or
   4. Stop the Work.

1.5 COSTS

A. The Owner’s Testing Agency and special Inspector costs for initial testing and inspection as specified in the Contract Documents will be paid for by the Owner. Initial tests and inspections are defined as those required to complete the first tests and inspections specified.

B. Additional tests and inspections not specified but requested by the Owner or A/E shall be paid for by the Owner.
   1. However, if the results of such tests and inspections are found to be not in accordance with the Contract Documents, the Contractor will be back-charged for all costs of this testing and inspection as well as re-testing, re-inspection and Owner's consultants’ services.

C. Costs for additional tests or inspections required because of a Contractor change in products or materials, or source, after a submittal has been reviewed and accepted, shall be borne by the Contractor.

D. Costs of any testing which is required solely for the convenience of the Contractor in its scheduling and performance of the Work shall be borne by the Contractor.

E. Costs for verification testing and inspection of Work done without timely notice, with improper supervision, or contrary to construction practice, shall be borne by the Contractor.

F. Costs for testing of materials for which fabrication and mill reports are required, but not furnished, shall be borne by the Contractor.

G. Costs of any testing which is the responsibility of the Contractor as specified in the Contract Documents shall be borne by the Contractor.

1.6 TESTS AND INSPECTION REPORTS

A. Copies of Test and Inspection Reports: Electronic copies of Owner’s Testing Agency (or other special inspection services) reports and Contractor’s test and inspection reports shall be
exchanged between Owner and Contractor at weekly intervals and shall be provided to AHJ as required. All reports will be signed by a registered engineer. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory. Samples taken but not tested and records of special sampling operations that are required shall also be reported.

1. Submit copies of inspection reports, certifications, notices, correspondence, and similar documents and records established in conjunction with building industry standards bearing upon the Work.

1.7 CONTRACTOR’S RESPONSIBILITIES

A. General: Inspection of the Work by the Owner’s special inspectors and/or Testing Agency shall not relieve the Contractor from responsibility for compliance with Contract Documents requirements. Owner’s special inspectors and/or Testing Agency and Owner’s Representative shall have authority to reject Work whenever the provisions of the Contract Documents are not being complied with, and the Contractor shall instruct his employees accordingly.

B. Coordination: The Contractor’s shall initiate, coordinate, and conform to the required tests and inspections of AHJ.

C. Access for the Purpose of Inspection: The Contractor shall ensure the Owner’s special inspectors and/or Testing Agency have free access to all parts of the Work and to the shops where the Work is in preparation; are provided proper facilities for safe access for such inspection; and are reasonably furnished equipment, tools, samples, certifications, test reports, design mixes, storage, and assistance as requested by the Owner’s Inspector.

D. Storage Facilities: The Contractor shall furnish adequate facilities for the sole use of the Owner’s Testing Agency to provide safe storage and curing space for test specimens that must remain on-site prior to transport to the laboratory.

E. Data: The Contractor shall furnish accepted submittals and approved Change Orders, certificates, and similar data as may be required by Owner’s inspectors to perform their work to assure compliance with the Contract Documents.

F. Notice: Furnish notice to Owner's Representative and coordinate with Owner's inspectors. Provide a minimum of five (5) working days notice in advance of all required tests and a minimum of forty eight (48) hours in advance of all required inspections, unless otherwise specified.

G. Cancellations: Contractor shall give sufficient advance notice to Owner’s Representative and Inspectors to allow rescheduling of their work load in the event of cancellation or time extension of any scheduled test or inspection.

1. Any charges from an Inspector due to insufficient advance notice of cancellations or time extensions shall be borne by the Contractor, at the Owner's sole discretion.

1.8 TEST FAILURES

A. General: The Owner's Representative may require a re-test of a sampled material when a sample or procedure has failed to pass the required tests. In such cases, two samples shall be tested and the material shall be rejected if either sample fails.

1. In the event any test or inspection indicates failure of a material or procedure to meet the requirements of the Contract Documents, all costs for re-testing or re-inspection shall be borne by the Contractor.
1.9 REPORTING TEST FAILURES

A. General: Immediately upon determination of a test failure, the Owner’s inspector shall telephone the test results to the Owner’s Representative and Contractor. By the end of the following day, the Owner’s inspector shall send written test results to those named on the distribution list.

B. Contractor shall similarly report test failures to Owner’s Representative resulting from work of testing agencies provided by the Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Minimum temporary facilities and controls requirements are specified in this Section. Nothing in this Section is intended to limit the types and amounts of necessary temporary facilities required to perform the Work, and no omission from this Section will be recognized as an indication that a necessary temporary facility is not required for successful completion of the Project, and compliance with the requirements of the Contract Documents and all applicable codes.

B. Included in this Section are the following headings:
   1. Product Delivery, Storage and Handling
   2. Project Site - Work Area
   3. Protection of Existing Utilities
   4. Shutdowns of Existing Equipment and Utility Services
   5. Temporary Support Facilities
   6. Temporary Enclosures and Miscellaneous Construction
   7. Noise and Vibration Control
   8. Construction Parking and Staging
   9. Construction Traffic

C. Owner’s forms referenced in this Section include (see Appendix A):
   1. UW or HMC Utility Shutdown Request form, as appropriate.

D. Behavior:
   1. The Owner will not tolerate inappropriate behavior by any worker on a jobsite toward a student, staff, patient, visitor, neighbor or employee.
   2. The Contractor shall not allow obscene, offensive or otherwise inappropriate material to be displayed at the Project site, or at remote construction staging and parking areas, including job offices and trailers. If such material is displayed, it shall be immediately removed by the Contractor and/or when requested by the Owner's Representative.
   3. Gratuities to Owner's employees by a Contractor are not allowed per Washington Administrative Code, Chapter 42.52 RCW.

E. Conservation: The Contractor shall install and operate temporary facilities and perform construction activities in a manner which reasonably will be conservative and avoids waste of energy and materials, including water.

F. Pest Control: The Contractor shall rid the Project site of rodents, birds, insects, and other pests which may have entered buildings under construction as a result of the work.

G. Pollution Control: The Contractor shall perform the Work so as to prevent water, soil, and air pollution.
   1. The Contractor shall not discharge volatile, harmful, or dangerous materials into the Owner’s sanitary sewer and storm water drainage systems.
      a. Non-storm water discharge into the Owner’s storm water system is prohibited, including the following types of discharge, unless the stated conditions are met:
         1) Discharges of potable water for, but not limited to, water line flushing, hyper-chlorinated water line flushing, fire hydrant system flushing, and hydrostatic test water must be de-chlorinated to a concentration of 0.1 parts per million or less, pH-adjusted if necessary, and volumetrically and velocity controlled to prevent re-suspension of sediments in the storm water system.
b. Street sweeping must be performed prior to washing the street at construction sites.
c. All discharges to the sanitary sewer require Owner's prior approval.

2. The Contractor shall not cause or allow visible emissions of fugitive dust from the construction site, unless reasonable precautions are employed to minimize the emissions. Reasonable precautions include, but are not limited to, the following:
a. During high winds, the use of control equipment and/or enclosures, the reduction of construction vehicle speeds, and the curtailment of all dust creating construction procedures shall be implemented.
b. When demolition, excavation, and construction activities generate dust, the construction site shall be sprinkled with water or chemical stabilizers to minimize dispersion.
c. Truck under-carriages shall be brushed to minimize the transporting of dirt off construction sites.
d. Truckloads shall be covered, wetted, or allowed adequate freeboard to prevent the escape of dust-bearing materials.

H. Silica Dust Control: The Contractor shall use best engineering and work practice controls to reduce exposure to silica dust at or below the Washington State Permissible Exposure Limit defined in the latest regulations from the Washington State Department of Labor and Industries (L&I), Puget Sound Clean Air Agency (PSCAA) and any other applicable federal, state, and local government regulations.
1. The Contractor shall assume that silica is present in all concrete, mortar, terrazzo flooring, plaster, sheetrock, fireproofing and other related building products.
2. The Contractor shall implement controls to contain and clean-up silica dust generated by cutting and demolition work and shall provide worker and equipment decontamination provisions. At no time is silica dust from the construction permitted beyond the “work area.”
a. The Contractor shall conduct air sampling for respirable crystalline silica in accordance with the National Institute for Occupational Safety and Health (NIOSH) method 7500.

1.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle specified products in accordance with the manufacturer’s recommendations and use means and methods that will prevent damage, including, but not limited to, moisture damage of materials, deterioration, and loss or theft.
1. Store materials and products off the ground and protect from weather.

B. Furnish products in the manufacturer’s original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

C. Include a waste reduction provision in purchasing agreements requiring that materials and equipment be delivered in packaging made of recyclable material, that the amount of packaging be minimized, and that packaging be taken back for reuse or recycling.
1. The Contractor shall require the same provisions in its Subcontractor’s purchasing agreements.

D. Inspect products upon delivery to ensure compliance with Contract Documents, and to ensure that products are dry and mold free, undamaged, and properly protected.
E. Store products at the Project site in a manner that will facilitate inspection and measurement of quantity or counting of units.

F. Store heavy products away from the Project structure in a manner that will not endanger the supporting construction.

G. Protect building products subject to damage, under cover in a clean and weather-tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer’s instructions.

H. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
   1. Ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

1.3 PROJECT SITE - WORK AREA

A. Confine operations, equipment, and storage to the designated work area.
   1. Maintain the Project site, including adjacent areas and properties, in a clean and orderly manner free from accumulations of combustible materials and construction waste, including rubbish and debris resulting from construction operations. Clean indoor work areas daily of construction waste, dirt, and dust. Do not store construction materials and equipment in Owner-occupied areas unless approved by the Owner. Immediately clean up any spilled material and/or fugitive construction spoils or debris from adjacent properties and vehicle travel ways. Keep streets, fire lanes, and walks clean and free from obstructions.
   2. Mechanical rooms shall not be used for construction storage, unless approved by Owner.
   3. All masonry cutting is to be done outdoors. Cut stations for all other work shall be located outdoors or within well ventilated dustproof enclosures or other approved containment.

B. Security:
   1. General:
      a. Protect work and stored products from theft and vandalism and protect premises from entry by unauthorized persons. At the end of workday, close temporary enclosures and lock exterior doors and/or gate. Secure all openings at any time the Project site is left unoccupied.
      b. Owner’s Keys: Owner’s Representative will issue keys, as required, for the Contractor to perform the Work. Prior to Substantial Completion, the Contractor will return all issued keys. Contractor’s responsibility shall include, but not be limited to, the following:
         1) Arrange for the issuance of access keys on a daily basis, or as mutually agreed with Owner.
            a) Owner’s costs associated with re-keying a system, including an entire tunnel system, due to lost keys shall be the responsibility of the Contractor.
         2) Lock all access doors when not attended and at the end of each shift.
         3) Provide security barriers, acceptable to Owner, at all utility openings which are created by the removal of gratings and/or the opening of utility tunnels or shafts.
         4) Coordinate Work to minimize need for access to restricted areas.
      c. Many buildings and spaces on Campus are high security areas, such as building mechanical and electrical equipment rooms, certain lab spaces, and computer facilities. Contractor shall use due care to maintain an equivalent level of security of Owner’s property, where appropriate, and as it normally exists (i.e., secure areas
when not actively working). Normally locked or closed doors shall not be propped open.

d. Contractor is advised to lock its gang boxes and secure them to the construction. Owner will not reimburse Contractor for any lost or stolen tools, material or equipment.

2. Tunnel System: Owner maintains rigid controls for persons entering the Owner’s tunnel systems. All tunnel doors and certain utility access gratings are equipped with special security locks. The remaining utility access gratings are secured by tack welding.

3. Criminal Background Checks: All construction personnel working in medical centers shall be subject to criminal background checks in accordance with Washington Administrative Code, RCW 43.43.830, et seq.

a. On the first day of work, each worker shall fill out a Washington State Patrol Request for Criminal History Information form and a Request for Criminal History Record form and submit them to the Contractor’s superintendent who shall submit the collected forms to the Owner’s Representative.

b. The Owner will request the background check from the Washington State Patrol.

c. A worker may be conditionally employed on the Project pending results of the criminal background inquiry.

d. Any worker who does not pass the criminal background check will not be permitted to work on the Project and the Contractor shall immediately remove, or cause the worker to be removed, from the Project.

4. Photo Identification Badges: The Owner requires that all construction personnel working within the Owner’s existing facilities obtain photo identification badges. The badge shall be worn above the waist with the photo visible at all times that the worker is on-site within the Owner’s existing facilities.

a. On the first day of work, the worker shall complete and submit to the Owner a badge application form(s) provided by the Owner’s Representative, and schedule a time and location with the Owner’s Representative to obtain a badge.

b. The Contractor shall return the badge to the Owner’s Representative at completion of each worker’s on-site work as a requirement of Final Completion.

C. Construction Waste: Remove construction collected materials from the Project site at a frequency acceptable to the Owner and dispose of in a lawful manner. Do not burn waste material, stockpile waste material, or bury waste material on Owner’s property. Do not use Owner’s waste containers for construction waste of any kind, unless approved by Owner. Dispose of all refuse and waste material, including excess earth from excavation, off of Owner’s property.

1. See Section 01 74 00 “Construction Waste Management” and, when specified, Section 01 11 01 “Summary of Work – Regulated Materials” for additional requirements.

D. Odor Control:

1. General: Adjacent Owner areas and/or neighboring buildings may be occupied during construction. The use of solvents and materials producing noxious fumes or any product or equipment that adversely impacts air quality shall be subject to the approval of Owner. Isolate odor-causing work away from building air intakes, private properties and pedestrian traffic areas. Where solvents are used within enclosed structures, vent to outside areas.

2. Emissions Control Plan: The Contractor shall submit a written procedure for control of emissions prior to any use.

a. The plan shall at a minimum consist of the following items:

1) Products to be used/Material Safety Data Sheets
2) Location of Work
3) Application
4) Ventilation plan
5) Hours of operation
6) Materials handling/storage

b. Considerations shall include, but are not limited to:
   1) Concrete curing
   2) Roofing and waterproofing
   3) Welding
   4) Exterior painting
   5) Adhesive and/or stripping or paint removal
   6) Asbestos abatement
   7) Soil remediation

3. Equipment and trucks producing fumes shall not be parked or located in the vicinity of building air intakes, entrances, and operable windows, unless approved by the Owner.
   a. Trucks that are idling for more than a few minutes shall shut off their engines. If trucks are queued and idling, there must be at least 20 feet between each truck or the exhaust shall be piped to have a 20-foot separation between each exhaust.
   b. All diesel-powered construction equipment shall utilize ultra-low sulfur diesel fuel.
   c. All diesel-powered construction equipment and trucks must be: 2007 model year or later (for vehicles); or Tier II heavy duty (for stationary engines); or equipped with 3-CARB verified oxidation catalyst-based particulate emissions control devices, operating at 600 degrees F or above.

E. Smoking: The University of Washington and Harborview Medical Center have restricted smoking policies. The Contractor shall not permit its employees or the employees of its Subcontractors of any tier to smoke on the Owner’s property, except in the areas indicated below:
   1. Smoking is permitted on University of Washington campuses where shown on maps: http://www.ehs.washington.edu/psosmoking/index.shtm
   2. For the Harborview Medical Center: Contact Owner’s Representative for information.
   3. If the Project site includes a fenced construction area, the Contractor shall establish an outside area, within the fenced area, where its employees and the employees of its Subcontractors may smoke, provided that the area is in compliance with the requirements of Chapter 70.160 RCW. The Contractor shall communicate the location of the permitted smoking area to its employees and Subcontractors, and shall require Subcontractors (of any tier) to communicate the location of the smoking area to its employees.

F. Construction Photographs: Photograph the Project site prior to the start of construction to document original site conditions and provide digital copies of the photographs to Owner. The photographs will be used for determination of the extent of restoration required.

1.4 PROTECTION OF EXISTING UTILITIES

A. The existing concealed utilities shown on the Drawings are not necessarily exact with respect to location or completeness. Therefore, the Contractor shall take the following steps:
   1. Notify Owner in writing, with a minimum two (2) week notice for each occasion, of the intent to work near existing known underground utility services or structures or when a new excavation operation is about to begin. Submit procedure for approval to assure safe and continuous operation of the services.
   2. Proceed with sufficient caution to preclude damaging any known utilities (i.e., hand digging or probing). In the event unidentified utilities are encountered, notify Owner’s Representative immediately.
   3. In the event utilities are damaged during construction, temporary services and/or repairs must be made immediately to maintain continuity of services.
a. Utilities installed by the Contractor, and damaged by the Contractor, shall be repaired at the Contractor's sole expense.

1.5 SHUTDOWNS OF EXISTING EQUIPMENT AND UTILITY SERVICES

A. It is generally critical that all building systems remain operational within occupied buildings, except for brief shutdowns that might be required to integrate or connect new Work. Similarly, continuity of equipment and utility services to adjacent buildings and Owner's site infrastructure shall also be reasonably maintained at all times.

B. Equipment or utility shutdowns required to facilitate the Work shall be accomplished in accordance with the following requirements:
   1. Submit a schedule of equipment and utility shutdowns (see Section 01 32 16 "Construction Progress Schedule").
   2. Submit a Utility Shutdown Request form to schedule all equipment and utility shutdowns not less than fourteen (14) days prior to the proposed date. Include, as a minimum, the following information:
      a. Equipment or utility services affected
      b. Reason shutdown is required
      c. Work to be accomplished during the shutdown
      d. Proposed date and time
      e. Duration of the shutdown
      f. Proposed method of providing back-up service during shut down
   3. The actual time and date of all shutdowns will be subject to approval of Owner. Shutdowns normally will be scheduled for nights, weekends, school vacations or other low intensity use periods.
   4. The duration of all shutdowns shall be held to a reasonable minimum as determined by Owner.
   5. Materials and equipment required for the Work to be accomplished during shutdown shall be complete and available on the job for review by Owner three days prior to the shutdown, if requested. If Contractor is not adequately prepared, the shutdown will be canceled and rescheduled.
   6. ONLY OWNER’S PERSONNEL WILL SHUT DOWN AND RESTART OWNER’S EQUIPMENT AND UTILITIES. Owner will inspect the installation prior to restarting and will not restart if an unsafe condition exists. In the event Contractor's Work is not completed during the time scheduled for the shutdown, Owner may elect to restart the equipment or utility service. In that event, additional shutdown requirements shall be rescheduled in accordance with the preceding requirements. Restarting shall not be construed as acceptance of the Work as complete.
   7. Include in the bid all costs associated with equipment and utility shutdowns. Owner will make no extra payment for overtime work, schedule changes or failure to complete utility connections within authorized shutdown periods.

C. For building electrical shutdowns involving de-energization of equipment on the campus high-voltage distribution system, including main breakers for a given building, the following enhancements to the requirements listed above apply. The Owner’s Representative will determine which shutdowns proposed by the Contractor require such enhancement.
   1. A minimum of 6 weeks before the proposed shutdown, the Contractor shall submit a Proposed Shutdown Plan to the Owner’s Representative. This Shutdown Plan shall include the following information:
      a. A description of Contractor tasks and safety measures (such as lock-out/tag-out), necessary to install or otherwise create the project improvements. Include specific names of devices to be switched and a complete list of equipment to be de-energized.
b. Inspections by the engineer of record, the high voltage shop, and/or the authority having jurisdiction, as applicable. Indicate what inspections are requested and where in the sequence of work they occur.

c. Proposed dates(s) and time(s) with duration(s) of the shutdown. Alternate dates may be proposed but the earliest of the proposed dates shall be no sooner than 6 weeks from the date of submittal of the Shutdown Plan.

d. A draft “UTILITY SHUTDOWN REQUEST” on the standard form in Appendix A.

2. At the Owner’s request, participate in a meeting with the Owner’s Representative and the University’s High Voltage Shop to explain and discuss the Proposed Shutdown Plan. This meeting shall occur at the time of plan submittal or within 2 business days of plan submittal. Insofar as the Shutdown Plan would necessitate tasks to be performed by the High Voltage Shop, the University’s high voltage electricians will use the information as an aid in formulating their approach to the actual switching, and in determining the level of effort and feasibility of the schedule and shutdown in general.

3. At the Owner’s request, check/verify that plans by the University’s zone electricians and others to mitigate building impacts are coordinated with, and safely support, the proposed construction activities.

4. If the Proposed Shutdown Plan is approved or approved with conditions, proceed as follows in paragraph 5. If rejected, work with the Owner’s Representative to reschedule the shutdown.

5. A minimum of 2 weeks before the proposed shutdown, review status with the Owner’s Representative and submit the final UTILITY SHUTDOWN REQUEST. If deemed necessary by the Owner’s Representative, also submit a final Shutdown Plan. These documents shall include, at a minimum, the following information:

   a. The final proposed date, time and duration of the shutdown.

   b. Responses to any conditions imposed on the shutdown by the University’s review and approval process.

   c. Any Contractor-proposed changes to the original (draft) plan.

1.6 TEMPORARY SUPPORT FACILITIES

A. Temporary support facilities include: construction power and lighting and heating and water, toilet and hand washing facilities, mobile communications, cranes and hoists, field offices, and field office communications; and similar miscellaneous facilities (i.e., storage sheds, first aid facilities, clean-up facilities, fire protection, waste disposal) as may be reasonably required for proficient performance of the Work and accommodation of personnel at the Project site, including Owner’s and A/E’s personnel. Locate temporary support facilities for convenience of users, and for minimum interference with construction activities. Placement of all temporary support facilities shall be subject to review and approval by the Owner’s Representative.

1. Do not block Owner’s access to adjoining buildings and occupied spaces through the use of temporary support facilities.

2. Keep temporary support facilities clean and neat in appearance and do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload temporary facilities or permit them to interfere with progress.

3. Erection and dismantling of cranes shall occur only on weekends, unless otherwise approved in writing by the Owner.

B. Remove all temporary support facilities including, but not limited to, power and water infrastructure, hoist foundations, and communications cabling and pathway, unless indicated otherwise in the Contract Documents. Restore the Project site to original or new conditions, patching and filling as required to match adjacent surfaces.
C. All connections to Owner utilities must be made in accordance with 1.5 of this Section, "Shutdowns of Existing Equipment and Utility Services."
   1. Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of the permanent service.

D. Electrical Power and Service: Contractor shall pay for, provide, and install all necessary Owner-approved temporary equipment required for use of the Owner’s electrical power for minor renovations and/or alterations construction work within the Project site of an Owner-occupied facility. Temporary equipment shall be installed and maintained in accordance with all applicable safety regulations and the Owner’s requirements.
   1. Electrical power for the operation of small tools and equipment required for work outside of the Project site will be provided by the Owner as reasonably available from approved existing sources.

E. Lighting: Provide and maintain LED (light-emitting diode) type construction lighting to provide adequate general illumination of the work area and trade task lighting. Shield construction lighting from adjacent residential areas.

F. Heating and Ventilation: Provide temporary heat as required to protect materials and equipment from dampness, cold, and mold growth. Method of heating is subject to approval of Owner’s Representative. Fuel fired “salamander type” heaters are not permitted, unless approved by Owner.
   1. Owner’s HVAC system shall not be utilized for construction in the UW Medical Center. Supply and return–air grills shall be completely sealed-off within the Project site.
   2. New building HVAC systems shall not be operated or used for construction until such time the Contractor has submitted the Contractor’s final punch list report, unless otherwise approved by Owner.
   3. Renovations of Owner’s facilities may utilize existing ducted ventilation supply diffusers but shall not utilize exhaust systems, including return-air grills or fans. Un-ducted plenums over a construction work area must have all ceiling tiles in place, unless otherwise indicated in the Contract Documents or approved by the Owner.
      a. If Owner’s HVAC system is utilized for construction, the Contractor shall:
         1) Protect the HVAC system from construction dust contamination and provide cleaning of the components exposed to contamination prior to Owner’s occupancy.
         2) Install filter media having a minimum efficiency reporting value of 8 (MERV 8) according to the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 52.2-1999 at each supply and return-air grill used during construction.
         3) Replace Owner’s filtration on any return air fan system with a minimum 85% filtration media (as determined by ASHRAE 52.1-1992) prior to Substantial Completion.

G. Water: Contractor shall coordinate and pay for: all temporary construction water with the local public utility; all cost of temporary piping including pressure reducing station, back flow preventer; and removal of piping and restoration as required by the public utility at the completion of the Work.
   1. Contractor shall provide drinking water from a proven safe source for all those connected with the Work.
      a. The Owner’s “potable” water drinking facilities may be used, if available and approved by Owner.

H. Toilet and Hand Washing Facilities:
1. The Owner’s toilet facilities may be used provided they remain in a clean condition, as approved by Owner.

2. Contractor shall provide alcohol hand sanitizers or hand gel dispensers for workers in medical centers, if restrooms and/or similar hand washing facilities are not available within the Project site.

I. Elevators: Use of Owner’s elevators is subject to approval of the Owner, unless indicated for construction use in the Contract Documents.

1. Use requires temporary protection and, if indicated in the Contract Documents, restricted hours of use apply.

J. Mobile Communications: The Contractor shall provide cellular phones with e-mail capability for its key on-site personnel.

K. Contractor’s Field Office: Contractor is to provide and pay all costs related to installation, removal, and site restoration of temporary office space within the Project site.

1.7 TEMPORARY ENCLOSURES AND MISCELLANEOUS CONSTRUCTION

A. Temporary enclosures include, but not by way of limitation, fire-rated barriers, dustproof enclosures, and site fences to protect the Work and to provide for public protection as required by law and ordinance.

1. Provide one-hour fire-rated barriers of gypsum sheetrock and metal studs with taped joints where shown on the Drawings or when removing and/or compromising existing fire safety partitions indicated on the Drawings, such as corridor walls and/or occupancy separations, to completely isolate the construction area from other occupied building areas. Remove and repair finishes to match existing at completion of Work.

   a. Fire Safety during construction, alteration, or demolition must be provided as indicated by the current edition of the International Fire Code with local amendments and applicable rules. Combustible materials are not permitted to be used as barriers.

   b. All existing finishes damaged by construction are to be repaired to their original condition and ceiling tiles damaged by the Contractor are to be replaced with equivalent undamaged tiles at completion of the Work.

   2. Provide dustproof enclosures within occupied buildings to enclose the entire work area and completely isolate it from surrounding areas, unless otherwise approved by Owner. At a minimum, construct dustproof enclosures on metal studs from one layer of: 5/8 inch gypsum sheetrock; 1/4 inch fire retardant low VOC (volatile organic compounds) shiny surface materials (such as melamine); 6-mil fire retardant plastic sheathing; or 4-mil fire retardant polypropylene. Tape all joints smoke tight and continuously seal all connection points to existing construction utilizing painters tape for existing surfaces to be retained, melamine tape for melamine enclosures, and duct tape for existing surfaces not to be retained. Enclosures must extend above ceilings to the structure above except when the entire work area ceiling is completely sealed from the above ceiling space, in which case, the seal may occur at the ceiling. If the Contractor employs a combination of temporary enclosures and existing construction to enclose the work area, the Contractor shall seal any penetrations found in the existing construction, including supply and exhaust HVAC duct grills that shall be blocked off and sealed shut.

      a. All existing finishes damaged by construction are to be repaired to their original condition and ceiling tiles damaged by the Contractor are to be replaced with equivalent undamaged tiles at completion of the Work.

      b. An Owner-approved portable mini-enclosure shall be utilized outside the containment area for ceiling work: that will be completed within one shift; with limited dust disturbance/creation; with little anticipated noise; and with no "hot work."

         1) Portable mini-enclosures shall be constructed of 6-mil fire-retardant plastic sheathing with zipper openings. Completely seal all joints and connection points with smooth vinyl tape. All ceiling tiles removed by Contractor must be placed back into position before the mini-enclosure is removed.
3. Fire barrier and/or dustproof enclosure doors are to be installed in rigid frames and be self-closing and fitted with a gasket or other material to restrict closing noise and inhibit airflow, except for plastic sheathing enclosures which shall have zipper wall doors for personnel access. The door and its frame shall be painted in medical centers.
   a. All interior Project site entrances and exits shall have dust containment walk-off mats (sticky mats) present at all times. Provide 24” x 36” minimum size with layers to be peeled off when fully loaded. Secure mats to floor and install snug to enclosure entrances.
      1) Mats must be clean, intact and maintained on a constant basis. Avoid locating adhesive walk-off mats in public walking areas and patient transport areas in medical centers.

4. All elevator openings within the work area of occupied buildings, except working construction elevators, shall be sealed airtight from the work area.

5. Site Fences: Provide temporary six (6) foot high chain link fence panels with top rail fastened to tubular metal posts set in heavy concrete bases to prevent ready relocation, unless otherwise indicated, to enclose exterior areas of the Project site and off-site lay-down and Contractor parking areas provided by the Owner. Panels are to be anchored together to prevent entry between panels. Provide gates or equal to facilitate access to fire hydrants, pumper connections and standpipes. No barbwire is permitted.

B. Provide miscellaneous construction to protect the Work. Furnish, install, and maintain for the duration of construction all required tarpaulins, barricades, security barriers, canopies, warning signs, steps, bridges, platforms and other temporary construction necessary for the safe and proper completion of the Work. Maintain the temporary construction in compliance with all pertinent safety and other regulations. Temporary barricades that obstruct exit paths from occupied areas shall not be installed unless approved by Owner.
   1. Egress Signage: Provide and install temporary exit signs, as needed, to insure a clear direction or emergency exit travel in occupied areas adjacent to the construction project. Review the temporary exiting routes and signage design and location with Owner’s Representative.
   2. Other Signage: Provide informational signs, warning signs, and any other sign required by AHJ for the Project.

1.8 NOISE AND VIBRATION CONTROL

A. Construction shall not exceed the maximum permissible sound levels defined by the local AHJ and shall meet the special conditions of the Project.

B. Exterior Construction Noise: Maintain the sound pressure level of exterior construction noise from exceeding decibels with a frequency rating function A (60 dBA) inside adjacent facilities with windows closed between the hours of 8:00 a.m. and 5:00 p.m. weekdays.
   1. If required, the Contractor shall meet this criterion by erecting barriers between work equipment and adjacent facilities.

C. Limited Hours of Use With-in Buildings: Noise-producing equipment exceeding 60 DB(A) and/or vibration-producing equipment is subject to approval of Owner and in general will be allowed only before 7 a.m. and after 6 p.m. except within medical centers where use will be allowed from 8 a.m. - 7 p.m., unless otherwise approved by the Owner.
   1. When possible, combine noisy and vibration-producing operations into one time period.
   2. Specific scheduling is required for Work within the UWMC, HMC and the UW Health Sciences Center. Contractor shall provide its work schedule to Owner for approval no later than three (3) weeks prior to commencing any noisy and/or vibration-producing work.
D. Noise and Vibration Control Plan: Contractor shall submit a written procedure to minimize construction vibration and noise prior to performing physical impacts to, or demolitions of, existing structural components.

E. Machinery & Equipment: Equipment shall be as quiet as feasible for the work being performed. Electric-driven or hydraulically drawn is preferred to gas, diesel, or pneumatic powered machinery. If noise levels on any gear cannot meet the criteria of this Section, either that gear will not be allowed on the job or use times will have to be scheduled subject to approval of the Owner. Conformance to this requirement shall be included in the Contract price and no compensation will be allowed for special equipment or overtime that may be required.
   1. Construction personnel shall limit the extent of unnecessary equipment idling.

F. Outdoor Vehicle and Internal Combustion Engine Noise: In addition to the requirements applicable to exterior construction noise in this Section, the sound pressure level of each piece of equipment shall not be greater than 85 dBA when measured at the property line of adjacent real property of another person, and when measured at a distance of 50 feet from the emission source under noisiest operating conditions.
   1. Rubber-tired equipment shall be used whenever possible instead of equipment with metal tracks.
   2. When required, mufflers for stationary engines shall be “hospital-area” quality of silencing.
      a. Contractor is to routinely verify equipment mufflers and/or noise barriers are intact and operational.

G. Air Compressors: Equip air compressors with silencing packages--electric-driven preferred.

H. Arc Welders: No arc welders are to be connected to Owner’s utilities, unless approved by the Owner. Provide separate gas generators for arc welders.

I. Jack Hammers and Rotary Hammer Drills: May be used where no other alternative is available, if permitted by the Owner. The use of core-drilling and saw cutting equipment, or electric driven drills is preferred. Time of use is subject to approval by Owner.

1.9 CONSTRUCTION PARKING AND STAGING:

A. Parking permits are required for all vehicles parking on campus. Parking without a valid parking permit will result in citation and possible impound of vehicle.
   1. Parking on or near University of Washington and Harborview Medical Center campuses is congested. To minimize disruptions to campus operations and the impact on the adjacent neighborhoods, Contractor shall limit the number of vehicle trips to the Project site and encourage carpooling. In addition, the Contractor shall advise construction workers not to park on city streets and in neighboring residential areas.
      a. Parking on the University of Washington campus, outside a fenced Project site, is not available or permitted for Contractor and Subcontractor vehicles on the dates of graduation, convocation, and on Husky football game days.
      b. This information shall be posted at the Project site along with bus pass/ticket information.
   2. The Contractor is responsible for advising all parties on the Project of their designated parking area and ensuring that all workers park there. If parking needs change for any reason, Contractor shall advise the Owner’s Representative so, to the extent possible, necessary accommodations can be made.
1.10 CONSTRUCTION TRAFFIC

A. The Contractor and the Contractor’s Subcontractors and suppliers shall minimize negative traffic impacts on city streets for construction. Scheduled truck traffic shall avoid the peak hours of 7:00 – 9:00 AM and 3:00 – 6:00 PM, Monday through Friday.

B. Deliveries on the Seattle campus: If a Contractor, Subcontractor, or supplier needs to make a delivery, the driver must stop at a Campus gatehouse upon entry during the posted hours of operation for UW Parking Services and obtain a commercial delivery permit.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies minimum requirements for protection from damage as a result of the Contractor’s operations and for maintenance of existing trees, shrubs, and other plant materials including lawn surfaces indicated to remain on the Project site.

B. The Contractor shall ensure all labor, equipment, and materials are provided for temporary tree, plant, and lawn protection during the work including, but not limited to:
   1. Marking of clearing limits;
   2. Protection signage and fencing;
   3. Tree trunk boxing;
   4. Tree and root pruning; and
   5. Maintenance of trees and landscaping.

C. Definitions:
   1. Landscape Requiring Protection and Maintenance: All existing on-site trees, plants, and lawn areas which are not identified for Contractor’s lay down or parking use, including tree canopies and root zones extending within the Project site.
   2. Critical Root Zone (CRZ): The area around a tree equal to one (1) foot radius for every inch of tree diameter measured at four (4) feet above grade.
   4. Dripline: The dripline of a tree is the imaginary line on the ground beneath the tree’s canopy.

1.2 SUBMITTALS

A. Tree and Landscape Protection Plan: Prior to any site disturbance, the Contractor shall submit for Owner’s approval a “Tree and Landscape Protection Plan” developed in consultation with a certified arborist for all trees, plants, and lawn indicated to remain. The Contractor shall submit the name and credentials of the certified arborist with the plan.

   1. The Tree and Landscape Protection Plan shall include:
      a. Proposed protection fence locations;
      b. The location of all on-site trees requiring protection (For the Seattle campus, identify by UW tree inventory tag-number);
      c. Identification of the CRZ for each tree requiring protection; and
      d. Temporary irrigation and fertilization schedule.

1.3 CONTRACTOR RESPONSIBILITY

A. The Contractor shall assume all landscape shall be protected, unless indicated to be removed in the Contract Documents, and shall be responsible for all damage and/or disturbance within the CRZ of trees indicated to remain such as, cutting or skinning of roots, skinning or bruising of bark, compaction of root zones, and breaking of branches.

   1. Damage and/or disturbance which, at the Owner’s sole discretion, can be remedied by corrective maintenance shall be immediately repaired by the Contractor upon written notice by Owner.
      a. The Contractor shall employ a certified arborist to repair damage to trees.
   2. Trees or shrubs which are injured or irreparably damaged shall, at the Owner’s sole discretion, be replaced by the Contractor with new trees or shrubs of the same size and type. However, the Owner is not bound to have the trees or shrubs replaced in the same
location and may request the Contractor provide the tree or shrub for installation by Owner.

   a. Trees which fail to fully foliate in the spring following Substantial Completion shall be presumed to have been injured or irreparably damaged due to construction.

3. If, in the Owner’s sole opinion, replacement of damaged trees is determined impracticable, the full replacement cost shall be borne by the Contractor at values based upon the square inches of cross sectional area of trunk measured at four (4) ft. above grade, in accordance with the following criteria:
   a. $75.00/square inch for trees less than or equal to six (6) inch diameter
   b. $50.00/square inch for trees greater than six (6) inch and less than eighteen (18) inch diameter
   c. $40.00/square inch for trees greater than or equal to eighteen (18) inch diameter

B. Trees or shrubs which require removal and/or replacement due to damage by construction shall be removed to a depth of two (2) feet below grade and include the refilling and repair of the ground surface, with such costs to be borne by the Contractor.

C. Protection and maintenance shall include, but not be limited to, replacement of damaged protection fencing; aeration of compacted soils; control of temporary irrigation water runoff; pruning and treatment of damaged roots, limbs, and branches; and replacement of wood chips within tree protection areas.

D. Site damage and/or disturbance caused by the Contractor outside the Project site shall be repaired or replaced, and all costs shall be borne by the Contractor.
   1. Repairs shall include, but are not limited to, pruning or removing damaged vegetation, replacement of damaged vegetation and/or lawn restoration, soil remediation to alleviate over-compaction, and temporary irrigation to establish new plantings.

PART 2 - PRODUCTS

2.1 PROTECTION FENCING

   A. Protection fencing shall be six (6) feet high, 11 gauge-galvanized, 2-inch mesh chain link fencing with nominal 2 1/2 inch diameter galvanized steel posts, or approved equal.
      1. The Contractor shall post weather-resistant 8 1/2” x 11” fluorescent green or yellow signage on protection fencing at twenty (20) foot intervals warning construction personnel to keep out of protective zones.

2.2 TREE TRUNK BOXING

   A. Existing trees that are not protected with fencing and are to remain shall be protected by boxing constructed with 4 x 4 inch posts at corners with 2 x 4 inch horizontal top, middle, and bottom rails on each side. Box shall be approximately 8 x 8 feet in size centered on the tree trunk to a height of approximately six (6) feet.

2.3 WOOD CHIPS

   A. Wood chips shall be composted for a minimum of one (1) year prior to use.

2.4 FERTILIZER

   A. Fertilizer shall be Osmocote Plus 15-9-12, or approved equal.
PART 3 - EXECUTION

3.1 ON-SITE PRE-INSTALLATION MEETING

A. Prior to on-site mobilization, the Contractor shall arrange a pre-installation meeting with the Owner’s Representative to identify and stake out all areas of trees, plants, and lawn that are to be protected or removed. The Contractor shall be responsible for all damage to landscape features that results from the failure to schedule and attend the pre-installation meeting.

3.2 PROTECTION OF EXISTING TREES AND SHRUBS

A. Trees indicated to remain within the Project site shall have protection fencing located at the CRZ drip line that shall be maintained by the Contractor in good condition until Substantial Completion. Tree trunk boxing may be permitted by approval of owner.

B. When no ground cover, lawn or shrubs exist within the CRZ of a tree indicated for protection, the ground shall be protected with a minimum of twelve (12) inches of wood chips extending from a three (3) foot radius clear zone around each truck to the protection fencing.

C. All site work within the CRZ shall be performed by hand. However, the use of heavy equipment to perform work within the CRZ may be requested by the Contractor for approval by the Owner. The Contractor shall perform approved heavy equipment work from angles and directions that minimize compaction to tree roots in the protection area.

D. The Contractor shall utilize a certified arborist to tie back all flexible limbs and overhead branches which may be damaged by the passage or activity of construction equipment.

E. Materials shall not be stored and equipment shall not be operated under the branches of existing trees which are to remain, except as approved by the Owner.

3.3 INSTALLATION OF TREE PROTECTION FENCING

A. Install posts a minimum of two (2) feet below grade and spaced ten (10) feet on center maximum. Provide diagonal bracing to posts at corners of enclosures and whenever needed to ensure rigidity of the fencing.

B. Install fencing tight to grade at the bottom edge and stretched uniformly between posts.

C. Provide one gate into each fenced area.

D. Take care not to damage roots or to compact soil inside the fence line during placement of posts. Do not use heavy equipment within the protection area for this operation.

3.4 USE OF AREA ADJACENT TO PROTECTION FENCING

A. Do not store materials potentially harmful to tree roots within twenty (20) feet of protection fencing. Potentially harmful materials include, but are not limited to, petroleum products, cement and concrete materials, cement additives, lime, paints and coatings, waterproofing products, concrete forms coatings, detergents, acids, and cleaning agents.
3.5 FERTILIZING AND IRRIGATING DURING CONSTRUCTION

A. All trees and landscape requiring protection shall be fertilized and watered by the Contractor until Substantial Completion, per the approved Tree and Landscape Protection Plan.
   1. Water used for irrigation shall be potable water.

3.6 ROOT PRUNING

A. Root pruning is the intentional cutting of tree roots to minimize root damage and promote healing. (Any construction operation which pulls and/or tears roots is unacceptable.)
   1. All root pruning shall be performed by a certified arborist.
   2. For all roots smaller than one (1) inch diameter, use a sharpened spade.
   3. For all roots greater than one inch (1) diameter, use an ax or chainsaw.
   4. A backhoe bucket, or any other excavating machine, should not be used to root prune.

B. When construction is in close proximity to existing trees to remain, and roots are encountered, the roots shall be pruned.
   1. Root pruning shall be performed as early as possible before trenching or tunneling operations.
      a. Hand-dig trenches in areas with extensive roots.
   2. Leave roots larger than two (2) inches in diameter intact and undamaged.
      a. Keep roots moist with wet mulch and burlap or equivalent during exposure.

C. Backfill trenches that require root pruning with existing soil mixed with peat moss to a mixture of approximately 75% loam and 25% humus by volume. Tamp soil in six-inch lifts. Each lift shall be compacted to a point at which a foot print makes only a 1/16 inch impression.

D. Apply mulch to a depth of four (4) inches at a minimum ten (10) to fifteen (15) foot radius around tree to reduce compaction and increase moisture retention.

3.7 PRUNING OF EXISTING TREES

A. Limbs and branches broken by construction shall be cut off cleanly above the nearest crotch in accordance with good horticultural practice.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the administrative and procedural requirements for field engineering, in addition to requirements specified elsewhere in the Contract Documents, requiring the Contractor to employ a registered “Structural Engineer” and/or “Land Surveyor.”

B. Related Sections:
   1. Section 01 73 29 “Cutting and Patching”

1.2 QUALITY ASSURANCE

A. Contractor shall employ a registered Structural Engineer (Contractor’s Structural Engineer) experienced in construction techniques and sequences, and temporary structural support systems, who is licensed in the State of Washington.

B. The Contractor shall employ a registered Land Surveyor (Contractor’s Surveyor) who is registered in the State of Washington, and acceptable to Owner, to perform survey work of this Section.

C. Submit the name, address, and telephone numbers of the Contractor’s Structural Engineer and Land Surveyor for Owner’s records, prior to their performance of Work.

1.3 CONTRACTOR’S STRUCTURAL ENGINEER

A. The Contractor’s Structural Engineer shall advise the Contractor as to the safety and adequacy of all temporary structural provisions necessary for cranes and hoisting, erection and/or alteration of the building structure and shall assume the responsibilities and duties as it relates to means and methods for these items (e.g., erection sequence, temporary bracing, cutting).
   1. Temporary bracing shall be coordinated with other trades to permit continuous operation of construction.
   2. Should it be necessary to modify the structural design to accommodate construction means and methods, the Structural Engineer shall advise the Contractor who shall immediately notify the A/E and await his/her direction.
   3. Proposed changes or modifications to the structural design shall be submitted to the A/E for approval prior to the Contractor incorporating changes or modifications into the Work.

1.4 OWNER’S PROPERTY SURVEY

A. Owner’s property survey for the Project is included in the Contract Documents.

B. The Owner will provide the services of a public land surveyor to locate the property corners noted on the Contract Documents and establish benchmarks for use by the Contractor.

1.5 PROJECT SURVEY REQUIREMENTS

A. Before proceeding with layout of actual work, the Contractor, working through the Contractor’s Surveyor, shall verify the layout information shown on Contract Documents and the Owner’s property survey.
B. As work proceeds, the Contractor shall check every major element for line, level and plumb, and shall require the Contractor's Surveyor to maintain a complete and accurate record book log of control of such checks and upon request shall make this log of control available for the Owner's and A/E's reference.

1. Record deviations from required lines and levels and promptly advise the Owner's Representative upon detection of any discrepancies including, but not limited to, conflicts, errors, inconsistencies, or deviations that exceed the Contract specified or indicated or industry recognized tolerances.

2. If discrepancies are found, no work shall be done until the Owner's Representative has been so notified and has provided the Contractor with written direction and/or drawings which correct and clarify the discrepancy.

3. All work which is determined to be incorrectly located will be rejected by the Owner. Any additional corrective work caused by discrepancies that should reasonably have been known to the Contractor and were not called to the attention of the Owner’s Representative, shall be borne at the Contractor's expense.

C. Protect Owner’s benchmarks and survey control points prior to starting site work and preserve during construction. Do not change or relocate benchmarks or control points without Owner’s written approval. Promptly report lost or destroyed benchmarks or control points.

1.6 PROJECT RECORD SURVEY

A. Contractor working through the Contractor's Surveyor shall perform the following:

1. Upon completion of new foundation walls, prepare and submit a certified survey showing that dimensions, elevations, angles, and location of the building are in accordance with the Contract Documents.

2. Upon completion of the below grade site work, certify that the Project Record site survey represents the actual dimensions, elevations, lines, grades, and levels, including invert elevations, constructed in the field for all below grade installations and existing services located during the Work referenced to Owner's benchmarks. This shall include the locations of all below grade site improvements including, but not be limited to, civil, electrical and mechanical services, utility tunnels, duct banks and vaults, and irrigation system.

3. The above documentation shall be submitted to the Owner under provisions of Section 01 77 00 for CAD As-built Shop Drawings.

1.7 PROJECT LAYOUT REQUIREMENTS

A. The Contractor shall be responsible for laying out the Work utilizing recognized engineering survey practices. Establish elevations, grades, lines and levels for:

1. Site improvements, including pavements, walks and retaining walls, stakes for grading, fill and topsoil placement, utility locations including slopes and invert elevations, and irrigation system.

2. Grid and axis of building structures.

3. Building foundations, column locations, ground floor elevations, elevations and levelness for floors and roofs.

4. Other elevations, grades, lines and levels, as needed to properly locate each element of the Project.

B. Calculate and measure required dimensions as shown within recognized tolerances. Do not scale drawings to determine dimensions.

C. Advise entities performing work of marked elevations, grades, lines and levels, provided for their use.
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the administrative and procedural requirements for cutting and patching and general alterations of the Project including, but not limited to, preparations, products, transitions and adjustments, and repairs and disposal.

B. Related Sections:
   1. 01 11 01 “Summary of Work – Regulated Materials”
   2. 01 35 23 “Owner’s Safety Requirements”
   3. 01 71 23 “Field Engineering”

1.2 CONTRACTOR RESPONSIBILITY

A. The Contractor shall bear all cost of correcting damaged or destroyed work, indicated to remain on the Contract Documents, which is caused from failure to comply with the requirements of the Contract Documents or failure to exercise reasonable care by the Contractor and/or the Subcontractors’ work.

1.3 SUBMITTALS

A. Notice:
   1. Submit written request two (2) weeks in advance of cutting or alteration which affects:
      a. Structural integrity of any element of the Project;
      b. Integrity of weather-exposed or moisture-resistant elements;
      c. Efficiency, maintenance, or safety of any operational element;
      d. Visual qualities of sight exposed elements; and
      e. Work of Owner or separate contractor.
   2. Include in request:
      a. Project name
      b. Location and description of affected work
      c. Description of proposed work
      d. Reason for cutting or alteration
      e. Alternatives to cutting and patching
      f. Effect on work of Owner or separate contractor
      g. Written permission to affect separate contractor
      h. Date and time work will be executed, including duration of work
      i. Utility Shutdown Request form, as appropriate
   3. Owner will respond in writing to the submitted request.

B. Visual Matching: When indicated to “match existing,” submit products and/or finishes to match existing adjacent finishes for Owner’s review and approval or, for patching new work, use the specified materials and finishes in the Contract Documents.

PART 2 - PRODUCTS

2.1 PATCHING AND EXTENDING WORK

A. The Contractor shall provide products specified in the Contract Documents and/or match existing products with an alternate product of the most suitable grade for the intended purpose.
B. The Contractor shall determine the type and quality of existing products and finishes by inspection and/or testing, where necessary.
   1. Remove samples of existing installed work for testing only when approved by Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to commencing work:
   1. The Contractor shall inspect existing conditions to ascertain elements subject to damage or movement and to determine the need for temporary bracing during cutting and patching work; and
   2. Verify that materials to be worked-on or removed have been evaluated in the Owner’s Regulated Materials “Good Faith” Survey report.

B. Beginning of cutting or patching means acceptance of existing conditions.

C. After cutting and/or removing existing work:
   1. The Contractor shall inspect conditions affecting performance of new work and notify Owner of any unforeseen physical conditions; and
   2. Verify that demolition is complete and areas are ready for installation of new work.

3.2 PREPARATION

A. Move, or remove, items as necessary for access to cutting and patching work.

B. For Owner occupied facilities, prepare a noise and vibration control plan in accordance with Section 01 50 00 “Temporary Facilities and Controls.”

C. Schedule shut-downs and obtain permits required for performance of the Work.

D. Provide temporary supports to ensure structural integrity of the Work.

E. Provide temporary enclosures, shielding devices and/or other methods to protect the following from damage:
   1. Existing conditions that are to remain
   2. Owner occupied areas
   3. Owner’s building systems, including HVAC systems

F. Establish “hot-works” fire safety precautions required for performance of the Work.

3.3 PERFORMANCE

A. Execute cutting and patching work in a manner to:
   1. Avoid damage to other work;
   2. Provide proper surfaces for installation of new work; and
   3. Provide a neat transition from existing finishes to new work.
      a. Fit new work to existing pipes, sleeves, ducts, conduit and other penetrations through surface

B. For all new work made to existing work under warranty, employ original installer or fabricator to perform cutting and patching unless otherwise approved by the Owner.
C. For additional cutting and patching requirements in medical centers, see Section 01 35 33 “Infection Control.”

D. Prepare surfaces to provide for the specified installation of new work and finishes.
   1. Remove and replace or repair unsuitable substrate materials (e.g., rotted wood, water damaged materials, corroded metals and deteriorated concrete) for new applications.

E. Restore existing building systems that are impacted by cutting and patching work to original operating conditions.

F. For penetrations cut in existing fire-rated separations, completely seal new work with fire-stopping materials to full thickness of the penetrated element.
   1. Replace existing fire-stopping materials when disturbed by new work.

G. Unless otherwise indicated in the Contract Documents, cut concrete and masonry materials using a diamond saw in accurately located straight lines. Pneumatic tools are not allowed without Owner’s prior approval.
   1. Concrete walls: Core drill pipe penetrations. Saw both sides of wall and break out remainder. Minimize overcuts.
   2. Concrete floors: Provide temporary support of elevated floor areas requiring removal and saw-cut. Core-drill pipe penetrations.
   3. Masonry walls: Saw-cut along mortar joints. Remove all mortar adhering to edges. Overcuts are not allowed.
   4. Wood and/or metal frames walls: Cut wall finish materials in straight uniform lines and remove wall framing as required.

H. Remove debris and abandoned items from the work area, including from concealed spaces.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This section includes administrative and procedural requirements for construction waste management activities.

B. Related Sections:
   1. 01 50 00 “Temporary Facilities and Controls”

1.2 GOALS AND PROCEDURES

A. The Owner has established waste management goals for this Project with the minimum requirement of diverting 50% of non-hazardous and non-regulated construction and demolition waste, including recycled or donated materials, by weight in tons, from landfill disposal and/or incinerator.
   1. For materials which contain lead or have lead-containing coatings, see Section 01 11 01 “Summary of Work – Regulated Materials.”

B. Waste classified as hazardous materials or dangerous waste will be disposed of by the Owner (see Section 01 11 01 “Summary of Work – Regulated Materials,” if applicable).
   1. If the Contractor suspects that an unidentified hazardous or dangerous material may exist in the Project area, the Contractor shall inform the Owner of this possibility. Owner will investigate and test the material to determine the extent and nature of the material and to decide on appropriate procedures.

1.3 CONTRACTOR RESPONSIBILITY

A. To the maximum extent possible, the Contractor shall separate recyclable materials from construction, demolition, and land clearing waste to be disposed of as garbage.

B. The Contractor shall designate an on-site construction “waste management coordinator” responsible for instructing the Contractor’s workers and Subcontractors in the requirements of the construction waste management plan and for overseeing and documenting results.
   1. When on-site dumpsters and recycling bins are required by the Contract Documents, the waste management coordinator shall conduct regular visual inspections of dumpsters and recycling bins to ensure materials are being separated properly and to remove contaminants.

1.4 DEFINITIONS

A. Construction, Demolition, and Land Clearing (CDL) Waste: Includes all non-hazardous solid wastes including material that is recycled, reused, salvaged, and/or disposed of as garbage.

B. Salvage: Recovery of materials for reuse.

C. Reuse: Making use of a material without altering its form for reuse on-site or reuse on other projects off-site (e.g., grinding of concrete for use as sub-base material and chipping of land clearing debris for use as mulch).

D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for use in the manufacture of a new product.
E. Source-Separated CDL Recycling: The process of providing on-site separation of recyclable materials into separate containers as they are generated. The separated materials are hauled directly to a recycling facility or a transfer station.

F. Co-mingled CDL Recycling: The collection of mixed recyclable materials in one on-site container. The container is taken to a material recovery facility where materials are separated for recycling.

G. Material Recovery Facility (MRF): A facility used to sort and recover CDL waste materials for recycling.

H. Transfer Station: A facility where waste is moved from collection vehicles to larger trucks for longer distance transport to a landfill, source-separated recycling facilities, or MRF.

I. Approved Recycling Facility: A facility that can legally accept CDL waste materials for the purpose of recycling into a new product where the method of recording and calculating the recycling rate is regulated by local or state government.

1.5 PERFORMANCE REQUIREMENTS

A. General: Divert CDL waste from landfills by one, or by a combination, of the following activities:
   1. Salvage
   2. Reuse
   3. Source-separated CDL recycling
   4. Co-mingled CDL recycling

B. CDL waste materials to be salvaged, reused, or recycled include, but are not limited to, the following:
   1. Acoustical ceiling tiles
   2. Asphalt
   3. Asphalt shingles
   4. Brick
   5. Cardboard
   6. Carpet and pad
   7. Concrete
   8. Drywall
   9. Insulation
   10. Metals
   11. Paint
   12. Porcelain
   13. Wood
   14. Plastic film such as sheeting, shrink wrap, and packaging
   15. Window glass
   16. Field office waste such as paper, aluminum cans, glass, plastic, and office cardboard

1.6 CONSTRUCTION WASTE MANAGEMENT (CWM) PLAN

A. Prior to performing any on-site work, the Contractor shall develop and submit a CWM plan for Owner's review and comment. The CWM plan shall include a reuse and salvage plan, identification of waste types by quantity and weight in tons, methods of disposal, and handling and transportation procedures. Include separate sections in plan for construction demolition, land clearing debris and construction waste.
B. The reuse and salvage plan shall include:
1. A list of items being reused in place or elsewhere on the Project;
2. A list of items for reuse off-site through salvage, resale or donation; and
3. A plan for protecting, dismantling, handling, storing and transporting the reused items.

C. The Contractor shall organize the CWM plan to include the following information:
1. Types and estimated quantities, by weight in tons, of CDL waste expected to be generated during demolition and construction.
2. Proposed methods for CDL waste salvage or reuse during demolition including, but not limited to, one or more of the following:
   a. Contracting with a deconstruction specialist to salvage materials
   b. Selective salvage as part of the demolition Subcontractor’s work
   c. Reuse of materials on-site, or sale or donation to a third party for reuse
3. For this Project, there is no on-site space available for source-separated CDL recycling and waste collection. The Contractor shall contract with a recycling hauler, who accepts commingled construction and demolition debris, for hauling to an approved MRF.
4. Name of recycling facility or MRF receiving the CDL wastes.
5. On-site Handling Plan: Proposed locations for collecting CDL waste and/or separating recyclable waste into containers including, but not limited to, types and sizes of containers, and frequency of removal.
6. CWM Communication Procedures: Describe how the CWM plan will be communicated to the Contractor’s workers and the Contractor’s Subcontractor’s workers (of any tier).

1.7 CONSTRUCTION WASTE MANAGEMENT (CWM) REPORT

A. CWM Report: The Contractor shall submit a cumulative CWM report on an Owner-approved form as a requirement of Final Completion with the following attachments:
1. A record of the type and quantity, by weight in tons, of each material salvaged, reused, recycled or disposed of
   a. Dirt and land debris must be documented separately
2. Total quantity of waste recycled as a percentage of total waste
3. Disposal Receipts: Copy of receipts issued by a disposal facility for CDL waste that is disposed in a landfill
4. Recycling Receipts: Copy of receipts issued by an approved recycling facility
   a. For co-mingled materials, include weight tickets from the recycling hauler or MRF and verification of the recycling rate for co-mingled loads at the facility.
5. Salvaged Materials Documentation: Types and quantities, by weight, for materials salvaged for reuse on-site, or sold or donated to a third party

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT MEETING

A. The Contractor shall schedule and administer a construction waste management meeting prior to construction activities and shall record and distribute copies of meeting minutes to all attendees (The Contractor may conduct this meeting as part of the first pre-installation meeting).
1. Attendees:
   a. Owner’s Representative
   b. A/E
   c. Contractor’s superintendent and waste management coordinator
   d. Major Subcontractors
e. Business and Industry Resource Venture representation, as appropriate

2. Agenda Items: Review methods and procedures related to waste management including, but not limited to the following:
   a. Review and discuss CWM plan, including identification of and responsibilities of the Contractor’s waste management coordinator
   b. Review requirements for documenting quantities of each type of waste and its disposition.
   c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays
   d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   e. Review waste management requirements for each trade.

3.2 SOURCE-SEPARATED CDL RECYCLING

   A. Provide containers for separating CDL waste that is to be recycled, clearly labeled with a list of acceptable and unacceptable materials.

   B. For managing on-site stockpiled recyclable materials until removed, stockpile without intermixing with other materials, place and shape to drain surface water, and cover to prevent windblown dust.
      1. Stockpile materials away from demolition areas. Do not store within drip line of existing trees.

3.3 CO-MINGLED CDL RECYCLING

   A. Do not put CDL waste that will be disposed of in a landfill into a co-mingled CDL waste recycling container.

3.4 LANDFILL AND/OR INCINERATOR WASTE

   A. Provide containers for CDL waste that is to be disposed of in a landfill or by incineration, clearly labeled as such.

3.5 REMOVAL OF CONSTRUCTION WASTE MATERIALS

   A. Transport CDL waste materials off Owner's property and legally dispose of them.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies minimum administrative and procedural requirements for mechanical and electrical systems functional performance testing required by the Contract Documents.

B. Related Sections:
   1. 01 91 00 “General Commissioning Requirements”

1.2 SERVICES

A. Test Engineer - provided by Contractor.

B. Commissioning Authority - provided by Owner.

C. Electrical Testing Contractor (ETC) - provided by Electrical Subcontractor (working through the Contractor’s Test Engineer).

D. Testing, Adjusting and Balancing (TAB) - provided by Contractor: Use Neudofer

1.3 REQUIREMENTS FOR TEST ENGINEER

A. The Contractor shall provide the services of a “Test Engineer” experienced in commissioning including the troubleshooting of equipment and systems. The Test Engineer shall be qualified to develop and write, coordinate and schedule, and manage and document mechanical systems functional performance tests (FPT). The Test Engineer shall also coordinate the work of the ETC and assemble the required electrical commissioning documentation.

   1. Qualified personnel experienced in the technical aspects of each system to be commissioned shall be provided, if necessary, to augment the expertise of the Test Engineer.

1.4 TEST ENGINEER DUTIES

A. The Test Engineer shall prepare and submit all FPT and commissioning documentation required by the Contract Documents for the actual equipment and systems installed, including but not limited to, start-up plans, installation verification audit reports, start-up and FPT deficiency report forms, test equipment identification lists, FPT procedures, FPT data forms, and one-line system and riser diagrams.

   1. Maintain separate mechanical and electrical (M&E) systems “Commissioning Binders,” indexed and tabbed according to the equipment or systems requiring commissioning, to compile the start-up and FPT documentation. Blank start-up forms, approved by the Commissioning Authority, shall populate the initial binders and be replaced with completed forms that shall be submitted in final M&E systems Commissioning Binders, as a requirement of Final Completion. The binders shall be on-site during the work (see Section 01 91 00 for the Commissioning Binders documentation requirements).

   2. Prior to testing, the Test Engineer shall have applicable Subcontractor’s and manufacturer’s representatives review the test and commissioning documentation to identify personnel safety issues, equipment protection issues, and to validate relevance to the actual equipment provided.
B. Prepare and submit a “Commissioning Plan” for Owner’s review and comment before developing the FPT procedures and prior to any equipment or systems testing and/or start-up required by the Contract Documents.

C. Develop a commissioning schedule for all FPT and commissioning activities required by the Contract Documents and integrate into the construction Progress Schedule. Identify:
   1. Commissioning Plan preparation, submittal, and review;
   2. Each required functional performance test;
   3. Sequence of testing, including commissioning activity start-up prerequisites, point-to-point testing, and balancing activities; and
   4. Submission and approval of test results.

D. Develop and write FPT procedures for all equipment tests, and systems and cross-systems tests required by the Contract Documents. Test procedures shall be in accordance with equipment manufacturer's recommendations, where applicable. Test procedures shall fully describe the equipment or system configuration and steps required for each test. The procedures shall be appropriately documented so that another party can repeat the identical test.
   1. Maintain a set of drawings for recording the sign-off of each component of the plumbing and piping system pressure testing, heating, ventilation, and air conditioning (HVAC) system duct work pressure testing, and the completed flushing/cleaning and treatment activities.

E. Coordinate the participation of each Subcontractor, including the ETC, specific to their start-up and testing responsibilities. Inform each Subcontractor as to what their test and expected results will be prior to commissioning.

F. Observe the progress of the work to assure that all installations requiring commissioning are being made in accordance with the Contract Documents. Prepare and submit installation verification audit reports prior to the start-up of equipment or systems for which a formal start-up is specified in the Contract Documents.

G. Coordinate all cross-systems testing such as HVAC, environmental controls, fire alarm, emergency power, life safety, elevators, and chiller controls.

H. Manage and observe the start-up testing and all final tests of equipment and systems required by the commissioning plan and document test results.

I. Report any deficiency in equipment or systems and either enforce compliance with the Contract Documents or provide Owner with technical expertise to recommend modifications to the equipment or systems to correct the deficiency. Oversee and direct the correction of deficiencies found during commissioning.

J. Coordinate the required Commissioning Authority, A/E or other Owner-witness participant for all test/approval procedures, after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.
   1. Notify the Owner’s Representative in writing of the date, time, location, and anticipated duration of start-up and test activities, with a minimum of five (5) working days advance notice.
   2. Obtain the signature of the designated witness on all data forms. If the witness is unavailable at the scheduled time and location of the activity, so note, and proceed per schedule without the witness.
K. Compare operation and maintenance information provided by the various Subcontractors and vendors with the Project Record documents and report any discrepancies to the Owner’s Representative.

L. Oversee and provide Owner with operating instruction and training for the mechanical and electrical equipment and systems specified in the Contract Documents, with coordination by the M&E Subcontractors.

M. Provide as-built information to update the commissioning basis-of-design criteria.

1.5 TEST FAILURES

A. In the event that a functional test fails, the Contractor shall determine the cause of failure, rectify the failure as soon as possible, and then retest. If more than two (2) functional tests of the same system are required, all costs for additional testing shall be borne by the Contractor, at the Owner’s sole discretion.

1.6 CANCELLATIONS

A. The Test Engineer shall give at least 48 hours advance notice to the Owner’s Representative of cancellation of any scheduled test.

1. Any costs incurred by Owner due to insufficient advance notice of cancellations shall be borne by the Contractor, at the Owner’s sole discretion.

1.7 WARRANTY TESTS

A. In the event a product fails during the warranty period, the Contractor shall determine the cause of failure, rectify the failure as soon as possible, and then retest. All warranty testing shall be borne by the Contractor.

1.8 TEST ENGINEER QUALIFICATIONS

A. The Contractor shall propose a Test Engineer, who is competent in the Project’s M&E systems design and intent, for the Owner to evaluate and approve or reject in writing, based upon the following criteria which shall be documented in the Test Engineer resume.

1. The Test Engineer shall have extensive experience in start-up and troubleshooting of HVAC, hot water heating, chilled water, steam, plumbing, electrical, emergency power, fire alarm, lighting controls, life safety systems and other systems of similar complexity to those contained in the Contract Documents that are required to be commissioned.

2. The Test Engineer shall:
   a. Be familiar with the Project’s control operating system(s);
   b. Be capable of troubleshooting control code and recommending necessary modifications;
   c. Be knowledgeable in testing and balancing of both air and hydronic systems;
   d. Have an excellent working knowledge of complex fire alarm, environmental and electric power control systems;
   e. Have excellent communication and writing skills, be highly organized, and be able to work well with the Project’s Subcontractors; and
   f. Have a Bachelor’s degree in mechanical engineering, PE certifications, and related field experience.

1) However, in lieu of a Bachelor’s degree and PE certifications, other technical training with extensive practical field experience may be considered.
B. Test Engineer Resume - The Contractor shall submit the Test Engineer’s resume, including the following documentation:
   1. Present or most recent employment:
      a. Company name and address
      b. Present title and job description
      c. Dates of employment
   2. Other relevant work experience:
      a. Company name and address
      b. Job title and description
      c. Dates of employment
   3. For a minimum of three (3) similar projects, description of commissioning experience and roles performed in commissioning activities that demonstrate working knowledge of complex systems.
   4. Samples of a commissioning plan, a start-up plan, and a FPT with data forms written by the Test Engineer.
   5. References from a minimum of three (3) project owners and/or commissioning authorities.
   6. Description of education, certifications, and other technical training or field experience.

1.9 COMMISSIONING AUTHORITY

A. The Owner will provide a “Commissioning Authority,” or appoint an Owner-designated witness, to act as the commissioning authority.
   1. The Commissioning Authority will provide no labor or equipment in the commissioning process.

B. The duties of the Commissioning Authority are to:
   1. Provide commissioning basis-of-design criteria, for Contractor’s information;
   2. Ascertaining that the Project commissioning processes and information provided is in accordance with the requirements of the Contract Documents;
   3. Review the Contractor's Commissioning Plan, start-up plans, installation verification audit reports, start-up and FPT deficiency report forms, and FPT data forms;
   4. Review the Contractor's equipment, systems and cross-systems FPT procedures;
   5. Witness, verify, and approve satisfactory completion of equipment, systems and cross-systems FPT, based upon the Contract Documents requirements;
   6. Review for accuracy, comment on, and approve specified close-out documentation;
   7. Recommend Substantial Completion when commissioning and training has been successfully completed; and
   8. Provide final commissioning reports to the Owner.

C. The Commissioning Authority will communicate as follows:
   1. The Commissioning Authority will formally communicate with the Contractor via approved project channels. It is expected, however, that informal communication and coordination will be conducted directly with the Test Engineer. As the Owner's commissioning representative, it is expected that the Commissioning Authority will communicate directly with A/E, as may be appropriate.
   2. The Commissioning Authority will keep the Owner's Representative advised regarding commissioning activities and progress, equipment and systems performance, and any problems and solutions thereto.
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for Contract closeout including, but not limited to:
1. Project Record
2. Operation and Maintenance Manuals
3. Warranties and Bonds Manual
4. Operating Instructions and Training
5. Cleaning
6. Owner's Final Inspection
7. Substantial Completion
8. Final Completion, and
9. Final Acceptance

B. For additional specific construction Work, closeout requirements are described in Divisions 02 thru 49 of the Specifications.

1.2 PROJECT RECORD

A. General: Project Record documents include the Contractor's as-built Drawings, as-built Specifications, and as-built Shop Drawings required by the Contract Documents. Project Record documents must be protected from deterioration and stored in a secure fire-resistant location.

B. As-built Drawings: Maintain black line prints of the bid set Contract Drawings and approved Shop Drawings. Mark the drawings to show new information that was not shown on the bid set Drawings, and on the approved Shop Drawings, including the actual installation where the installation varies substantively from the work as originally shown. Mark drawings to show conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
1. Organize as-built Drawings in manageable sets, bind with durable paper cover sheets, and print suitable titles, dates, and other identification on the cover of each set.
2. Mark with reproducible pencil and distinguish between variations in separate categories of the Work. Text size is to be 1/8" minimum. Good basic drafting practice must be applied.
3. Show bid addenda items, Change Orders, and Request for Information (RFI) responses by their number, and date the revisions with a "cloud" around the revision.
4. Keep accurate measurements of below-grade site work, including permanent shoring, in accordance with Section 01 71 23 “Field Engineering.”
5. Show mechanical dampers, valves, reheat boxes, cleanouts, and other equipment and items that require maintenance.
6. Show location of construction-concealed mechanical, electrical and plumbing (MEP) riser installations including, but not limited to, piping, ductwork, and conduits referenced to visible and accessible features.
7. Show field changes of dimensions and details.
8. X-out conditions not constructed and appropriately annotate "not constructed" to convey the actual as constructed condition.

C. As-built Specifications: Maintain one (1) copy of the bid set Contract Specifications showing all addenda, substitutions, Change Orders, and RFIs. Give particular attention to the selection of
options, changes in product data, and information on elements engineered by the Contractor and note related as-built Drawing information, as appropriate. Clear, legible documentation must be applied.

D. As-built Shop Drawings: The Contractor shall comply with the following CAD (Computer-Aided Drafting), BIM (Building Information Modeling) and PDF (Portable Document Format) standards and requirements when preparing as-built record Shop Drawings required by the Contract Documents.

1. SUBMITTAL CONTENT
   A. Transmission
      1. Drawing package to be submitted using Owners’ construction management system (CMS).

   B. Included Drawings
      1. Submittal must include one Master Sheet Index on a single sheet that lists all drawing files submitted for all disciplines, including the sheet containing the Master Sheet Index. Only if the Master Sheet Index cannot fit on a single sheet may it be split over multiple sheet.
         a. For each file listed on the Master Sheet Index there must be one matching .DWG and one .PDF.
         b. Each drawing file provided in the submittal must be listed on the Master Sheet Index.
      2. If the Master Sheet Index is an OLE object, the index must also be submitted as an Excel .XLS or Text (.txt, .csv, etc.) file.

2. SHEET TITLEBLOCKS
   Sheets must contain a title block on the right or bottom side of the sheet. Title blocks must include labels and the following information:
      a. Date
      b. UW Project Name
      c. UW Project Number
      d. UW Facility Number (FACNUM)
         1. Every title block must include all FACNUMs affected by the project.
      e. Sheet Name
      f. Sheet Number
      g. Consultant Company Name
      h. Jurisdiction Seal where required by jurisdiction.
         1. Example: Within the City of Seattle

3. BIM STANDARDS
   A. Format
      1. BIM models must be submitted in Revit .RVT format.
   B. Packaging for Submission
      1. Models must be detached from central
      2. All worksets must be relinquished
      3. On final export dialog box, UNCHECK the box saying “Export views of sheets and links as external references.”
      4. Use eTransmit to package model and related files.
C. File Names
   1. Revit model file names must start with the UW CPD Project Number

4. CAD STANDARDS
   A. Format
      1. CAD files must be submitted in AutoCAD .dwg format.
   B. File Organization
      1. Each CAD drawing file must represent a single printed sheet.
   C. File Names
      1. Drawing and PDF file names must be titled <Sheet Number> <Sheet Name>.
         a. Examples: A-101 1ST FLOOR PLAN.dwg; A-101 1ST FLOOR PLAN.pdf
   D. Image and .PDF References
      1. Unreferenced and Unloaded images must be detached from the drawing.
         a. No Unreferenced or Unloaded images or PDF underlays should appear
            in the Xref Manager
   E. External References (XREFs)
      1. External drawing references are not allowed.
      2. External references used during the project must be bound using the ‘Bind’
         option (instead of the ‘Insert’ option) before submitting.

5. PDF STANDARDS
   A. Single Sheet .PDF
      1. Each .PDF file must represent a single sheet and must not contain multiple
         pages.
   B. File Names
      1. .PDF file names must match the corresponding .DWG file names except for
         the file extension.
   C. File Creation
      1. .PDF files are to be created by printing from the native CAD/BIM format by
         printing to PDF. Scanning is not permissible.
   D. Layer Content
      1. .PDF files must not contain layers.
   E. Image Resolution (if applicable).
      1. All documents must be created with a resolution of no less than 300 dpi.
   F. Fonts
      1. All fonts must be embedded in the .PDF.
   G. Compression
      1. When compression is used, the algorithm must be LZW, CITT Group 4, or
         PackBits.
   H. Page Size
      1. The .PDF page size must be the same as the original page size if the page
         were printed.
         a. Example: ANSI D sized sheet must have a .PDF sheet size of 22 x 34.

1. CAD Compliance Submittal Review Requirements: CAD Shop Drawings shall be
   electronically submitted for Owner’s CAD compliance review and approval prior to
   submitting as-built record Shop Drawings. The Contractor may request a compliance
   review at any time during the work prior to Substantial Completion.
2. Project Record submittal: Provide all record as-built Shop Drawings required by the Contract Documents in CAD, BIM and PDF format (per the requirements of Section 01 33 00 “Submittal Procedures”).
   a. CAD files shall be submitted in latest release of AutoCAD .dwg format.
      1) Custom menus or arx applications are not allowed if they create a requirement for the drawing to be used. No menus, custom user interface files or arx applications are to be submitted.
      2) Each CAD drawing shall represent a single printed sheet where the file name conspicuously identifies the sheet number (e.g. sheet A2.1 CAD file name might be A2-1.dwg).
      3) For all disciplines in a submittal, the CAD drawings shall be in a single folder. All supporting files (font files, line types, plot configurations, plot style tables, etc.) are to be in a subfolder.

1.3 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. Separate manuals shall be provided by the Mechanical and Electrical (M&E) Subcontractors titled MECHANICAL or ELECTRICAL and an additional manual provided by the General Contractor titled ARCHITECTURAL for all other information. The preliminary manuals shall be labeled “Preliminary” and comply with all requirements.

B. The O&M Manuals shall contain all the information needed to operate, maintain and repair all systems, equipment, and product finishes provided in the Project. They shall be presented and arranged logically for efficient use by Owner's operation personnel. As a minimum, the information provided shall include, but not be limited to, the following: (see Architectural, Mechanical and Electrical Divisions for additional requirements)
   1. Product description including, but not limited to, manufacturer, product name or equipment make and model number (and other nameplate data), size and dimensions, color, Material Safety Data Sheets (and related product information), and other pertinent information
   2. Supplier's name, address, e-mail address, phone, and reference order numbers
   3. Product finishes maintenance and cleaning instructions
   4. Performance and calibration data for specific product provided (extraneous catalog data must be eliminated)
   5. Descriptions and diagrams of system assembly and configuration (including components and interrelations)
   6. Manufacturer’s recommended equipment operating and maintenance instructions, including routine lubrication and servicing data, start-up and shutdown procedures, and any seasonal or emergency procedures
   7. Manufacturer’s checklists and methods for troubleshooting
   8. Complete parts list with parts numbers indicating common replacement parts and anticipated useful life
   9. Copies of: digitally signed warranties; any certificates from respective manufacturers, suppliers, and Subcontractors; permits and/or licenses, and; equipment maintenance and service contracts.

C. The O&M Manuals shall contain the following information for specified items, when the item is specified elsewhere in the Contract Documents:
   1. As-built door hardware schedule and submittal documentation
   2. Elevator systems documentation
      a. Wiring/equipment locations diagrams
   3. Refrigeration controls schematics/sequence of operation documentation
   4. Motors data and variable frequency drives (VFDs) documentation
      a. Final settings programmed into the VFDs
5. Fan and pump curves documentation
6. HVAC filters schedule
7. Environmental controls systems (ECS) documentation including hardware and software manuals
8. Electrical—Short Circuit Coordination and Arc Flash Study Report
9. Pull calculations documentation for MV wire, cable, and terminations
10. Electrical transformer factory test reports documentation

D. Drawings included in the manual shall not exceed 11" x 17."

E. Hard copy manuals shall be bound in a slant-D, 3-ring, view binder with a clear overlay insert on the front cover and spine.
1. Provide a cover slip sheet and a spine sheet typed with ARCHITECTURAL, MECHANICAL, and (or) ELECTRICAL OPERATIONS AND MAINTENANCE MANUAL, University Project name, University Project number, University Facility number, A/E name, and Contractor name. Label manuals consecutively (ex., Mechanical 1 of 3).
2. Each manual shall have a typed index and tabbed dividers between specification divisions and sections or, when presented in a logical format by Contractor and approved by Owner, between systems/equipment categories.
3. Contents of the manual shall be printed on 8-1/2" x 11" acid free, recycled copy paper.

F. ARCHITECTURAL, MECHANICAL, and ELECTRICAL manuals may be combined into one manual, with approval of Owner.

1.4 WARRANTIES AND BONDS MANUAL

A. Assemble executed warranties and bonds, and any certificates from the respective manufacturers, suppliers, and Subcontractors. Provide preliminary review copies of all warranties and bonds and a final manual with the original documents, titled "Warranties and Bonds Manual." Manuals shall be assembled in the same format as the O&M Manuals and include a table of contents in complete and orderly sequence.

1.5 OPERATING INSTRUCTIONS AND TRAINING

A. The Contractor shall provide on-site instruction and training for Owner’s personnel in all aspects of the philosophy, operation and maintenance of equipment and systems. Instruction and training shall be provided by a qualified trainer from the Contractor or Subcontractor who supplied and installed the equipment and systems and/or a manufacturer's training representative who is familiar with all aspects of the design, operation, maintenance, and troubleshooting of the specified equipment and systems. Training shall be conducted in a classroom setting with appropriate schematics, handouts, and audio/visual aids. All training shall also be digitally recorded in video, cataloged, and provided to Owner in a DVD/container labeled with session identification and date. Attendance shall be recorded. For work requiring commissioning, see Section 01 91 00 “General Commissioning Requirements” for further training session agenda requirements.

1. Prepare and submit a training plan for Owner's information and coordination. For each training session, the training plan shall include the following:
   a. Dates, start and finish times, and locations
   b. Outline of the information to be presented
   c. Names and qualifications of the presenters
   d. List of texts and other materials required to support training
1.6 CLEANING

A. Contractor clean up during construction is specified in the Contract Documents.
   1. If Contractor fails to clean as specified in the Contract Documents, and after reasonable notification from Owner, Owner may do so and the cost thereof shall be charged to the Contractor.
   2. For work in medical centers, reference housekeeping in Section 01 35 33 "Infection Control."
   3. Contractor shall employ continuous housekeeping cleaning during construction to minimize interior construction dust and particulates during the Work.

B. Preliminary Cleaning: Perform the following preliminary cleaning operations as a prerequisite for Owner’s Final Inspection. The following are examples, without limitation, of minimum cleaning requirements:
   1. Remove labels that are not permanent.
   2. Remove temporary protective coatings and wrappings from all products.
   3. Remove glazing compounds and other vision obscuring substances from transparent and reflective materials provided by the Contractor including, but not limited to, mirrors, glass in doors and interior construction, glass canopies and skylights, and windows inside and out.
   4. Clean all exposed building interior surfaces, including cabinet interiors, and new exterior surfaces to be free of foreign substances including, but not limited to, stains and films.
   5. Leave floors broom-clean. Vacuum carpeted surfaces and clean consistent with manufacturer’s recommendations for installation.
   6. Remove and clean all construction debris and refuse from:
      a. Roofs, mechanical and electrical rooms, tunnels and equipment vaults
      b. Limited access spaces, including above ceiling areas and shafts
      c. Physically inaccessible components of the Work including wall and chase cavities, gutters and downspouts, floor drains and other drainage systems
   7. Wipe surfaces of M&E equipment, including elevator equipment and similar Architectural equipment. Remove excess lubrication and other substances.
   8. Clean the Project site of construction waste, rubbish, and litter. Sweep paved areas broom clean and remove stains, spills, and other foreign deposits.

C. Final Cleaning: Prior to Substantial Completion, employ experienced workers or professional cleaners for final cleaning of the Work. Clean to a condition expected of a normal commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
   1. Leave entire Project clean and ready for occupancy. All new interior, including cabinet interiors, and exterior building surfaces, fixtures and equipment shall be turned over to the Owner in a new condition, free of all damage, dust, dirt, spots, stains, encrustations, and other blemishes.
   2. Clean transparent materials including mirrors, glass in doors and interior construction, glass canopies and skylights, and windows inside and out.
   3. Clean plumbing fixtures to a sanitary condition.
   4. Clean light fixtures and lamps.
   5. Apply floor finishes.

D. Compliance: The Contractor shall:
   1. Use non-toxic Green Seal Certified cleaning products, or products with low-volatile organic compounds (VOC), and cleaning paper with a post-consumer recycled content;
   2. Employ equipment with high efficiency particulate filtration and sweep compound to keep dust down; and
   3. Comply with current regulations and standards of authorities having jurisdiction and the safety standards for cleaning specified in the manufacturer’s instructions.
1.7 OWNER’S FINAL INSPECTION

A. Prior to Final Inspection: The Contractor shall satisfactorily complete the following actions prior to the Owner’s final inspection of the Project.

1. Submit written notice that the Project is ready for final inspection. Include a copy of the Contractor’s final punch list report (see Section 01 45 00 “Contractor Quality Control”) and list all incomplete work items that have been reviewed with the Owner, and which the Owner has agreed are not necessary prior to Substantial Completion.
   a. Include: a written plan/schedule outlining all actions necessary to achieve Substantial Completion, without requiring extra ordinary participation by Owner and A/E.

2. Complete preliminary cleaning operations.

3. Submit a list of all equipment and systems requiring instruction and training with a proposed schedule of times and locations for the instruction, for Owner’s review and comment.

4. Replace all ventilation systems air filters specified for construction with final filters.

5. Complete start up and functional performance testing of all systems required by the Contract Documents and AHJ including, but not limited to: electrical testing; environmental control systems point-to-point testing; emergency eyewash and safety shower testing; fume hood face velocity testing; and HVAC air balancing (if included in the scope of the Work).

6. Submit one (1) hard copy each of the current air balancing report and the M&E Commissioning Binders labeled “Preliminary,” listing all deficiencies, for Owner’s review and comment.

7. Submit the final mechanical pressure test and flushing forms, signed-off by Owner’s Representative.

8. Submit the final copper and fiber optic communications cabling test results in PDF format, on Owner’s CMS.

B. Owner’s Final Inspection: Upon satisfactory completion of the actions in 1.7A, Owner will determine if the Project is complete and ready for final inspection and, at Owner’s sole discretion, commence final inspection, or provide a written deficiency list of items to the Contractor of work that must be completed to the satisfaction of the Owner prior to the Owner’s final inspection. Final inspection is performed by the A/E and Owner’s representatives.

1. After the Owner has issued the final inspection list of corrective work items, the Contractor shall make the required corrections and/or identify items that the Contractor feels are not required by the Contract Documents, and resolve these items with the Owner.

C. Re-inspection: Contractor shall request, in writing, re-inspection after completing the Owner’s final inspection list of corrective work items and providing the Owner the final inspection report notated with a signed-off approval for each of the corrected items. Those items whose completion is delayed due to circumstances acceptable to the Owner will be exceptions. The Owner’s Representative will back check the items or have the A/E perform a re-inspection.

1. If the A/E is required to perform more than one re-inspection, the costs for additional inspections may be borne by the Contractor, at the Owner’s sole discretion.

1.8 SUBSTANTIAL COMPLETION

A. Substantial Completion: Substantial Completion (for either the entire Work or portions thereof) shall be achieved when all Work, other than incidental corrective and incidental punch list work, is complete including, but not limited to, the following actions:

1. Complete final cleaning operations.
2. Submit the “Preliminary” Operations and Maintenance Manual for Owner’s review and comment in one (1) hard copy and in PDF format, on Owner’s CMS.

3. Submit all sign-offs, releases, jurisdictional settlements, judgments, and other records from AHJ allowing the Owner’s full and unrestricted use and benefit of the facilities including, but not limited to, a temporary or permanent certificate of occupancy permit, operating permits and/or licenses for the use of building equipment such as elevators, boilers, paint booths, etc. and similar necessary certificates and releases.
   a. Provide a list of any outstanding work required by AHJ.

4. Submit the current Project Record as-built Drawings and Specifications identified “Preliminary” Project Record (marked with the date of submission) in PDF format, on Owner’s CMS.

5. Submit the Project Record as-built Shop Drawings required by the Contract Documents in accordance with this Section 1.2D, on Owner’s CMS.

6. Remove all construction tools and temporary facilities not required for Final Completion work from the Project site including, but not limited to, storage sheds, samples and mock-ups, Project identification signage, site fences, crane and hoist base foundation construction, temporary enclosures, and construction electrical power and service.

7. Complete Owner’s personnel operating instructions and training and submit training DVD’s.

8. Deliver specified maintenance equipment and tools to Owner, with itemized summary list.

9. Complete final change-over of locks, transmit new keys to Owner, and return Owner’s loaned construction keys.

10. Complete all air balancing, testing and commissioning work required by the Contract Documents, allowing the Owner to fully occupy the Work for the use for which it is intended. Incidental Work, that is not life safety or occupational safety commissioning work, whose completion is delayed due to circumstances excused by the Owner, will be the exception.
   a. Submit one (1) hard copy each of the current air balancing report and M&E Commissioning Binders (marked with the date of submission) noting the corrections for deficiencies listed in the “Preliminary” report and binders and indicating any incomplete Work.

11. Submit all controls systems software files required by the Contract Documents including, but not limited to, lighting and environmental controls.

B. Substantial Completion: Upon a satisfactory completion of the actions in 1.8A above and the General Conditions requirements for Substantial Completion, the Owner will prepare a letter of Substantial Completion and forward to Contractor. The letter will identify the date of Substantial Completion and include the final punch list report and the commissioning deficiencies list, listing all remaining incomplete work. Contract warranties will begin as of the date of Substantial Completion, as specified in Section 01 78 36 “Warranties,” or as otherwise indicated in the Contract Documents.
   1. Substantial Completion and the start of warranties for incomplete items will be established in writing by the Owner when the item is determined complete.

1.9 FINAL COMPLETION

A. Prior to Final Completion: Final Completion shall be achieved when the Work is fully and finally complete, to the Owner’s satisfaction in accordance with the Contract Documents including, but not limited to, the following:
   1. All Work, including incidental corrective or punch list work, and air balancing and commissioning work (if included in the scope of the Work) is complete and correct to the satisfaction of the Owner.
   2. All remaining temporary facilities are removed from the Project site and the site (including landscape) is restored to original conditions or Contract Documents requirements.
3. All final permits, originally issued as temporary permits, have been submitted.
4. The final marked-up Project Record as-built Drawings and Specifications identified Final Project Record (marked with the date of submission) have been submitted using Owner’s construction management system (CMS).
5. The complete Operations and Maintenance Manual and Warranties and Bonds Manuals have been submitted in PDF format, on Owner’s CMS, and a hard copy of the Warranties and Bonds Manual with original documents has been submitted.
6. The Contractor’s final 3-ring binder of all MSDS used for construction, marked with the date of submission, has been submitted in PDF format, on Owner’s CMS.
7. The Contractor’s final cumulative Construction Waste Management Report (marked with the date of submission) has been submitted in PDF format, on Owner’s CMS.
8. All Change Orders are approved and signed by both parties.
9. A draft of the Final Application for Payment has been submitted to Owner for review and approval.
10. The final Schedule of Values and the Building Componentization Report in hard and electronic copies (see Section 01 29 76 “Progress Payment Procedures”) have been submitted.
11. The final air balancing report and the final M&E Commissioning Binders (marked with the date of submission) have been submitted in PDF format, on Owner’s CMS.
   a. For Projects with a Test Engineer, the as-built information updating the A/E commissioning basis-of-design has been submitted with the Commissioning Binders.
12. The final environmental control systems point-to-point testing documentation and (when specified as work of the Contractor) the final air balancing report marked with the date of submission, has been submitted in PDF format, on Owner’s CMS.
13. The software file used to calculate the power systems studies (Power Tools – SKM®) has been submitted.
14. Specified spare parts, extra stock of materials, and extra materials of value to the Owner, with itemized summary list, have been submitted.
15. The “Regulated Materials – Waste Manifests” (marked with date of submission) have been submitted in PDF format, on Owner’s CMS.

B. Final Completion: Upon satisfactory completion of the requirements in 1.9A above to achieve Final Completion, the Owner will approve and process the final Application for Payment and establish the date of Final Completion thereon.

1.10 FINAL ACCEPTANCE

A. Final Application for Payment has been approved by Owner and payment made to the Contractor.

B. The Owner will establish the date of Final Acceptance and issue the letter of Final Acceptance after the Contractor has completed the requirements of the Contract Documents.
   1. The Contractor shall follow the requirements outlined in the General Conditions and Section 01 29 76 “Progress Payment Procedures” for release of retainage.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer’s standard warranties on products and special warranties.

1. Refer to the following General Conditions for terms of the Contractor’s warranty of Work:
   a. Part 5.16 “Correction of Non-conforming Work”
   b. Part 5.21 “Warranty of Construction”

1) If there is any discrepancy in the Contract Documents regarding the warranty period or its date of commencement, the specified passage granting the Owner the longest warranty period ending on the latest date shall govern.

2. General closeout requirements are included in Section 01 77 00 “Closeout Procedures.”

3. Specific requirements for warranties for the Work and products and installation that are specified to be warranted are included in the individual sections of the Specifications.

4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

B. Disclaimers and Limitations: Manufacturer’s disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and Subcontractors that are required to countersign special warranties with the Contractor.

1.2 DEFINITIONS

A. “Standard Product Warranties” are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. “Special Warranties” are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.3 WARRANTY REQUIREMENTS

A. General: Upon determination that Work covered by a warranty has failed, correct or replace the Work to an acceptable condition complying with requirements of Contract Documents.

B. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected or replaced and retested and/or re-commissioned reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

D. Costs: The Contractor is responsible for the cost of correcting or replacing including the cost for retesting and/or re-commissioning defective Work, regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
E. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

2. Right to Refuse Work: The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.4 SUBMITTALS

A. Submit written warranties to the Owner's Representative. Provide a draft for Owner's review and comment prior to final execution. Warranties shall identify:

1. Scope description of what is covered (indicate labor and/or materials requirements);
2. The Specification reference stating the warranty;
3. The date of the warranty's start and finish (indicate the specified warranty duration);
4. Service and maintenance contracts, when specified in the Contract Documents;
5. Supplier's name, address, e-mail address, and telephone number;
6. Proper procedure in case of failure; and
7. Instances which might affect validity of warranty.

B. When a special warranty is required to be executed by the Contractor, or the Contractor and a Subcontractor, supplier, or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties.

1. Refer to individual sections of the Specifications for specific content requirements, and particular requirements for submittal of special warranties.

C. Include warranties in the Operations and Maintenance Manual (see Section 01 77 00 “Closeout Procedures”).

D. Review and acceptance, by the A/E or Owner's Representative, of submitted warranties does not relieve the Contractor of the warranty requirements of the Contract Documents.

E. The Owner may generate and keep electronic copies of original executed warranties, certifications, and other similar commitments and such copies shall be considered as originals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. The Owner will employ an independent Commissioning Authority (CxA). The CxA is an independent and knowledgeable third party, hired to verify that the systems work as intended. The CxA will inform the Owner and the Architect of the results of commissioning and provide recommendations for final acceptance of commissioned systems.

B. Commissioning is the process to verify to the Owner that mechanical and electrical systems, as well as other special systems, function together properly to meet the facility performance requirements and design intent as described in the Contract Documents. The Contractor shall be responsible for participation in the commissioning process as outlined below, and in references and attachments throughout the Contract Documents. The Contractor shall furnish labor and materials sufficient to meet all requirements of building commissioning under this contract.

C. The CxA, acting on the behalf of the Owner, will be cognizant of the Owner’s Facilities Staff’s need to be informed and given the opportunity to participate actively in the commissioning process to ensure a complete, thorough turnover of systems once the project is complete. To this end, the CxA will ensure that Facilities Personnel are informed of commissioning activity and schedule, and of any coordination issues, such as special testing procedures or opportunity for hands-on training during functional testing.

D. The CxA is not authorized to modify, add to, or revoke the requirements of the Contract Documents. A change in the work can only be made as provided in the General Conditions.

E. Specification sections in Division 1 - General Requirements (019100); Division 22 Plumbing (220800 - Commissioning of Plumbing); Division 23 - Heating, Ventilating, and Air Conditioning (230800 - Cx of HVAC); and Division 26 - Electrical (260800 - Cx of Electrical); outlines the specific commissioning responsibilities of each subcontractor for that division, and also obligates the Contractor to coordinate and manage the commissioning responsibilities of those subcontractors.

1.2 RELATED WORK

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this section.

B. General requirements for testing agencies as specified in the Division 1, “Section Quality Control Services.”

C. Applicable Divisions 22 and 23 sections identifying the requirements for plumbing and HVAC systems relating to the installation of mechanical equipment and systems, particularly with respect to equipment and system testing, start-up and performance demonstration/observation. Coordinate with the work of Division 26.
D. Applicable Division 26 sections specifying the requirements for materials and installation of electrical equipment and systems, particularly with respect to equipment and system testing, start-up, arc flash and selective coordination and performance demonstration/observation. Coordinate with the work of Divisions 22 and 23.

1.3 TERMS

A. Acceptable Performance: A component or system being able to meet specified design parameters under actual load, including satisfactory documented completion of all functional performance tests, BAS trending, and resolution of outstanding issues.

B. Basis of Design (BoD): The A/E Design Team's interpretation of Owner's Project Requirements in terms of systems, codes, standards and performance criteria.

C. Commissioning Authority (CxA): An independent and knowledgeable third party hired to verify that the systems achieve acceptable performance.

D. Commissioning Plan: The Commissioning Plan is prepared by the CxA and defines the scope and format of the commissioning process and the responsibilities of all involved parties. The Commissioning Plan is provided to all commissioning team members to inform them of the intent and scope of the commissioning work to ensure inclusion in the project scope and to expedite the commissioning process.

E. Commissioning Team: The term used to define the overall group associated with performing commissioning work, including designated representatives of the Owner, Facilities Staff, A/E Design Team, Construction Team, and the CxA.

F. Completion Tracking Matrix: Electronic log established by the CxA and used by installing contractors to track and confirm construction completion progress, with endorsements and attachment of related documentation, and to provide notice that installation is complete and system is ready for functional testing.

G. Construction Team: The term used to define the overall group responsible for performing the work to complete the work on the Contract Documents, including the Construction Manager, Contractor, the Mechanical Contractor and associated subcontractors, and the Electrical Contractor and associated subcontractors.

H. Controls Summit: A meeting or meetings that occurs early after project award between the CxA, engineer of record, Owner, BAS Contractor and Contractor to coordinate and finalize how BAS architecture and sequence of operations is to be implemented before completion of the BAS Contractor’s hardware and software shop drawings, graphics and other related submittals.

I. Design Intent: The goal behind design decisions that were made to meet the Owner's project requirements. The design intent describes the systems, components, conditions and methods to provide a fully functioning building.

J. Functional Performance Testing or Functional Testing: Full range of checks, tests and demonstrations carried out to determine that all components, sub-systems, systems, and interfaces between the systems function in accordance with the Contract
Documents. In this context, function includes all modes and sequences of control operation, all interlocks and conditional control responses, and all specified responses to abnormal emergency conditions.

K. Issue Resolution Log (IRL): Log to provide tracking and resolution of issues discovered as a result of the commissioning process. This log also includes disposition of issues and the date of resolution as confirmed by the CxA.


M. Owner’s Project Requirements (OPR): A document developed by the Owner, with help of the CxA and A/E Design Team. The OPR details the functional requirements of the project, and the expectations of the buildings use and operation as it relates to the systems being commissioned.

N. Performance Period: A period of time following the completion of Functional Performance Testing with minimal involvement/intervention from the installing contractor(s) where the performance of the Commissioned Systems is monitored and tracked for any deviations from expected outcomes. A Performance Period may also sometimes be referred to as a “trending period.”

1.4 DUTIES OF CONTRACTOR

A. It is the responsibility of the Construction Manager or General Contractor to assure that all requirements of this specification section are completed by the CM/GC and their sub-contractors.

B. Provide vendor information to the CxA as requested enhancing the CxA’s understanding of contractor and vendor obligations and responsibilities, and as needed to benefit the commissioning effort.

C. Provide to the CxA electronic copies of all submittals, shop drawings, coordination drawings, manufacturer’s literature, maintenance information or other information as may be needed for systems to be commissioned.

D. Submit all manufacturer’s installation inspection and start-up procedures for review by the CxA.

E. Incorporate commissioning activities into the overall construction schedule.

F. Coordinate participation of the Mechanical, Electrical, BAS, Security, Fire Alarm and TAB contractors in the commissioning process.

G. Collect and provide to the CxA information requested for development of a complete commissioning plan, Completion Tracking Matrix and functional test procedures.

H. Review the commissioning plan, IRL and test results, and submit comments to the CxA.
I. Coordinate participation in the Controls Summit prior to finalization of BAS submittal. Participate in efforts to finalize system points, BACnet object IDs, point naming and sequence of operations with the Owner, A/E Design Team and CxA.

J. Manage, track and complete commissioning documentation, including Completion Tracking Matrix and commissioning related specification requirements.

K. Verify that coordination, installation, quality control, and final testing have been completed such that installed systems and equipment comply with construction documents.

L. Participate in any efforts to finalize sequences of operations with Owner, A/E Design Team, and CxA.

M. In a timely manner, address issues identified during construction that may affect the commissioning process or final system performance.

N. Participate in commissioning meetings with the CxA.

O. Ensure that the building automation system graphics are submitted for approval by the A/E prior to testing and that these graphics are operational prior to the start of functional testing.

P. Provide a fully operational system per the contract documents, started, verified, debugged, calibrated, balanced, tested and under automatic control.

Q. Provide written notice of Cx readiness for each system to CxA through completion and endorsement of the Completion Tracking Matrix. Functional testing will not begin for any system until signed notice of Cx readiness is issued.

R. Provide proprietary test equipment required to test all the systems and equipment in this project.

S. Operate equipment and systems, as required, for functional performance testing. This includes, but is not limited to, manipulating the appropriate controls to achieve the expected response for the functional test procedure and initiating HVAC system fire alarm interactions via the fire alarm system.

T. Participate in the fine-tuning or troubleshooting of system performance if either becomes necessary.

U. Submit complete operation and maintenance information and as-built drawings to the CxA for review.

V. If Performance Period verification is required by the Owner, or included in the contract documents, Contractor shall provide the necessary support for Commissioned Systems during the Performance Period. This includes, but is not limited to, providing the necessary personnel to operate all Commissioned Systems during a performance period to last 7 days (or as agreed to, responding to hot/cold calls and other complaints from building occupants, notifying the Commissioning Team in writing of any issues.
that arise during the Performance Period, providing requested trend data, and correcting any issues that are identified for correction during this period.

W. Provide documentation of training for the systems specified.

X. Within (60) days of approval of all submittals, the contractor shall submit to the CxA:
   1. All Operation and Maintenance information.
   2. One electronic set of approved submittals,
   3. All maintenance procedures and schedules as well as operational record keeping recommendations.
   4. Emergency contact and service contact information for all equipment provided as part of the project including names, agency, address, phone number, and email address
   5. At the time of substantial completion, the contractor shall submit the following additional information to the CxA for inclusion in the systems manual
      a. One electronic set of as-built drawings, single-line diagrams, flow diagrams, equipment preventative maintenance schedules, as built sequences of operation, original setpoints, emergency operating procedures, and a record of all changes made throughout the project.
      b. Confirmation record of completed training.

Y. Compensation for the CxA for retesting and/or troubleshooting time will be requested to the Owner from the CxA if the Contractor’s systems do not meet specified performance. Contractor will be required to reimburse Owner for this additional expense.

1.5 DUTIES OF COMMISSIONING AUTHORITY (CxA)

A. Provide Contractor with expected durations of commissioning activities for inclusion in the construction schedule.

B. Collect and review OPR and BoD, if available, from the A/E Design Team.

C. Review the Contract Documents.

D. Develop the commissioning plan.

E. Develop the Completion Tracking Matrix for use by the installing contractors to track each piece of equipment to be commissioned.

F. Organize a commissioning kickoff meeting and present the commissioning plan to the Commissioning Team.

G. Review the Contractor submittals relative to the systems to be commissioned.

H. Conduct a Controls Summit meeting with the Owner, Architect, Contractor and BAS contractor.

I. Review construction progress and verify system installation quality and readiness for testing.
J. Observe the start-up activities and initial testing of equipment and systems, as required, and review Contractor start-up documentation.

K. Develop functional test procedures from Contractor submittals, including approved BAS documentation, and narrative sequences of operation and control diagrams.

L. Direct and perform and document functional testing with assistance from Contractor.

M. Provide site observation, functional test and other project reports in a timely manner. Document inconsistencies or deficiencies in system operations and system compliance.

N. Coordinate participation of Owner’s Personnel involved with equipment, component and systems performance verification, and participation in required training.

O. Witness and verify satisfactory completion of equipment and component tests and systems and inter-systems functional performance tests.

P. Maintain the Issues/Resolution Log (IRL). Verify resolution of issues identified through the commissioning process.

Q. Verify training for commissioned equipment and systems is provided to the Owner.

R. Complete a commissioning report.

1.6 ADDITIONAL DUTIES OF THE TAB CONTRACTOR

A. Perform site observations of all air and hydronic systems for access to all balancing devices (i.e. manual volume dampers and hydronic balance devices) prior to installation, system fill and insulation.

B. Provide as-built TAB one-line documentation for all balanced systems. Hydronic systems shall include risers and main branch take-offs complete with pipe size and balanced flow. Airside systems shall include duct risers and main branch take-offs with duct size, balanced flow and pressure and full flow conditions.

C. Provide static pressure profiles for all air handling equipment while same is operating at design capacity specifically noting equipment components and airflow volumes.

D. Pressure test all rooms with FGI specified airflow direction or pressure requirements utilizing the airflow offset found on the contract documents. Report findings to the Contractor for repair.

E. Include a table that includes required and calculated air changes per hour (ACH), room volumes and space pressures (negative or positive) for all spaces with FGI specified airflow direction or pressure requirements. Include measured space pressures for operating rooms, cath labs, C section rooms, airborne infectious isolation rooms, protective environment rooms and compounding pharmacy rooms.
F. Conduct air flow station calibration verification in the presence of the CxA, and document results in TAB report.

G. Provide preliminary TAB report, indicating all actual field values recorded, to the CxA prior to initiation of functional testing. This report may be handwritten.

H. Re-measure air and water flows as directed by the CxA to verify proper TAB measurement procedures were followed, and the results are repeatable.

I. Measure building pressure during peak heating season with all air handlers controlling to minimum outside air flow.

J. Measure building pressure during peak cooling season with all air handlers controlling to minimum outside air flow.

K. Measure building pressure under 100% outside air economizer conditions (if applicable) with all air handler fans operating under normal BAS control.

L. Observe duct pressure testing.

1.7 ADDITIONAL DUTIES OF THE BUILDING AUTOMATION SYSTEM CONTRACTOR

A. Participate in the Controls Summit prior to finalization of BAS submittal to finalize system points, BACnet object IDs (if applicable), point naming and sequence of operations with the Owner, A/E Design Team and CxA. BAS network and controller IP addressing will be determined along with analytic tool connection to this network.

B. Provide to the CxA the BAS complete point listing that includes a summary of all points; full description; point name, address, type and units, including mapped points integrated from third party equipment controls and calculated or virtual points. This information shall be in Excel or .csv format.

C. Existing or Renovation Projects: It is expected the Contractor will provide input on the operation of the mechanical equipment as it relates to the existing facilities operations for expansion and remodel projects. Sequences and preliminary submittal review will occur with the mechanical contractor, BAS contractor, A/E, CxA and Owner.

D. Testing and start-up of the equipment including completed BAS systems, point-to-point verification of all system inputs and outputs, calibration checks and accurate system graphics.

E. Providing qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.

F. Provide test holes in ducts and plenums where directed or necessary for sensor calibration verification. Test holes shall be provided with an approved removable plug or seal. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.

G. Provide test connection ports for airside differential pressure switches and transmitters.
H. Provide test connection ports for waterside differential pressure transmitters.

I. Provide all devices, software, cables and devices necessary to communicate with controllers, so that commissioning can proceed in an efficient manner.

J. All commissioning activities will utilize the graphics on the building automation system workstation. This Contractor shall be responsible for submitting graphics for review by the A/E prior to commencement of field testing. Commissioning testing will not begin until graphics are A/E approved and fully functional.

K. Provide remote access to the automation system for the CxA.

L. Provide a dedicated site license, access to the programming and graphics tools for the BAS front-end workstation for use by the CxA prior to downloading BAS programming. The CxA shall review all completed BAS programming against the approved sequences of operation. The CxA will communicate directly with the BAS Contractor by noting all comments in the programming tool. Any deficiencies identified will be recorded to the IRL report.

M. Provide 2-way radios, as necessary, for coordination during field testing with the CxA.

N. Providing training to the CxA on basic operation of the BAS system along with appropriate personal access for commissioning.

O. Fulfill contract and warranty requirements by providing equipment, software, software programming materials and labor necessary to correct deficiencies found during the commissioning process.

P. After completion of Cx activities but before Owner occupancy, set up and provide interval trends for duration of Performance Period for all points required by the CxA. The list of points and frequency required will be developed as part of the Commissioning Plan. Provide this data in a Microsoft Excel compatible format.

Q. Provide sequences of operation in a MS Word compatible format.

R. Provide as-built control diagrams in individual PDF format on a per system basis.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Standard test equipment for commissioning will be provided by the CxA.

B. Division 21, 22, 23 and 26 Contractors shall provide standard and specialized test equipment as necessary to test and start up the systems.

C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the installing contractor. Manufacturer shall provide the test equipment, demonstrate its use and assist the CxA in the commissioning process.
D. The Contractor shall provide all equipment, software and all test programming support as necessary to start up, calibrate, debug and verify proper function of the BAS. This equipment and software shall be provided for use by both the test and balance Contractor and the CxA.

2.2 BUILDING AUTOMATION SYSTEM TEST EQUIPMENT

A. The BAS Contractor shall provide all equipment, software and all test programming support as necessary to start up, calibrate, debug and verify proper function of the BAS. This equipment and software shall be provided for use by both the test and balance Contractor and the CxA at no additional charge to the project.

B. Proprietary test equipment, including hardware, software and specialized test instruments, required by the manufacturer for system testing and commissioning, whether specified or not, shall be provided by the BAS Contractor at no additional charge to the project. This Contractor shall provide the test equipment, demonstrate its use and assist the CxA in the commissioning process. This includes, but is not limited to, provision of any proprietary software required for communication with terminal equipment controllers and access to graphical user interfaces.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS

A. Commissioning Schedule
   1. Contractor to incorporate commissioning activities into the overall construction schedule. If construction is phased, commissioning activities are to be included in all phases of the schedule. The schedule defines the milestones and conditions that must be achieved before functional testing can commence. The schedule also includes the expected duration of the various tasks. The CxA will provide the Contractor with expected durations of commissioning activities.

   2. Special consideration shall be given to the schedule to prevent unrealistic overlap of activities within the same area of the building with each other and with commissioning (e.g., air and water balancing, enabling return air without floor level cleanliness, flooring installation, and fire alarm testing).

   3. Contractor to develop a systematic start-up / close-out / commissioning schedule or include the same information in the overall construction schedule. For each of the equipment/systems, the following activities shall be indicated on the Startup and Commissioning Schedule as a minimum (note that not all of these activities apply to all equipment/systems and that some equipment/systems will require additional activities and prerequisites to be indicated):
      a. Equipment Installation Completion Date(s) with referenced prerequisites from the General Schedule,
      b. Permanent Power Completion Date(s), including power connection to equipment,
      c. Availability of central plant services (i.e. chilled water, hot water, steam)
      d. BAS Wiring Completion Date(s)
      e. Manufacturer’s Representatives’ Equipment/System Startup Date(s)
      f. Contractors’ Equipment/System Startup Date(s)
g. BAS Point to Point Testing Date(s)

h. Test and Balancing Date(s)

i. 3rd-Party Electrical Testing Agency Testing Date(s)

j. Floor level final clean and dust free

k. Fire Alarm System Pre-Testing Date(s)

l. Fire Department Fire Alarm and Fire Suppression Systems Testing Date(s)

m. Functional Performance Testing Date(s)

n. Substantial Completion Date(s)

o. Owner Move in Date(s)

p. Owner personnel training.

B. Contract Document Review

1. The CxA will collect and review design intent information from the design team and verify that it meets the Owner’s project requirements. Design intent documentation will be used in conjunction with the Contract Documents to develop the commissioning plan, Completion Tracking Matrix, and functional performance tests.

C. Commissioning Plan

1. The CxA will develop a commissioning plan for the project. The commissioning plan is a tool through which the commissioning process is described and incorporates the Owner, A/E Design Team, Contractor and CxA’s roles relative to the commissioning process. The commissioning plan will include the following:

   2. Elements of the Plan
      a. Detail the commissioning process
      b. Specify activities to be completed prior to substantial completion and/or occupancy
      c. Identify commissioning team members and organizations represented
      d. Define commissioning team member responsibilities
      e. Describe construction verification activities and functional test procedures
      f. Outline systems to be commissioned
      g. Provide a narrative of additional tasks required to successfully complete a functional facility
      h. Provide a list of Commissioning Activities, including durations
      i. Submittal review protocol
      j. issues resolution protocol
      k. deliverables for training, operations and maintenance
      l. Conditions of acceptance including measurable criteria
      m. 10-month post occupancy review agenda

D. Commissioning Kickoff Meeting

1. The commissioning plan will be presented to the Commissioning Team during a commissioning kickoff meeting. The Commissioning Team will review the plan and provide comments to the CxA. The CxA will incorporate appropriate comments into the plan and a finalized commissioning plan will be distributed to the Commissioning Team.

2. The Completion Tracking Matrix will be presented to the Contractor during the commissioning kickoff meeting. Instruction for its use will be conveyed during the meeting.
E. Construction Progress Review
1. During construction, the CxA will review installation of equipment and systems to be commissioned. Deficiencies and/or recommendations will be noted and conveyed in the IRL for review by appropriate Commissioning Team members.

F. Completion Tracking Matrix Completion
1. The CxA will develop the Completion Tracking Matrix for use by installing contractors to track, document and communicate installation, start-up and operational assessment completion for each piece of equipment to be commissioned.
2. Using the Completion Tracking Matrix, including attachment of completed startup forms, installing contractors will verify that equipment and systems are installed in compliance with the construction documents and fully functional.
3. Functional testing will only begin when the Completion Tracking Matrix is completed, with endorsement by installing contractors of readiness for functional testing.

G. Contractor Submittal Review
1. The Contractor will provide electronic copies of the submittals for commissioned systems and equipment to the CxA for use in development of functional test procedures.
2. The CxA will review submittals for conformity with the design intent.

H. Functional Test Procedures
1. The CxA will develop functional test procedures for each piece of commissioned equipment. The functional tests outline the process for testing the building’s systems. Functional tests verify the performance of equipment adhere to the design intent.
2. Functional test procedures include, but are not limited to, verification of the following:
   a. Testing, adjusting and balancing
   b. Function of BAS in all seasonal modes
   c. Function of HVAC system
   d. Function of electrical systems
   e. Function of plumbing systems
   f. Operation of life safety interactions with the HVAC systems
   g. Response of BAS to interlocks, failure modes, alarms, fire alarm input, and power failures
   h. Trending capabilities of the BAS.

I. Functional Testing
1. Functional testing is intended to begin upon completion of systems. The CxA will not begin the functional testing process until each system is complete. Testing may proceed prior to the completion of systems and/or sub-systems if expediting this work is in the best interests of the Owner.
2. Functional testing is performed by the Contractor and witnessed by the CxA to verify proper sequencing, operation, and performance of installed equipment and systems under realistic operating conditions. As tests are successfully completed, systems will be deemed acceptable by the CxA.
3. The Contractor is responsible for coordinating participation of CxA and Subcontractors in functional testing.

J. Issue Resolution Log (IRL)
1. When acceptable performance cannot be achieved by tested equipment and systems, the cause of the deficiency will be identified. Deficiencies will be documented and tracked in an IRL maintained by the CxA. Where appropriate, recommendations for corrective measures will be documented by the CxA in the IRL.

K. Corrective Measures
1. If acceptable performance cannot be achieved by a piece of equipment or a system, and if the deficiency is the responsibility of the Contractor, the necessary corrective measures shall be carried out by the Contractor. Once corrective measures have been completed, the equipment or system will be retested by the CxA until acceptable performance is achieved. The CxA is in an advisory capacity and does not have authority to direct design changes or deviations from the contract documents. If the Contractor disputes responsibility for corrective measures, resolution shall be through established contractual channels.

L. Project Communication Reports
1. In addition to the Completion Tracking Matrix, functional test procedures, the IRL, and project communication reports will be provided to document all other commissioning activities performed by the CxA. Project communication reports will be issued to the Contractor and key members of the Commissioning Team to document apparent deficiencies identified during examination of design and construction documents, daily activities on-site, installation deficiencies, and successful or unsuccessful functional testing results.

M. Commissioning Meetings
1. Commissioning meetings will be held periodically during the construction process to review the status of the construction and commissioning work, develop construction completion and testing schedules, and the status of submittals required by this section. Attendance by the Construction Team is required for commissioning meetings.
2. Commissioning meetings will be coordinated by the Contractor.
3. Meeting minutes will be developed and maintained by the CxA.

N. Training
1. A training plan will be developed by the Contractor outlining equipment that requires training, who will perform the training, when the training will occur, and the required duration of the training. Once the training plan is developed, the Owner will review and approve training durations and quantities proposed by the Contractors and coordinate the training schedule with the construction team to ensure that the appropriate personnel attend the training.
2. CxA will review the training plan for comprehensiveness.
3. Training sessions should include using the Operations & Maintenance Manuals and as-built drawings assembled by the Contractor.
4. Contractor to provide a copy of all Owner Training documentation to the CxA for review.

O. Commissioning Report
1. Once acceptable performance is achieved, the CxA will complete a commissioning report. The report shall include:
   a. A commissioning activity executive summary.
   b. The finalized commissioning plan.
   c. The completed Completion Tracking Matrix and specified commissioning related documentation.
   d. Completed functional test procedures.
   e. Commissioning project communication reports.
   f. Up-to-date Issue Resolution Log.

3.2 SYSTEMS TO BE COMMISSIONED

A. Systems and equipment to be functionally tested include, as described in Division 1 (019100), Division 22 (220800), Division 23 (230800) and Division 26 (260800):
   1. Heating water system (new piping and changes to existing system operation)
   2. Chilled water system (new piping and changes to existing system operation)
   3. Air handling units, air distribution and air terminals (new ductwork and changes to existing system operation)
   4. Unitary HVAC equipment
   5. Domestic water and domestic water heating and distribution system (new piping and changes to existing system operation).
   6. Building automation system
   7. Normal power electrical system (oversight of 3rd Party Testing)
   8. Backup power system (as it applies to new systems on emergency/standby power)
   9. Lighting Control System (new components and changes to existing system).

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Selective demolition of building elements.

1.2 RELATED REQUIREMENTS
   A. 01 11 01 - Summary of Work Regulated Materials.
   B. 01 31 00 Project Management and Coordination: for administrative requirements.
   C. 01 33 00 - Submittal Procedures: for additional requirements of preinstallation meeting.
   D. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.3 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 00 Project Management and Coordination.
      1. Review preparation and installation procedures and coordinating and scheduling required with related work.
      2. Review Owner salvage requirements and conduct a walk-through with Owner present.
      3. Review locations of roof and structural penetrations with mechanical subcontractor, structural engineer and Architect.

1.4 SUBMITTALS
   A. Qualification Data: For demolition contractor listing projects and references.
   B. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
      1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of partitions, barricades and fences. Demolition plan shall also address temporary protection for existing facilities, systems, and materials to remain that may be exposed to construction activities or weather.
      2. Include procedures and coordination with other work in progress, a disconnection schedule of utility services, and a detailed description of methods and equipment to be used for each operation and of the sequence of operations.
      3. Identify demolition firm and submit qualifications.
      4. Include a summary of safety procedures.
   D. Existing Condition Survey.
E. Shop Drawings: Indicate required flashings, sealing at openings.

F. Closeout Submittals: Accurately record actual locations of capped and active utilities and subsurface construction.

1.5 QUALITY ASSURANCE

A. Demolition Contractor Qualifications: Company specializing in selective demolition comparable in scope, environmental and historical sensitivity of work specified in this section with minimum 5 years experience.

B. Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.

1.6 MAINTAINING EXISTING ROOFING AND TRAFFIC COATING WARRANTIES

A. Existing Warranties: Coordinate with Building Owner for existing and continuous warranty requirements. Provide copy of existing warranty and documentation of required methods, materials and contractors for selective demolition to maintain existing warranty.

B. Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods required to maintain the existing warranties. Notify warrantor before proceeding.

C. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Selectively demolish existing elements to accommodate tie-in of new work to existing conditions.

B. Comply with provision of Section 01 11 01 Summary of Work Regulated Materials.

2.2 PERFORMANCE AND DESIGN CRITERIA


2.3 MATERIALS

A. Locations and extent in accordance with demolition drawings.
2.4 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before start of work.

B. Review record documents provided by Owner and schedule listing salvage and remove for reuse items.

3.2 PREPARATION

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

B. Provide fire watch during hot work.

C. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

D. 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.

3.3 SELECTIVE DEMOLITION OF BUILDING ELEMENTS

A. 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.

B. Radar image all existing concrete penetrations for rebar extent and location. Avoid cutting rebar where possible, and notify Architect and structural engineer if reinforcing steel must be compromised.

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.

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

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

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The Contractor shall perform all planning, notifications, administration and execution necessary to safely remove, dispose and/or handle the regulated materials listed within this Section in accordance with local, state and federal regulations.

1.2 RELATED WORK

A. Drawings, General Conditions, Modifications to the General Conditions, and Supplemental Conditions to the General Conditions, and other Divisions apply to this Section.

1.3 WORK INCLUDED

A. The Contractor shall supply all labor, equipment, notifications, services, insurance, special permits and equipment necessary for the following regulated materials:

   1. Asbestos:

      a. Asbestos abatement is not included in this Project. Refer to other sections for Infection Controls or Covid-19 mitigation plan for safe work practices and procedures and associated implementation.

      b. Contractor shall refer to the Hazardous Materials Survey Report (Attached in Appendix C and prepared by PBS Engineering and Environmental). This document lists suspect asbestos-containing materials (ACM) sampled and analyzed for asbestos content, or presumed to exist, at the areas of the building included in the Work. The Contractor shall ensure that copies of this information are made available to and retained at the project site by all subcontractors. Asbestos-containing materials were not identified at the project site.

      c. Contractor shall be aware that suspect-ACMs may exist in inaccessible locations of the spaces included in the Work and in areas not included in the Work.

      d. Contractor is advised that, should additional ACMs not included in the Hazardous Materials Survey Report be encountered, the Owner may elect to include the abatement of such materials in the work at a mutually agreed upon price. Work impacting such materials is not to occur prior to the Contractor receiving explicit written authorization from the Owner, and any Work performed without such approval is performed at the Contractor’s own risk and expense.

      e. The disturbance or impact of ACMs may cause asbestos fibers to be released into the building’s atmosphere, thereby creating a potential health hazard to building and tunnel occupants. Contractor is to apprise all workers, supervisory personnel, subcontractors and consultants who will be at the jobsite of the seriousness of this
potential hazard and of proper Work procedures that must be followed, should it occur.

f. Where in the performance of the Work, workers, supervisory personnel, subcontractors, or consultants encounter, disturb, or otherwise function in the immediate vicinity of any identified ACMs, Contractor shall take appropriate continuous measures, as necessary, to protect its employees, sub-contractors, building occupants from the potential hazard of exposure to airborne asbestos. Such measures shall include the procedures and methods described herein, and compliance with applicable local, state and federal regulations.

g. Damage of Asbestos by the Contractor: Damage to asbestos-containing materials to remain caused by the Contractor shall be repaired to the satisfaction of the Owner by the Contractor using certified asbestos workers according to these specifications, and at the sole expense of the Contractor.

2. Metals/Lead:

a. Lead/metals-containing materials and associated health and safety compliance and controls.

b. The Owner’s consultant has conducted a survey of representative areas in the Building to be impacted by the Work for the presence of lead-containing components. Findings and related analytical data are included in the attached Appendix C Hazardous Materials Good Faith Survey Report. Lead-containing paint was not identified at the project site.

c. Contractor shall comply with all applicable Metals regulations, laws and ordinances concerning the impact, removal, handling, storage, disposal, monitoring and protection against exposure or environmental pollution related to building components containing lead coatings or lead products. Impacts to lead that may be required by the Work include, but are not limited to; product installation, manual demolition, mechanical demolition, cutting, sawing, drilling, sanding, scraping, welding or torch-cutting. Confirm required impacts with other applicable specification sections and drawing sheets. In addition, provide all infection controls and engineering controls per contract requirements.

d. Work impacting lead/metals-containing painted coatings and lead/metals-containing items and products within this contract is the responsibility of the Contractor, and all affected Sub-Contractors, and shall be performed in accordance with all applicable local, state and federal regulations.

3. Polychlorinated Biphenyls (PCBs)

a. PCB-containing light ballast or leaking ballasts were not identified at the project site.

e. Representative light ballasts inspected were found to be labeled “No PCBs” or the electronic types without suspect potting compound. However, all magnetic ballasts
not marked (unlabeled) or labeled with “No PCBs” must be segregated and recycled through the Owner as they may contain PCBs in low concentrations. As part of the scope of the project, contractor is to inspect light fixtures and individual ballast (magnetic devices for suspect potting compound regardless of labeling) during demolition activities for proper handling and disposal/recycling.

f. Contractor is responsible for handling, removal, and proper storage of magnetic ballasts for Owner disposal in accordance with applicable local, state and federal regulations and these Specifications. Remove all magnetic ballasts (labeled or unlabeled with “No PCB”) as part of the scope for proper disposal by Owner.

g. Provide U.S. Department of Transportation approved 55-gallon drums (with approved lid) and deposit all removed ballast into containers.

h. Drummed ballast will be disposed-off or recycled by Owner through the UW Environmental Program Office (EPO) as a state regulated waste.

i. Prevent damage to any unlabeled ballasts and immediately report any leaking ballasts to the Owner’s Representative.

j. Submit for review a work plan to address handling and removal of PCB-containing light ballast (labeled and non-labeled) including all appropriate worker protection, environmental controls, and cleanup procedures.

4. Mercury

a. Fluorescent Lighting Tubes/Bulbs and Thermostats.

i. Work includes handling and removing of light tubes, compact bulbs, high-intensity discharge lamps and thermostats for Owner to properly dispose. Fluorescent lighting tubes/bulbs and thermostats may not be disposed of as construction debris because they contain mercury. Thermostats and whole/intact fluorescent and shall remain intact during handling, removal, storage, and transportation.

ii. Thermostats, whole fluorescent light tubes/bulbs and light ballast from the project on the Seattle campus are recycled through UW Recycling Program. Coordinate with the Owner’s representative for the recycling program. To initiate this process, the Owner will contact UW Recycling by calling the Recycle Information Line at 206.685.2811 or sending an email to recycle@u.washington.edu at a minimum one week prior to the scheduled removal of lamps.

iii. The Owner’s fluorescent tube recycling vendor will drop off and subsequently pick up the appropriate number of fiber drums at the project location on specified dates – coordinate with Owner for logistics. The project will be billed directly for tube recycling. Fluorescent tubes must be managed under the state Universal Waste rules. This means that all fluorescent tube drums must be labeled as Universal Waste (usually the recycling contractor does this, but it is the ultimate responsibility of the
Owner to label them). The drums must also be under the generator’s control at all times and must be stored at a covered or indoor site.

iv. Damaged and broken tubes/bulbs are disposed of as hazardous waste through the UW Environmental Program Office (EPO) as well. Contractor to provide to Owner for review their work plan to address handling and removal of light tubes and light ballast including all appropriate worker protection and environmental controls.

5. Refrigerants

a. Coordinate with the Owner prior to refrigerant-containing equipment altering work, demolition, installation and any refrigeration discharge activities.

b. All University air conditioning, chiller or refrigeration equipment (including removal of equipment) or installing new equipment, contractor shall notify the Facilities Services Refrigeration Shop Supervisor at (206) 685.8835 or (206) 543.3010 - UW Seattle main campus.

c. Submit to Owner a work plan for the demolition, decommissioning and dismantling of equipment that may contain refrigerants (chiller unit). All ozone-depleting refrigerants (CFC) including HCFCs and HFCs must be recovered from equipment and appliances prior to demolition or disposal. It is the responsibility of the contractor to ensure recovery machines, gauges and other recovery equipment shall meet the required standards for evacuation levels, hydrostatic testing dates, DOT guidelines, color coding, cylinder identification and pressure ranges per Section 608 of the Federal Clean Air Act.

d. Information about the contractor, company, agents and type of equipment to be removed or installed including who perform the work and their EPA certifications must be on file at the UW Refrigeration Shop before work begins. Notification forms are at https://www.washington.edu/facilities/fstech/node/609.

e. Spent refrigerants that cannot be reclaimed or recycled: these refrigerants are subject to all the applicable requirements of 173-303 WAC (Dangerous Waste Regulations) and must be treated as hazardous waste. UW EH & S Environmental Programs will handle such disposal.


8. Contaminated Lab P-Traps - Refer to Section 02 83 50 Lab Pipe Decommission


a. The purpose of the site specific safety plan (SSSP) is to inform workers of the unique characteristics of SARS-CoV-2 including common reference to the virus Covid-19 and to provide general guidelines for protecting workers, UW staff, visitors and the job site. As part of the scope the Contractor shall incorporate the best management work practice to prevent the spread of Covid-19 virus for this project and execute the safe work practices.
b. The mitigation plan and work practice submitted should incorporate by reference and not limited (including all amendments) of the University of Washington’s Project Delivery Group Covid-19 prevention guidance document, UW PDG Covid-19 construction project site guidance, April 9, 2020 and the Department of Labor and Industries, Division of Occupational Safety and Health (DOSH), General Coronavirus Prevention Under Stay Home - Stay Healthy Order Updated. And subsequent amendments, extensions, and clarifications, including the Implementation of Phase 1 Construction Restart – Proclamation 20-25 Addendum (4/24/2020) and associated guidance (e.g. DOSH F414-164 and F414-162).

c. Submit SSSP Covid-19 for Owner review: Such plans should have the minimum guidelines such as a Covid 19 site supervisor, Covid 19 symptoms, worker Covid 19 safety training, infection prevention measure, social distancing, worker screening, engineering controls to prevent spread of virus, PPE, sanitation and cleaning, employee health symptoms, reporting system for confirmed cases and corrective action such as contact tracing and decontamination and enhanced sanitizing of work areas, job hazard analysis if work task is within the 6 feet distancing and project documentation.

10. Silica and Fugitive Dust

a. Presumed silica-containing building materials such as in structural and finish assemblies of masonry walls and mortar, concrete slab (exterior walls, interior walls, floor, columns and ceiling assemblies), ceiling tiles and wallboard assemblies are present in the areas of work. Silica controls and risk assessment shall apply during concrete floor grinding or preparation of new floor finish and new wall assembly’s installation.

b. Contractor is responsible for proper handling, removal, storage, and proper recycling of silica-containing materials according to all applicable regulation, employee and environment protection. Refer other section for engineering requirements for dust and particulate controls during all work including demolition activities.

c. Construction activities including but not limited to floor preparation, grinding, chipping, drilling, sawing, cutting and jack hammering and other general construction or demolition require control of potentially airborne silica dust from contaminating the environment within the facility. Impact of these building materials with detectable concentrations of silica shall be performed according to Washington Labor and Industries regulations for Silica in Construction (WAC 296-840 and -841 Airborne Contaminants) including all applicable employee exposure assessment.

d. All employers of personnel performing work related to the above are to address the following information related to all tasks to be performed by their personnel. Provide for Owner review Work Safety Plan or Job Hazard Plan to address Silica in building materials to be impacted, including: worker training, personal protective equipment and engineering controls (to limit and control dust) to be implemented during the work, decontamination procedures, access restriction procedures and controlled/restricted areas, enclosures, debris clean-up procedures, worker exposure assessments and any related air monitoring.

11. Contaminated Soil Remediation – Not Used – Not in the Scope

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Not Used

2.2 EQUIPMENT
   A. Not Used

PART 3 - EXECUTION

3.01 WORK PERFORMED BY ENVIRONMENTAL CONSULTANT
   A. In addition to contractor’s ambient and personnel monitoring other necessary sampling such as post-remediation clearance, determination of hazardous and regulated materials or dangerous waste profiling for disposal may be performed by the Owner’s Environmental Consultant.

END OF SECTION
SECTION 02 83 50 – LAB P-TRAP DECOMMISSION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope Work: Purge and clean **All** laboratory waste plumbing and remove **ALL** laboratory P-traps associated with Lab sink drains and waste lab piping at the project site. Hazardous materials encountered during handling and cleaning activities of sink drain and lab waste plumbing may potentially include regulated metals (such as mercury), chemical residue, and hazardous substances listed in 29 CFR 1910 (Subpart Z). Owner will dispose of containerized p-traps.

1.2 RELATED SECTIONS

A. General Conditions, Modifications to the General Conditions, Supplemental Conditions to the General Conditions and Drawings, and other Divisions apply to this Section.

1.3 SUBMITTALS

A. Submit for review by the Owner and Environmental Consultant electronic documentation of a detailed Work Plan, which contains, at a minimum, with the following information:

1. Information related to the work procedures intended for use during handling of lab waste plumbing and p-traps, including protection of existing finishes, restriction of the work area, controls to prevent spillage and migration of drain contents, disposal of removed waste plumbing etc.

2. A description of worker protection to be used during plumbing and drain purging, pre-cleaning, including types of personal protective equipment (PPE), any respiratory protection and chemical/infection controls requirements, etc.

3. A description of procedures for waste handling, including location of materials to be stored for any period of time during laboratory analysis (to be completed by Owner's representative for waste disposal), security measures for stored materials, etc.

1.4 PERFORMANCE

A. Contractor shall implement the following procedures, in the order they are presented, during the performance of laboratory sink drain decommissioning:

1. Notify the Owner a minimum of ten calendar days prior to beginning Work covered by this Specification. The Owner will notify the Environmental Program Office (EPO) of the UW Environmental Health and Safety (EH&S) to obtain waste receptacles (containers) for both the liquid from the traps and drained product (solids) from lab waste plumbing.

2. Demarcate the work area with caution tape, warning signs, or the equivalent and restrict access to the work area to authorized personnel. Provide other safety controls per Owner requirements.

3. Workers shall wear protective clothing, eye protection, and gloves as appropriate to adequately protect employees per WAC 296-62, and WAC 296-841/842.

4. The Contractor shall utilize proper waste receptacles provided by UW EPO.
5. Respirators used shall be NIOSH/MSHA approved and comply with WAC 296-62 and WAC 296-841/842.

6. The cleaning of the sink drains and lab waste plumbing includes opening the traps and collecting any physical debris, including but not limited to solids, pipettes, sharps, glass, and bottle tops, for disposal.

7. The Contractor shall flush the sink drains and associated lab waste piping with adequate quantities of water and pressure to ensure the plumbing lines have been cleaned prior to adequately wiping the drains with appropriate rags.

8. Sink and drain p-traps, rags and waste product from purging of plumbing are to then be containerized in receptacles provided by UW EPO. UW EPO will then pick-up and ship the containers, bins or receptacles for proper disposal.

B. Proper temporary storage of the waste will be the responsibility of the Contractor.

C. The Contractor shall store drain traps and associated debris in the receptacles provided in the room where the water was generated. Drain traps and rags are to be stored in containers separate from the wastewater.

D. Containers are to be clearly labeled with the building name and room number, the type of waste, the date generated and the Owner’s project number.

E. Contractor shall handle drain traps, waste-water and rags on site in accordance with requirements of 40 CFR 262 and 40 CFR 265.

F. Contractor shall document accumulated time of storage, amount of material stored, use of proper containers, personnel training, and confirmation of the date the material is collected by UW EPO.

G. The Contractor may not store waste longer than 90 days, or the duration of the Contract, whichever is shorter.

H. The Contractor is responsible for complying with all applicable regulations for accumulating waste on-site.

I. All workers and any authorized personnel shall undergo a personal decontamination process prior to leaving the restricted area.

1.5 DISPOSAL

A. The Contractor shall notify the Owner for pickup, transport and disposal by UW EPO no later than 24 hours following completion of decommissioning and purging of lab waste plumbing and associated p-traps from sinks and drain lines.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Features

1. Cast-in-place structural concrete
2. Concrete mix design
3. Concrete placement procedures
4. Concrete finishing
5. Concrete curing
6. Repair of surface defects

B. Related Sections

1. 013300 – Submittal Procedures
2. 014523 – Structural Testing, Inspection, and Quality Assurance

1.2 REFERENCE STANDARDS

A. The latest versions of the publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

1. ACI 117 Standard Specification for Tolerances for Concrete
2. ACI 301 Standard Specifications for Structural Concrete, including other standards referred to in ACI 301, such as ASTM, etc.
3. ACI 305.1 Standard Specification for Hot Weather Concreting
4. ACI 306.1 Standard Specification for Cold Weather Concreting
5. ACI 308.1 Standard Specification for Curing Concrete

1.3 SUBMITTALS

A. General: Make submittals in accordance with Section 01330, "Submittal Procedures."

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

C. Concrete Mix Design Proportions: Submit concrete mixture proportions and characteristics. Submit the concrete mix design to the local building officials where required. Do not begin concrete production until concrete mix designs have been reviewed and approved. Mix designs
shall include proportions of all ingredients, including admixtures added at time of batching or at job site. Include the following:

1. Specify the locations for each mix design.
2. Specify the method used to determine proposed concrete mix design. Include field test records or trial mix test data used to establish the average compressive strength of the concrete mixture.
3. For aggregates, submit types, pit or quarry locations, producers’ names, gradings, specific gravities, certification, and evidence not more than 90 days old demonstrating compliance with this specification. Aggregate weights shall be based upon saturated surface dry conditions. Include concrete mix gradation of fine and coarse aggregates.
4. For admixtures, submit types, brand names, producers, manufacturer’s technical data, and certification data.
5. Submit the cement type and certification, fly ash type and certification, water/cementitious materials ratio, and source of water supply.
6. Submit the slump.
7. Submit the air content of freshly mixed concrete.
8. Submit the concrete compressive strength at 7, 28, and 56 days. The 56 day strength is required only when specified in the Concrete Mix Specification Table in the General Notes.
9. Submit the chloride ion content of concrete.
10. Submit the fibrous reinforcing type, fiber length, dosage rate, and dosage procedures.

D. Curing Methods: Submit written methods, procedures, and products for curing of all concrete.

E. Repair Methods: Submit the proposed methods of repair, along with repair material specification, manufacturer’s data on the proposed patching material, and the proposed preparation and application procedure.

F. Construction Joints: Submit information for acceptance of proposed location and treatment of construction joints proposed but not indicated on the Construction Documents.

G. Qualification of Finishers: Submit qualifications of the finishing contractor and the finishers who will perform the Work.

H. Matching Sample Finish: When required by Contract Documents, submit sample finish.

I. Exposed-Aggregate Surface: When an exposed-aggregate surface is specified and a chemical retarder is proposed, submit specification and manufacturer’s data for the retarder and the proposed method of use.
J. Records: Retain records of all concrete poured, including exact mix proportions, slumps, test strength, date, time, location of the placement, weather conditions at time of placement, and the source of concrete. Submit copy to Owner’s Representative and Building Official.

1.4 QUALITY ASSURANCE

A. The Contractor is responsible for correcting Work that does not conform to the specified requirements, including strength, tolerances, and finishes. The Contractor shall submit the proposed solution for review and approval.

B. Unless otherwise noted, maintain the allowable tolerances in ACI 117.

C. Maintain records verifying materials used are of the specified and accepted types and sizes and are in conformance with the Contract Documents.

D. Special Inspection and Testing: Concrete work is subject to special inspection and testing as specified; notify the Testing Agency at least 48 hours before inspection is required.

E. Single Source Responsibility: Provide materials for concrete work made or produced from a single source of supply; no mixing of brands or types of cement will be allowed; no substitution of aggregate type or size from those approved will be permitted.

F. Concrete Contractor Qualifications: An experienced concrete contractor who has completed concrete Work 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.

G. Concrete Producer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94. Producer must be certified according to the National Ready Mixed Concrete Association’s Certification of Ready Mixed Concrete Production Facilities.

H. Pre-Construction Conference: At least 30 days prior to start of concrete work, the Contractor shall hold a meeting to review the finish appearance requirements, reveal locations, joint spacings, concrete design mixes, requirements for submittals, construction procedures, schedules for testing, inspection, and certifications.

1. Notify attendees 10 days prior to the scheduled date of the meeting.

2. Required in attendance:
   a. Contractor and Subcontractors
   b. Testing Laboratory representative
   c. Concrete subcontractor
   d. Ready-mix producer
   e. Architect/Engineer
   f. All subcontractors with work to be installed in or affected by concrete work
1.5 DELIVERY, STORAGE, AND HANDLING

A. Cementitious Materials: Store cementitious materials in dry, weather-tight buildings, bins, or silos that will exclude contaminants.

B. Aggregates: Store and handle aggregate in a manner that will avoid segregation and prevent contamination with other materials or other sizes of aggregates. Store aggregates to drain freely. Do not use aggregates that contain frozen lumps.

C. Admixtures: Protect stored admixtures against contamination, evaporation, or damage. Protect liquid admixtures from freezing and from temperature changes that will adversely affect their characteristics. Store and handle products in a manner to retain original quality. Do not use products stored beyond the manufacturer’s recommended shelf life.

D. Delivery of Materials: Deliver site applied materials, such as joint and curing materials, in original factory packaging and unopened containers and protect from damage and contamination.

E. Place concrete within the time limits specified. Concrete shall possess the specified characteristics in the freshly mixed state at the point of placing.

1.6 WARRANTY

A. Project Warranty: Refer to Condition of the Contract for project warranty provisions.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by an authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under the contract documents.

1. Performance Warranty: Provide warranty to repair water leakage through industry-accepted and approved means such as epoxy injection.

2. Warranty Period: 10 years commencing upon date of acceptance of building occupancy by Owner.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cementitious Materials:

1. Portland Cement: Portland cement shall conform to ASTM C150, Type I or Type II.

   a. The cement shall be of the same brand and type and from the same plant of manufacture as the cement used in the concrete represented by the submitted field test records or used in the trial mixtures.

   b. For architectural concrete, use one brand of cement throughout project, unless otherwise acceptable to the Architect.

   c. Type III cement may be used for cold weather construction.
2. Fly Ash: Pozzolanic mineral admixture conforming to ASTM C618, Class F. Use fly ash from one single source for the whole project. When fly ash is used, the maximum amount shall be 30% by weight of the total cementitious materials, unless otherwise noted in the Construction Documents.


B. Aggregate: Aggregates and aggregate grading requirements shall conform to ASTM C33. Aggregates shall be free from any substance that may be deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of the concrete. Aggregates used in concrete shall be obtained from same sources and have the same size ranges as the aggregates used in the concrete represented by submitted historical data or used in trial mixtures.

C. Admixtures: The use of admixtures shall be the responsibility of the Contractor. When more than one admixture is used in the mix, furnish satisfactory evidence to the Architect that the admixtures to be used are compatible in combination with the cement and aggregates. Provide only one brand of each type of admixture. Accelerating admixtures shall not be used. Unless approved by the Architect, admixtures shall be free of calcium chloride and thiocyanate (not more than 0.05% chloride ions). The following types of admixtures are approved:


D. Water: Water shall be in conformance with ASTM C94.

2.2 RELATED MATERIALS

A. Dissipating Resin Curing Materials: Liquid type membrane-forming curing compound complying with ASTM C309, Type I. Curing compound must be of a type that does not inhibit subsequent moist curing operations. The film shall chemically break down in a 6- to 8 week period and shall not affect adhesion of coverings or membranes. Acceptable products are Burke "RES X Curing Compound," Euclid Chemical Co. "Kurez DR," Dayton "Day-Chem Rez Cure (J 11 W)," or approved equal.

B. Cure and Seal Combination Materials (Exposed Interior Concrete Slabs, including Garage Slabs): Use curing and sealing compounds that conform to ASTM C309 (Types 1 and 1D, Class B) or ASTM 1315. Acceptable products are Master Builders "Acryseal," Euclid Chemical Co. "Rez-Seal," Sonneborn "Kure-N-Seal," or approved equal. Cure and seal material for use in parking garages must resist de-icing chemicals.

C. Moisture Retaining Cover: Use waterproof sheet materials that conform to ASTM C171.
D. High Density Insulation Fillers: Extruded polystyrene foam insulation complying with ASTM C578, Type VII.

E. Commercial Bonding Grout and Repair Materials: Use products in accordance with manufacturer's recommendations. Products include, but are not limited to, the following:

1. Portland-cement mortar modified with a latex acrylic, non re-emulsifiable bonding agent conforming to ASTM C1059 Type II. Acceptable products include Euclid Chemical Co. "Flex-Con," Dayton "Day-Chem Ad Bond (J 40)," or approved equal.

2. Epoxy mortars and epoxy compounds that are moisture-insensitive during application and after curing and that embody an epoxy binder conforming to ASTM C881. The type, grade, and class shall be appropriate for the application as specified in ASTM C881.


2.3 PROPORTIONING AND DESIGN REQUIREMENTS OF CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete by Field Experience Method or, if not available, by Laboratory Trial Batch Methods as specified in ACI 301. Mix proportions shall produce consistent and workable concrete that can be worked readily into forms and around reinforcement without segregation or excessive bleeding.

1. Field Experience Method: If field test data is available, in accordance with ACI 301, submit for acceptance the mixture proportions along with the field test data. The mix design shall be pre-approved by the City of Renton or Seattle Building Department in accordance with DPD Director's Rule 27 87.

2. Trial Batch Method: Use an independent, qualified Testing Facility for preparing and reporting proposed mix designs. All expenses connected with such testing and submittals shall be borne by the Contractor.

B. Concrete Mixes: Provide concrete mixes conforming to the requirements as indicated in the Structural Drawing General Notes.

1. Strength Requirements: Compressive strength requirements are indicated on drawings and are based on cylinder tests at indicated age. Concrete made with high-early strength cement shall have a 7 day strength equal to the specified 28 day strength for concrete made with Type III Portland cement.

2. Cement Content for Slabs: Not less than those indicated in ACI 301.

3. Water/Cementitious Material Ratio: Not to exceed limits indicated on Structural drawings.
4. **Air Entrainment:** Use air entraining admixture in exterior exposed concrete as indicated on the Structural drawings.

5. **Slump:** The Contractor shall determine slump. Each concrete mix submitted shall have the slump specified. Slump tolerances shall meet the requirements of ACI 117.

6. **Admixtures:** Concrete may contain admixtures, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete. When admixtures are specified or required for workability for particular parts of the Work, use the types specified.

7. **Chloride Ion:** Maximum water soluble chloride ion concentrations in hardened concrete at ages 28 to 42 days contributed from the ingredients, including water, aggregates, cementitious materials and admixtures, shall not exceed a maximum, by weight of cement, of 0.06% for prestressed concrete and 0.30% for other concrete.

C. **Adjustment to Concrete Mixes:** Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to the Owner. New field data, data from new trial mixtures, or evidence that indicates that the change will not adversely affect the relevant properties of the concrete shall be submitted for acceptance before use.

**PART 3 - EXECUTION**

3.1 **PREPARATION**

A. Do not place concrete until the Architect approves all required submittals.

B. Remove snow, ice, frost, water, and other foreign materials from form surfaces, reinforcement, and embedded items against which concrete will be placed.

C. Place concrete on properly prepared and unfrozen sub-grade or forms and only in dewatered excavations and forms.

D. Do not allow mud or foreign materials into the concrete during placement operations.

E. When the ambient temperature necessitates the use of cold or hot weather concreting, make provisions in advance of concrete placement.

F. Do not begin placing concrete when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing.

G. Do not begin placing concrete while rain, sleet, or snow is falling unless adequate protection is provided. Do not allow rainwater to increase mixing water or to damage the surface of the concrete.

3.2 **JOINTS**

A. **Construction Joints:** Locate construction joints as indicated on the structural drawings or as approved by the Architect. Remove laitance and thoroughly clean and dampen construction joints prior to placement of fresh concrete.
B. Bonded Construction Joints: Coat concrete joined with new concrete, including topping, with a concrete bonding compound. Mix and apply in strict accordance with manufacturer’s recommendations for the conditions of the application. Concrete surfaces to which other concrete is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete; remove all laitance and loose particles.

C. Control Joints in Slabs-on-Ground: Construct control joints in slabs-on-ground to form panels of patterns as approved. Use inserts 1/4 inch wide x 1/4 of slab depth. Where saw-cut joints are required or permitted, start cutting as soon as concrete has hardened sufficiently to prevent dislodgment of aggregates. Saw a continuous slot to a depth of 1/4 the slab thickness, but not less than 1 inch. Complete sawing within 12 hours after placement. If an alternative method, timing, or depth is proposed for saw cutting, submit detailed procedure plans for review and acceptance.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

1. Embedded items include, but are not limited to, expansion joints, joint fillers, waterstops, anchor bolts, embedded plates, dovetail anchor slots, etc.

2. Items shall be free of oil, loose scale, rust, etc.

3. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent the entry of concrete into the voids.

4. Do not embed aluminum in concrete, except where the aluminum is protected from direct contact from the concrete.

3.4 CONCRETE DELIVERY

A. Ready Mix Concrete: Comply with requirements of ASTM C94 and as herein specified.

1. Elapsed time from start of batching at plant to completed discharge at job site shall not exceed 90 minutes or more than 300 revolutions, whichever comes first after introducing mixing water.

2. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 90 minutes to 75 minutes. When air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

3. The concrete temperature shall be monitored in the truck. A rise in temperature of 5°F within 10 minutes or less indicates concrete setting has started before discharge and the load shall be rejected.

4. Ready-Mix Concrete: Provide certificate signed by authorized official of supplier with each load of concrete, stating the following:

   a. Time truck left plant
b. Mix of concrete

c. Amount of water and cement in mix

d. Amount and type of admixtures

e. Time truck is unloaded at site

f. Additional water amount allowed at the project site

g. A truck without batch tickets will be rejected.

B. Control of Mixing Water: Water may be added once to increase the slump of the concrete within the first 15 minutes after the truck arrives at the job-site, provided the following requirements are adhered to:

1. The specified slump and maximum allowable water/cement ratio is not exceeded.

2. The Independent Testing Agency is present to monitor the amount of water added to compare with the amount of water added at the plant. Testing Agency shall keep written record of the amount of water added at the job site to each truckload delivered.

3. The drum shall be turned an additional 30 revolutions, or more if necessary, until the added water is uniformly mixed into the concrete.

4. Water shall not be added to the batch after the taking of test cylinders, unless new test cylinders are taken at the expense of the Contractor.

5. Do not add water to concrete after adding high-range water-reducing admixtures to mix.

C. Admixtures: Add admixtures within an accuracy of 3%. Where two or more admixtures are used in the same batch, they shall be added separately and must be compatible. Approved admixtures must be added at the appropriate time in strict compliance with manufacturer’s directions. Concrete that shows evidence of total collapse or segregation caused by the use of admixtures shall be removed from the site.

3.5 CONCRETE PLACEMENT

A. Pre-Placement Inspection: Before concrete placement operation begins, perform the following procedures:

1. Inspect and complete formwork installation and all reinforcing, and embed items. Notify other crafts to permit installation of their work.

2. Ensure that the reinforcing will be maintained in the proper position during concrete placement operations.

3. Moisten wood forms immediately before placing concrete where form coatings are not used.
4. At topping slabs, thoroughly saturate base slab just prior to placing topping, but do not leave pools of water.

5. Verify all dimensions and elevations.

6. Verify that site conditions are acceptable for placement of waterproofed concrete.

7. Do not proceed with concrete placement until conditions unacceptable to the concrete waterproofing manufacturer’s on-site representative are corrected.

B. Conveying: Methods of conveying concrete is the responsibility of the Contractor. Convey concrete from mixer to the place of final deposit rapidly by methods that prevent segregation or loss of ingredients and that will ensure the required quality of concrete. Do not use aluminum pipes or chutes. Use acceptable conveying equipment of a size and design that will prevent cold joints from occurring. Clean conveying equipment before each placement.

1. Provide runways or other means for wheeled equipment to convey concrete to deposit points. Do not run wheeled equipment used to deposit concrete over reinforcement; do not support runways on reinforcement.

2. Belt Conveyors: Use belt conveyors that are horizontal or at a slope that will not cause excessive segregation or loss of ingredients. Protect concrete to minimize drying and effects of temperature rise. Use an acceptable discharge baffle or hopper at the discharge end to prevent segregation. Do not allow mortar to adhere to the return length of the belt.

3. Chutes: Use metal or metal-lined chutes having rounded bottoms and a slope between 1:2 and 1:3 (vertical:horizontal). Chutes more than 20 feet long and those not meeting slope requirements may be used, provided they discharge into a hopper prior to distributing into the forms.

4. Pumping or Pneumatic Conveying: Use pumping conveying equipment that permits placement rates that avoid cold joints and prevent segregation in discharge of pumped concrete. In addition:

   a. Pipeline shall be steel pipe or heavy-duty flexible hose.
   
   b. Inside diameter of the pipe shall be at least three times the maximum size of the coarse aggregate.
   
   c. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer.
   
   d. Provide continuous supply of concrete to the pump.
   
   e. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place.

5. Cleaning: Do not discharge rinse water into forms or areas to receive concrete.
C. Depositing: Deposit concrete continuously in one layer, or in multiple layers if the fresh concrete is deposited on in-place concrete that is still plastic. Do not deposit fresh concrete on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joint as specified. Deposit concrete as near to its final location as practicable to avoid segregation. In addition:

1. There shall be no vertical drop greater than 3 feet, except where suitable equipment is provided to prevent segregation and where specifically authorized.
2. Do not use concrete that has surface-dried or partially hardened or that contains foreign material.
3. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs.

D. Consolidating: Consolidate concrete by vibration. Thoroughly work concrete around reinforcement and embedded items and into corners of forms, eliminating air and stone pockets that may cause honeycombing, pitting, or planes of weakness.

1. Workers shall be experienced in use of the vibrators.
2. Vibrators shall have a frequency of not less than 8,000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mix being placed. A spare vibrator shall be kept at the job site during all concrete placing operations.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniform spacing over the area of placement; distance between insertions shall be approximately 1 1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just vibrated area by a few inches. Do not place vibrators within 2 1/2 inches of form face.
4. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set; if there is a delay of more than 15 minutes, vibrate previous lift prior to placing the new concrete. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix. Withdraw vibrators slowly.
5. Consolidation of slabs shall be obtained with vibrating screeds, rolling pipe screeds, or internal vibrators.

E. Re-tamping of concrete that has taken its initial set is not allowed.

F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as specified herein.

1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators.

G. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305.1 and as specified herein. Loss of slump, flash set, or cold joints due to temperature of concrete as placed will not be acceptable.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.

2. When temperature of steel reinforcement, embedments, or forms is greater than 120°F, fog steel reinforcement, embedments, and forms with water immediately before placing concrete. Remove standing water before placing concrete.

3. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, if approved by the Architect.

3.6 CONCRETE CURING AND PROTECTION

A. General: Cure concrete in accordance with the Curing Methods noted below for a minimum of 7 days after placement. Cure high-early strength concrete for a minimum of 3 days after placement. The materials and methods of curing shall be subject to acceptance.

B. Protection: Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Protect concrete during the curing period such that the concrete temperature does not fall below requirements of ACI 306.1. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and to ensure the necessary strength development for structural safety.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing, or as soon as marring of the concrete will not occur.

2. Begin final curing procedures immediately following initial curing and before concrete has dried. Avoid rapid drying at end of final curing period. Upon completion of curing cycle on slabs, withdraw water at a gradual rate over an additional 7 days.

3. Monitor the curing operations as required to ensure the concrete surfaces remain fully wetted and that cover materials are not displaced during the full curing period; at a minimum, the curing method shall be checked every 8 hours, including Saturdays, Sundays, and holidays.
4. Additional Curing Periods: When the 7 day compression test cylinders, representative of parts of a structure already placed, indicate that the 28 day strengths may be less than 85 percent of the design strengths, give those parts of the structure additional curing.

C. Curing Unformed Concrete Surfaces: Apply one of the Curing Methods after completion of placement and finishing of concrete surfaces not in contact with forms.

D. Curing Formed Concrete Surfaces: Keep absorbent wood forms wet until they are removed. After formwork removal, cure concrete by one the Curing Methods.

E. Curing Methods: After placing and finishing, use one or more of the following methods to preserve moisture in concrete. When one of the curing procedures is used initially, the curing procedure may be replaced by one of the other procedures when concrete is 1 day old, provided the concrete is not permitted to become surface-dry at any time.

1. Ponding, continuous fogging, or continuous sprinkling
2. Application of mats or fabric kept continuously wet
3. Continuous application of steam (under 150°F)
4. Application of sheet materials conforming to ASTM C171
5. Application of a curing compound conforming to ASTM C309 or C1315 (note permitted for exposed floor slabs, including the hangar floor slab)
   a. Apply the compound in accordance with manufacturer’s recommendation as soon as water sheen has disappeared from the concrete surface and after finishing operations. The application rate shall not be less than 1 gallon per 200 square feet.
   b. For rough surfaces, apply curing compound in two applications at right angles to each other. The material applied in each coat shall not be less than 1 gallon per 200 square feet.
   c. Do not use curing compound on any surface where concrete or other material will be bonded unless the curing compound will not prevent bond or unless measures are to be taken to completely remove the curing compound from areas to receive bonded applications.
   d. Curing compound may be used on concrete that is to receive resilient flooring, carpet, sand cushion terrazzo, and wood flooring, unless otherwise required by finish treatment manufacturer. Provide written certification from the finish floor treatment manufacturer as previously specified.
   e. The Contractor shall be responsible for removing any traces of the dissipating curing compound that remains on the substrate prior to applying subsequent floor finish. This shall include, but is not limited to, removing the curing compound using power scrubbers and industrial strength detergents and using fresh water to remove the detergents. Comply with any additional instructions and
recommendations of the manufacturer whose products are to be applied directly over concrete slab.

### 3.7 CONCRETE SURFACE REPAIRS

**A. General:** All surface defects shall be reported to the Architect.

**B. Repair of Formed Surfaces:** Remove and replace concrete having defective surfaces if defects cannot be repaired to the satisfaction of the Owner’s Representative. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins, stains, and other discolorations that cannot be removed by cleaning.

1. Repair concealed formed surfaces that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace the concrete.

2. Repair tie holes and surface defects immediately after formwork removal. Where the concrete surface will be textured by sandblasting or bush-hammering, repair surface defects before texturing.

**C. Repair of Unformed Surfaces:** Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects include crazing, cracks in excess of 0.01 inch wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop outs, honeycomb, rock pockets, and other objectionable conditions.

1. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope.

2. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Architect.

**D. Repair of Tie Holes:** Plug tie holes except where stainless steel ties, non-corroding ties, or acceptably coated ties are used. When Portland cement patching mortar is used for plugging, clean and dampen tie holes before applying the mortar. When other materials are used, apply them in accordance with manufacturer’s recommendations.

**E. Repair of Surface Defects:** Outline honeycombed or otherwise defective concrete with a 1/2- to 3/4 inch-deep saw cut and remove such concrete down to sound concrete. When chipping is necessary, leave chipped edges perpendicular to the surface or slightly undercut. Do not feather edges. Dampen the area to be patched, plus 6 inches around the patch area perimeter. Prepare bonding grout and thoroughly brush grout into the surface. When the bond coat begins to lose water sheen, apply patching mortar and thoroughly consolidate mortar into place. Strike off mortar, leaving the patch slightly higher than the surrounding surface to permit initial shrinkage. Leave the patch undisturbed for 1 hour before finishing. Keep the patch damp for 7 days.
F. Removal of Stains: Remove stains, rust, efflorescence, and surface deposits considered objectionable by the Owner's Representative by acceptable methods.

G. Site-Mixed Repair Materials

1. Bonding Grout: Mix approximately 1 part cement and 1 part fine sand with water to the consistency of thick cream.

2. Repair Mortar: Mix repair mortar using the same materials as concrete to be patched with no coarse aggregate. Do not use more than 1 part cement to 2 1/2 parts sand by damp loose volume.

   a. For repairs in exposed concrete, make a trial batch and check color compatibility of repair material with surrounding concrete. Blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding.

   b. Use repair mortar at a stiff consistency with no more mixing water than is necessary for handling and placing. Mix repair mortar and manipulate the mortar frequently with a trowel without adding water.

H. Commercial Repair Products: Acceptable commercial repair products other than site-mixed repair materials may be used for repair, as specified in Part 2. Use repair products in accordance with manufacturer's recommendations.

PART 4 - END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Liquid-applied self-leveling floor underlayment:

1.2 RELATED REQUIREMENTS

A. 01 25 00 - Substitution Procedures.
B. 01 31 00 - Project Management and Coordination: for administrative requirements.
C. Division 9 Flooring sections.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 00 Project Management and Coordination.
   1. Review preparation and installation procedures, and coordinating and scheduling required with related work.

1.4 SUBMITTALS

A. Qualification Data: For installer.
B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.
   1. Installer shall be listed with the manufacturer as a having special skill in this work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

1.7 FIELD CONDITIONS

A. Do not install underlayment until floor penetrations and peripheral work are complete.
B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during, and 72 hours after installation of underlayment.
C. During the curing process, ventilate spaces to remove excess moisture.

1.8 REGULATORY REQUIREMENTS

A. Conform to applicable code for combustibility or flame spread requirements.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of underlayment materials in the required fire rated assembly.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Where specified floor flatness tolerances are not achieved, or where defects unacceptable to the finish flooring installer are present, use the work of this section to remedy such work.

2.2 MATERIALS

A. Gypsum-Cement-Based:
   1. Basis of Design: Ardex Engineered Cements ARDEX GS-4 or approved equal.
   2. Comparable products by the following:
      c. USG Corporation; Levelrock 2500.
   3. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.3 ACCESSORIES

A. Aggregate:
   1. Dry, well graded, washed silica aggregate, approximately 1/8 inch in size and acceptable to underlayment manufacturer.

B. Reinforcement:
   1. Galvanized metal lath complying with recommendations of underlayment manufacturer for specific project circumstances.

C. Water:
   1. Potable and not detrimental to underlayment mix materials.

D. Primer:
   1. Manufacturer's recommended type.

E. Joint and Crack Filler:
   1. Cementitious type recommended by manufacturer.
2.4 MIXING

A. Site mix materials in accordance with manufacturer's instructions.

B. Add aggregate for areas where thickness will exceed 1/2 inch. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.

C. Mix to self-leveling consistency without over-watering.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.2 PREPARATION

A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.

B. Wood: Install metal lath for reinforcement of underlayment.


D. Vacuum clean surfaces.

E. Prime substrate in accordance with manufacturer's instructions.

F. Close floor openings.

3.3 APPLICATION

A. Install underlayment in accordance with manufacturer's instructions.

B. Pump or pour material onto substrate. Do not retemper or add water.
   1. Pump, move, and screed while the material is still highly flowable.
   2. Be careful not to create cold joints.
   3. Wear spiked shoes while working in the wet material to avoid leaving marks.

C. For final thickness over 1-1/2 inches, place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.

D. Place concrete floor topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.
   1. Screed surface with a straightedge and strike off to correct elevations.
2. Slope surfaces uniformly where indicated
3. Begin initial floating using bull floats to form a uniform and open-textured surface plane free of humps or hollows.

E. Place before partition installation.

F. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.

G. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.4 CURING

A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.

B. Air cure in accordance with manufacturer's instructions.

3.5 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.6 FIELD QUALITY CONTROL

A. An independent testing agency will perform field inspection and testing, as specified in Section 01 45 23.

B. Placed Material: Agency will inspect and test for conformance to specification requirements.

3.7 PROTECTION

A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.

B. Do not permit traffic over unprotected floor underlayment surfaces unless allowed in writing by manufacturer.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Miscellaneous metal fabrications.

1.2 RELATED REQUIREMENTS

A. 09 90 00 - Painting and Coating: Field applied paint finish.

B. 323113 - Chain Link Fences: for chain link fences with support framing and swinging gates.

1.3 SUBMITTALS

A. Qualification Data: For fabricator and design engineer.

B. Product Data: On all cleaning, galvanizing, and finishing products, including VOC content.

C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

D. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

E. Maintenance Data: For users operation and maintenance of system including:
   1. Methods for maintaining system's materials and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

A. Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.

B. Fabricators Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172). Company specializing in performing the work of this section with minimum 5 years' experience on projects of similar size and complexity.

1.5 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Items designed and shop fabricated out of steel and aluminum sections, tubing, plates and pipe for exposed and concealed locations.

2.2 MATERIALS

A. Steel:
   1. Steel Sections:
      a. ASTM A36/A36M.
   2. Steel Tubing:
      a. ASTM A500/A500M, Grade B cold-formed structural tubing.
   3. Plates:
      a. ASTM A283/A283M.
   4. Pipe:
      a. ASTM A53/A53M, Grade B Schedule 40, black finish.
   5. Slotted Channel Framing:
      a. ASTM A653/A653M, Grade 33.
   6. Slotted Channel Fittings:
      a. ASTM A1011/A1011M.
   7. Fasteners:
      a. To suit application. Unless noted otherwise, match fasteners exposed to view with the material and color/finish of the material being fastened if metal; color and finish if not metal. Fasteners not exposed to view: Galvanized steel unless otherwise noted.
   8. Bolts, Nuts, and Washers:
      a. ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
   9. Welding Materials:
      a. AWS D1.1/D1.1M; type required for materials being welded.
   10. Touch-Up Primer for Galvanized Surfaces: See Section 09 90 00.

B. Stainless Steel:
   1. Stainless-Steel Sheet, Strip, and Plate:
      a. ASTM A240/A240M or ASTM A666, Type 304.
   2. Tubing:
      a. ASTM A554, Grade MT 304.
3. Pipe:
   a. ASTM A312/A312M, Grade TP 304.
4. Castings:
   a. ASTM A743/A743M, Grade CF 8 or CF 20.
5. Stainless-Steel Bars and Shapes:
   a. ASTM A276/A276M, Type 304.
6. Rolled-Stainless-Steel Floor Plate:
   a. ASTM A 793.
7. Stainless-Steel Bolts and Nuts:
   a. Regular hexagon-head annealed stainless-steel bolts, ASTM F593; with hex nuts, ASTM F594.

C. Aluminum:
1. Extruded Aluminum:
   a. ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
2. Sheet Aluminum:
   a. ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
3. Aluminum-Alloy Drawn Seamless Tubes:
   a. ASTM B210 (ASTM B210M), 6063 alloy, T6 temper.
4. Aluminum-Alloy Bars:
   a. ASTM B211 (ASTM B211M), 6061 alloy, T6 temper.
5. Aluminum-Alloy Sand Castings:
   a. ASTM B26/B26M.
6. Aluminum-Alloy Die Castings:
   a. ASTM B85/B85M.
7. Bolts, Nuts, and Washers:
   a. Stainless steel.
8. Welding Materials:
   a. AWS D1.2/D1.2M; type required for materials being welded.

D. Fabricated Materials:
1. Items listed below and as noted on the drawings or as required for complete installation:
   a. Ledge Angles, Shelf Angles, Channels, Backing Plates and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
   b. Anchor bolts, steel pipe, cast in masonry anchors, pipe protection.
2. Slotted channel framing complying with ASTM A653/A653M, grade 33, and slotted channel fittings complying with ASTM A1011/A1011M.
2.3 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Glazing Clips: Spacing, attachment, placement analysis and engineering to be confirmed by manufacturer.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

2.5 FINISHES

A. Steel:

1. Prime paint all painted steel items.
   a. Exceptions:
      1) Galvanize items to be embedded in concrete or masonry.
      2) Galvanize items specified for galvanized finish.
      3) Do not prime surfaces indicated for spay fire proofing, weathering steel or blackened steel finish.
      4) Field welding is required.

   b. See Section 09 90 00 - Painting and Coating for field finish painting.

2. Prime Painting: One coat.
3. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

4. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

5. Powder Coating: See Section 05 05 13 Shop-Applied Coatings for Metal.

2.6 ACCESSORIES

A. All accessory materials required by the fabricator for a complete installation of the installed products in a manner that meets the Performance and Design Criteria.

B. Non-Weld Mechanical Fittings: Slip-on, fabricated fittings, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

C. Welding Fittings:
   1. Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.

D. Sealant: Silicone; black.

E. Finish Touch-Up Materials: As recommended by manufacturer for field application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.3 INSTALLATION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.4 PROTECTION

A. Protect installed work as required by the fabricator to maintain finishes, product performance, design criteria, and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Roof-mounted curbs.
B. Roofing nailers.
C. Preservative treated wood materials.
D. Communications and electrical room mounting boards.
E. Miscellaneous wood nailers, furring, and grounds.

1.2 RELATED REQUIREMENTS

A. 05 50 00 - Metal Fabrications: Miscellaneous steel connectors and support angles for rough carpentry.
B. Structural Notes: For additional requirements.

1.3 SUBMITTALS

A. Qualification Data: For fabricator.
B. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualification: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
B. Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
B. Preservative Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.
1.6 WARRANTY

A. Installation Warranty: Contractor shall correct defective Work within a 2 year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

B. Manufacturer Warranty: Provide five year warranty for waterproofing failing to resist penetration of water.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Provide miscellaneous rough carpentry items including fire retardant treated wood materials, preservative treated wood materials, roof-mounted curbs, miscellaneous wood nailers, furring, and grounds.

2.2 MATERIALS

A. Lumber, General:
   1. Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by the American Lumber Standards Committee's (ALSC) Board of Review. Provide dressed lumber, S4S, with each piece factory marked with grade stamp of inspection agency.

B. Wood-Preservative-Treated Materials:
   1. Comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review. Dimension Lumber: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated. Refer to Structural "General Notes" located in the Drawings.

C. Miscellaneous Lumber:
   1. Provide No. 3 or Standard grade lumber of any species for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, and similar members.

2.3 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B. Fasteners and Anchors:
   1. Metal and Finish: Stainless steel for exterior, high humidity or preservative-treated wood locations, unfinished steel elsewhere.

C. Sill Flashing:
   1. Sill Flashing: As specified in Section 07 62 00 - Sheet Metal Flashing and Trim.
PART 3 - EXECUTION

3.1 EXAMINATION

A . Verify existing conditions meet the manufacturer’s requirements before starting work.

3.2 PREPARATION

A . Prepare surfaces to receive work in accordance with manufacturer’s instructions.

3.3 INSTALLATION - GENERAL

A . Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.4 BLOCKING, NAILERS, AND SUPPORTS

A . In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

B . In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C . In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D . Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.5 ROOF-RELATED CARPENTRY

A . Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B . Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.6 INSTALLATION OF CONSTRUCTION PANELS

A . Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.

B . Subflooring: Glue and nail to framing; staples are not permitted.

C . Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. Size and Location: As indicated on drawings.
2. Paint all mounting boards. Leave one copy of fire treatment stamp visible (unpainted) for building inspector.

3.7 TOLERANCES

A. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.8 CLEANING

A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

B. Prevent sawdust and wood shavings from entering the storm drainage system.

3.9 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Finish carpentry materials.

1.2 RELATED REQUIREMENTS
   A. 06 10 00 - Rough Carpentry: for additional carpentry items.
   B. 09 90 00 - Painting and Coating: for field finish of finish carpentry items.

1.3 SUBMITTALS
   A. Qualification Data: For fabricator.
   B. Product Data:
      1. Provide data on fire retardant treatment materials and application instructions.
      2. Provide instructions for attachment hardware and finish hardware.
   C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
      1. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot.
      2. Provide the information required by AWI/AWMAC/WI (AWS) Architectural Woodwork Standards.
   D. Sample: Submit three samples of each type of wood exposed to view, 11 inches by width of board (or 8 inches max) inch in size illustrating wood grain and specified finish.
   E. Maintenance Data: For users operation and maintenance of system including:
      1. Methods for maintaining system's materials and finishes.
      2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE
   A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
      1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
      2. Single Source Responsibility: Provide and install this work from single fabricator.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. As required by the Quality Certification Program for installation of the installed products to meet the Performance and Design Criteria.
1.6 WARRANTY

A. Installation Warranty: Contractor shall correct defective Work within a 2 year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Wood frames, dimensional lumber and plywood, wall base, and other wood trim, moldings, bases, casings, and miscellaneous trim for doors, glazed lights, window sills, loose shelving. Carpentry items shop fabricated and finished in accordance with AWI/AWMAC/WI (AWS) Architectural Wood Work standards.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Finish Carpentry Items

1. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) Architectural Woodwork Standards for Custom Grade.
   a. Premium Quality for all transparent finished material
   b. Typical: Custom Quality.

2.3 MATERIALS

A. Interior Woodwork Items:

1. Molding:
   a. Profile and size to match existing adjacent molding.
   b. Finish: painted to match existing adjacent molding.
   c. Location: Hallway ceiling.

B. Lumber Materials:

1. Softwood Lumber: fir species, quarter sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.

C. Sheet Materials:

1. Softwood Plywood Not Exposed to View: Any face species, veneer core; PS 1 Grade A-B; glue type as recommended for application.
2. Softwood Plywood Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B; glue type as recommended for application.

D. Shop Finishing:

1. Sand work smooth and set exposed nails and screws.
2. Apply wood filler in exposed nail and screw indentations.
3. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

4. Finish work in accordance with AWI/AWMAC/WI (AWS) Architectural Woodwork Standards, Section 5 - Finishing for Grade specified and as follows:
   a. Transparent:
      1) Stain: As selected by Architect.
   b. Opaque:

5. Back prime woodwork items to be field finished, prior to installation.

E. Site Finishing:
   1. In accordance with Section 09 90 00 - Painting and Coating.

2.4 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the requirements of the quality standard specified before starting work.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with quality standard specified.

3.3 INSTALLATION

A. General: Install all materials in accordance with quality standard specified based on conditions present.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut to fit adjoining work. Refinish and seal cuts as recommended by quality standard.

2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32 inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

4. Install stairs with no more than 3/16 inch variation between adjacent treads and risers and with no more than 3/8 inch variation between largest and smallest treads and risers within each flight.
C. Install with trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

3.4 PROTECTION

A. Protect installed work as required by the quality standard to maintain product performance, design criteria, and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A . Acoustical Batt Insulation.

1.2 RELATED REQUIREMENTS

A . 09 21 16 - Gypsum Board Assemblies: For acoustic insulation installed as a component of assemblies.

1.3 SUBMITTALS

A . Qualification Data: For installer, manufacturer, and design engineer.

B . Product Data: Provide data on product characteristics, performance criteria, and product limitations.


D . Shop Drawings: Indicate required flashings, control joints, and expansion joints, and sealing details at openings, projections, penetrations, and sleeves to maintain continuous thermal barrier.

E . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

1. QUALITY ASSURANCE

A . Manufacturer Qualification: Company with a minimum of three years of experience manufacturing products of this type.

B . Installer Qualifications: Company specializing in performing the work of this section with minimum 2 years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Acoustical batt insulation.

2.2 MATERIALS

A. Fiber Batt Insulation:

1. Acoustic Batt Insulation: Mineral fiber flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   a. Basis of Design Manufacturer: CertainTeed.
   b. Other approved equal products by one of the following are also acceptable. See Section 01 25 00 - Substitution Procedures for submittal requirements.
   c. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.
   d. Performance Criteria:
      1) Combustibility: Non-combustible, when tested in accordance with ASTM E136.
      2) Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
      3) Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
      4) Thermal Resistance (R Value) at 40 degrees F/inch of thickness: 3.1.
   e. Features:
      1) Formaldehyde Free.
   f. Location: Walls (in cavity).

2.3 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.
3.2 PREPARATION
   A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION
   A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 PROTECTION
   A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vapor retarder.
B. PVC roofing membrane.
C. Walkway protection pad.

1.2 RELATED REQUIREMENTS

A. 06 10 00 - Rough Carpentry: Wood nailers, curbs and cant strips.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 10.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.
   2. Review UL, FM and Owner requirements for quality assurance and testing.

1.4 SUBMITTALS

A. Qualification Data: For Manufacturer and Installer.
B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
C. Shop Drawings: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
   1. Provide additional layer at dog run locations if required by manufacturer for warranty and performance.
D. Fire Classification Test Report: Showing test reports for classification, assembly, application and roof slopes indicated.
E. Installer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
F. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
H. Maintenance Data: For user's operation and maintenance of system including:
   1. Methods for maintaining system's materials and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years of documented experience in PVC roof membrane manufacture.

B. Installer Qualifications: Company specializing in performing the work of this section with a minimum five years of experience and approved by the manufacturer. Applicator shall have installed at least three (3) roofing applications of this type or similar (single-ply membrane) system of equal or greater size within the past three (3) years.

1.6 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.7 WARRANTY

A. Installation Warranty: Contractor shall correct defective Work within a 2 year period after Date of Substantial Completion.

B. Manufacturer Warranty: Provide 20 year manufacturer's Total Roofing System (no dollar limit) Warranty covering all materials incorporated into the roof and labor.
   1. Provide additional layer at dog run locations if required by manufacturer for warranty and performance.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Single ply polyvinyl chloride (PVC) membrane roofing system including vapor retarder and all manufacturer's required accessories for watertight, warrantable installation.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Fire Classification: Class B per ASTM E108 or UL 790; for application and roof slopes indicated.

B. Slope: Thermoplastic single-ply membrane roofs shall have a design slope of a minimum of one-fourth unit vertical in 12 units horizontal (2-percent slope).

C. Exposure Category: As indicated.
   1. ICC (IBC)-2015.1504.8 Maximum mean roof height table.

D. Nominal Design Wind Speed: As indicated.
1. ICC (IBC)-2015.1504.8 Maximum mean roof height table.

E. Wind Resistance: Roof coverings installed on roofs in accordance with Section 1507 that are mechanically attached or adhered to the roof deck shall be designed to resist the design wind load pressures for components and cladding in accordance with Section 1609.
   1. ICC (IBC)-2015.1504.3.
   2. Design Wind Load Pressure: As indicated.

F. Insulation Thermal Value (R), minimum: As indicated on Drawings; provide insulation of thickness required.

G. Perform work in accordance with NRCA Roofing and Waterproofing Manual, and manufacturer's instructions.

H. Detail roofing system as required by membrane manufacturer to attain required warranty and comply with performance criteria indicated.

I. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980.
   1. Requirement for white roofing only.
   2. Field applied coating may not be used to achieve specified SRI.

J. Thermal Emissivity: 0.80, minimum, initial, and 0.79, minimum, 3-year, certified by Cool Roof Rating Council.
   1. Requirement for white roofing only.

2.3 MATERIALS

A. Vapor retarder: Material approved by roof manufacturer complying with requirements of fire rating classification; compatible with roofing and insulation materials.
   1. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.
   2. Features:
      a. Approved by manufacture as part of tested assemblies.
      b. Approved by manufacture to be exposed without cover and use as temporary roof.

B. PVC roofing membrane:
      a. Comparable products by one of the following:
         1) UltraPly TPO by Firestone Building Products.
         2) Sure-Weld TPO by Carlisle Roofing Systems, Inc.
   2. Performance Criteria:
         1) ICC (IBC)-2015 1507.13.2.
b. Physical Integrity: Passes 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM G152, ASTM G155, or ASTM G154.
   1) ICC (IBC)-2015.1504.6.

c. Impact Resistance: Resist impact damage based on the results of tests conducted in accordance with ASTM D3746/D3746M, ASTM D4272/D4272M, CGSB 37-GP-52M, or the "Resistance to Foot Traffic Test" in Section 5.5 of FM 4470.
   1) ICC (IBC)-2015.1504.7.

3. Features:
   a. Thickness: 0.080 inch.
   b. Sheet Width: Factory fabricated into largest sheets possible.
   c. Reinforcing: Manufacturer's standard.
   d. Membrane Attachment: Fully adhered.
   e. Colors: Installed in pattern indicated.
      1) White.
      2) Gray.

C. Roof Walkway Protection Pad:
   1. Manufacturer's recommended product to increase viability and slip-resistance and puncture resistance in walkway areas.
      a. Basis of Design Product: As recommended by membrane manufacturer or the following:
         1) Firestone Protection Mat.
      b. Layout per Architectural Drawings.

2.4 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.

B. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with manufacturer's instructions.
3.3 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 FIELD QUALITY CONTROL

A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes.

B. Perform all corrections necessary for issuance of warranty.

3.5 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Penetration firestopping.
   B. Fire resistive joint systems.

1.2 RELATED REQUIREMENTS
   A. 09 21 16 - Gypsum Board Assemblies: For fire rated assemblies requiring firestopping.
   B. Divisions 21-28: For items typically penetrating fire rated assemblies requiring firestopping.

1.3 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 10 - Submittal Procedures.

1.4 SUBMITTALS
   A. Qualification Data: For manufacturer and fabricator.
   B. Product Data: Provide product criteria, characteristics, accessories, and jointing methods, and termination conditions.
   C. Shop Drawings: Indicate system design listing by UL, FM Research, Intertek Testing Services, Omega Point Laboratories (OPL).
      1. Where system design listing is not available for a particular configuration provide an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFERRA) for submittal
   D. Contractor Installation log.
   E. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
   F. Maintenance Data: For user's operation and maintenance of system including:
      1. Methods for maintaining system's materials.

1.5 QUALITY ASSURANCE
   A. Manufacturer of firestop products shall have been successfully producing and supplying these products for a period of not less than 3 years, and be able to show evidence of at least 10 projects where similar products have been installed and accepted.
   B. Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.
1.6 MOCKUP

A. Prior to installing firestopping, erect mockups for each different firestop system indicated to verify selections made and to demonstrate qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final installations.

1. Locate mockups on site in locations indicated or, if not indicated, as directed by Owner.

2. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging completed unit of Work. Accepted mockups in an undisturbed condition at time of Substantial Completion may become part of completed unit of Work.

1.7 WARRANTY

A. Installation Warranty: Contractor shall correct defective Work within a five year period after Date of Substantial Completion.

B. Manufacturer Warranty: Provide five year warranty for firestopping systems.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Interior Firestopping: Provide firestopping of all joints head of walls and penetrations in fire-resistance rated and smoke-resistant assemblies. Single source installer.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Penetrations: Provide firestopping systems that resist the spread of fire, and the passage of smoke and other gases according to requirements indicated:

1. Firestop all penetrations passing through fire resistance rated wall and floor assemblies and other locations as indicated on the drawings.

2. Provide complete penetration firestopping systems that have been tested and approved by third party testing agency.

3. F - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E814, but not less than one hour or the fire-resistance rating of the construction being penetrated.

4. T - Rated Through-Penetration Firestop Systems: Provide firestop systems with T ratings, in addition to F ratings, as determined per ASTM E814, where indicated by Code.

5. Provide T-Rating Collar Devices tested in accordance with ASTM E814 or ANSI/UL 1479 for metallic pipe penetrations requiring T-Ratings per the applicable building code.

6. L - Rated Through-Penetration Firestop Systems: Provide firestop systems with L ratings, in addition to F and T ratings, as determined per UL 1479, where indicated by Code.

7. W - Rated Through-Penetration Firestop Systems: Provide firestop systems with W Water Resistance ratings, in addition to F, T and L ratings, as determined per UL 1479, where indicated.
B. Perimeter Fire Containment Systems: Provide interior perimeter joint systems with fire-resistance ratings indicated, as determined per ASTM E2307, but not less than the fire-resistance rating of the floor construction.

C. Fire-Resistive Joints: Provide joint systems with fire-resistance ratings indicated, as determined per UL 2079, but not less than the fire-resistance rating of the construction in which the joint occurs.

D. For firestopping exposed to view, traffic, moisture, and physical damage, provide appropriate firestop systems for these conditions.
   1. Exposed to view firestopping must be paintable.

E. Firestop material must be able to be installed per manufacturers written instructions in temperatures ranging from 35 degrees F to 120 degrees F, and have the ability to be frozen, thawed and still comply with its UL designation and testing results.

F. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.

G. Movement:
   1. Provide firestop sealants and fire resistive joint sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
   2. Provide fire-resistive joint sealants designed to accommodate a specific range of movement and tested for this purpose in accordance with a cyclic movement test criteria as outlined in Standards, ASTM E-1399, ASTM E1966, or ANSI/UL 2079.

H. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.

I. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.

J. When mechanical cable pathways are not practical, openings within walls and floors designed to accommodate voice, data and video cabling shall be provided with re-enterable products specifically designed for retrofit.

K. Penetrants passing through fire-resistance rated floor-ceiling assemblies contained within chase wall assemblies shall be protected with products tested by being fully exposed to the fire outside of the chase wall. Systems within the UL Fire Resistance Directory that meet this criterion are identified with the words “Chase Wall Optional”.

L. Provide penetration firestop systems, fire-resistive joint systems, or perimeter fire barrier systems subjected to an air leakage test conducted in accordance with Standard, ANSI/UL 1479 for penetrations and ANSI/UL 2079 for joint systems with published L-Ratings for ambient and elevated temperatures as evidence of the ability of firestop system to restrict the movement of smoke.
2.3 MANUFACTURERS

A. Specification is based on products listed in assemblies shown on Drawings.
   1. Other approved equal products by one of the following are also acceptable. See Section 01 25 00 - Substitution Procedures for submittal requirements.
      a. 3M Fire Protection Products.
      b. HILTI, Inc.
      c. Hydroflame.
      d. Specified Technologies, Inc.

2. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.

2.4 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping.

3.2 PREPARATION

A. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer’s recommended products and methods. Confine primers to areas of bond. Do not allow spillage and migration onto exposed surfaces.

B. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed. Remove tape as soon as it is possible to do so without disturbing the firestopping seal with substrates.

C. Verify that system components are clean, dry, and ready for installation.

D. Verify that field dimensions are as shown on the Drawings and as recommended by the manufacturer.

3.3 PENETRATION FIRESTOP INSTALLATION

A. Ensure that all pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.

B. Ensure that partitions and all other construction that conceal penetrations are not erected prior to the installation of firestop and smoke seals.
C. Install forming/damming materials and other accessories in accordance with manufacturers written instructions.

D. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
   1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
   2. Install materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed finish to produce smooth, uniform surfaces.

3.4 FIRESTOP JOINT SYSTEM INSTALLATION

A. Install joint fillers to provide support of firestop materials during application.

B. Provide at the position to produce the cross-sectional shapes and depths of installed firestop material relative to joint widths for optimum sealant movement capability and required fire-resistance.

C. Install systems that result in firestop materials:
   1. Directly contacting and fully wetting joint substrates.
   2. Completely filling recesses provided for each joint configuration.
   3. Providing uniform, cross-sectional shapes and depths relative to joint width that optimize movement capability.

D. Tool non-sag firestop materials immediately after application and prior to skinning begins. Form smooth, uniform beads of configuration indicated or required to:
   1. Produce fire-resistance rating.
   2. Eliminate air pockets.
   3. Ensure contact and adhesion with sides of joint.

3.5 INSTALLATION LOG

A. Include the following items for all firestop and fire resistive joint installations:
   1. Contractor’s name, address, and phone number.
   2. Through-penetration firestop systems designation of applicable testing and inspecting agency.
   3. Date of installation.
   4. Firestop systems manufacturer’s name.

B. Provide as a pdf file with bi-directional links to floor plans and elevations to clearly illustrate location of material.
3.6 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems.

3.7 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses. Use methods and cleaning materials approved by manufacturers of firestopping products and or assemblies in which openings and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sealants for interior surfaces.

1.2 SUBMITTALS

A. Qualification Data: For Manufacturer, Installer, Testing Agency.

B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

C. Preliminary Selection Sample: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Field Samples for Confirmation: Provide sealant samples in the color selected based on Manufacturer's charts for sealants other than the ones included in the Visual and Performance Mockup. Field samples shall be minimum 12 inches long and installed at joints intended for each particular sealant use. Mockup and field samples will be used to confirm sealant color selection.

E. Sanded sealant samples: Include in the Visual and Performance mockup, as part of the brick portion of the mockup.

F. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

G. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

H. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

I. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

J. Field Test Report Log: For each elastomeric sealant application.

K. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

L. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
M. Maintenance Data: For user's operation and maintenance of system including:

1. Methods for maintaining system’s materials and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
3. Recommendations on maintenance schedule.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.

B. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project. Minimum 5 years of documented experience in facilities of this size and scope.
   1. Prequalification of single source installers for exterior sealants is encouraged.

C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.5 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric 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: Ten (10) years from date of Substantial Completion.

C. Special warranties exclude deterioration or failure of elastomeric joint sealants from the following:
   1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.
PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Joint sealers for properly designed joints in interior materials; selected for durability, movement capacity, adhesion to substrates and non-staining characteristics.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

C. Elastomeric Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.

D. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

2.3 MATERIALS

A. Substitutions for products by manufacturers other than those listed below: See Section 01 25 00 - Substitution Procedures

B. Sealants for interior surfaces:
      a. Basis of Design: Silicone products by DOWSIL, Peccora Corporation, Tremco Inc., or approved equal.
      b. Tested as part of acoustical assemblies.
      c. Use where indicated.
   2. Clean Room Sealant:
      a. Basis of Design: EVERFLEX 565 CLEANROOM SILICONE by SIKA, or approved equal.
      b. Designed for a low modulus, FDA approved, neutral cure, low odor silicone sealant that adheres to wide range of both porous and non-porous surfaces; antibacterial and mold resistant.
2.4 ACCESSORIES

A. Joint sealant backing:
   1. General:
      a. Provide sealant backings of material and type that are nonstaining; are compatible
         with joint substrates, sealants, primers, and other joint fillers; and are approved for
         applications indicated by sealant manufacturer based on field experience and
         laboratory testing.
   2. Bond-Breaker Tape:
      a. Polyethylene tape or other plastic tape recommended by sealant manufacturer for
         preventing sealant from adhering to rigid, inflexible joint-filler materials or joint
         surfaces at back of joint where such adhesion would result in sealant failure. Provide
         self-adhesive tape where applicable.

B. Miscellaneous Materials:
   1. Primer:
      a. 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.
   2. Cleaners for Nonporous Surfaces:
      a. Chemical cleaners acceptable to manufacturers of sealants and sealant backing
         materials, free of oily residues or other substances capable of staining or harming
         joint substrates and adjacent nonporous surfaces in any way, and formulated to
         promote optimum adhesion of sealants to joint substrates.
   3. Masking Tape:
      a. Non-staining, nonabsorbent material compatible with joint sealants and surfaces
         adjacent to joints.
   4. Natural Sand:
      a. Washed natural sand containing no contaminants that would affect the sealant.
         Color as approved by the architect for sanded joints as indicated or scheduled.

C. All accessory materials required by the manufacturer for a warrantable installation of the
   installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify existing conditions meet the manufacturer’s requirements before starting work.

3.2 PREPARATION
   A. Prepare surfaces to receive work in accordance with manufacturer’s instructions.
3.3 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Non-fire rated steel doors.
B. Fire rated steel doors.
C. Sound rated steel doors.
D. Bullet resistant steel doors.
E. Non-fire rated steel frames.
F. Fire rated steel frames.

1.2 RELATED REQUIREMENTS

A. 08 16 13 - Fiberglass Doors: for FRP doors and non-metal hardware.
B. 08 71 00 - Door Hardware: For hardware installed in hollow metal doors.
C. 08 80 00 - Glazing: For glass in doors and borrowed lites.
D. 09 90 00 - Painting and Coating: For field painting.

1.3 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes. Include U-value data for thermally broken doors and frames.
B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
C. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
E. Maintenance Data: For user's operation and maintenance of system including:
   1. Methods for maintaining system's materials and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
1.5 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Hollow metal frames for hollow metal doors, wood doors and glazing. Hollow metal doors for fire rated, non-fire rated, sound rated, and bullet resistant and insulated openings.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Accessibility Requirements: For doors required to be accessible, comply with applicable provisions in the Accessible and Usable Building Facilities ICC A117.1 and 2010 ADA Standards for Accessible Design – Department of Justice.

B. Comply with ANSI A250.8 in general and for grade and style specified.

C. NAAMM HMMA doors of equivalent or better construction are allowed.

D. Provide hardware preparation in accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard. Coordinate with Section 08 71 00 - Door Hardware.

2.3 MANUFACTURERS

A. Specification is based on Doors and Frames by one of the following:
   1. Assa Abloy.
   2. Ceco.
   3. Curries.
   4. Fleming.
   5. Steelcraft.
   6. Substitutions for products by manufacturers other than those listed above: 01 25 00 - Substitution Procedures.

2.4 MATERIALS

A. Steel Doors:
   2. Fire Rated Steel Doors: Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
   3. Features:
      a. Size: 1” and 2” where indicated on Drawings.
b. Assembly: Fully welded.

c. Finish: Painted, with solid grout.

B. Steel Frames:

1. Non-Fire Rated Steel Frames:
   a. Comply with the requirements of grade specified for corresponding door.
   b. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage.
   c. Frames for Glass: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage.

2. Fire Rated Steel Frames:
   a. Comply with the requirements of grade specified for corresponding door.
   b. Frames for Glass: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage.
   c. Fire Rating: Same as door, labeled, tested in accordance with UL 10C.
   d. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage.

3. Features:

C. Non-fire rated steel doors.

1. Performance Criteria:
   a. Grade: ANSI A250.8 Level 3, physical performance Level C, Model 2, seamless.
   c. Exterior Doors, Non-Fire Rated:
      1) Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
      2) Insulating Value: U-value of 0.37, when tested in accordance with ASTM C1363.

2. Features:
   a. Door Top and Closures: Steel, Flush with top of faces and edges.
   b. Door Edge Profile: Beveled on both edges.
   c. Face Texture: Smooth.
   d. Glazed Lights: Sizes and configurations as indicated on drawings. Provide secure glazing stops on secure side of door.
      1) Glazing: Fully Tempered Float Glass specified in Section 08 80 00 - Glazing.
   e. Finish: Factory primed for field finishing.
   f. Field Finish: In accordance with Section 09 90 00 - Painting and Coating.
g. Field Finish Color: To be selected from manufacturer's full range.

D. Fire rated steel doors.

1. Performance Criteria:
   a. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
      1) Provide units listed and labeled by UL.
      2) Attach fire rating label to each fire rated unit.
   b. Grade: ANSI A250.8 Level 3, physical performance Level C, Model 2, seamless.
   d. Interior Doors, Fire Rated:
   e. Exterior Doors, Fire Rated:
      1) Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M with manufacturer's standard coating thickness.
      2) Insulating Value: U-value of 0.29, when tested in accordance with ASTM C1363.

2. Features:
   a. Door Top and Closures: Steel, Flush with top of faces and edges.
   b. Door Edge Profile: Beveled on both edges.
   c. Face Texture: Smooth.
   d. Glazed Lights: Sizes and configurations as indicated on drawings. Provide secure glazing stops on secure side of door.
      1) Glazing: In accordance with ICC (IBC)-2012 716 Tables.
         a) Fire Protective Glazing as specified in Section 08 80 00 if door rating is 45 minutes or less and lite size is under 100 square inches.
         b) Fire Resistive Glazing as specified in Section 08 80 00 if door rating is over 45 minutes or lite size is over 100 square inches.
   e. Color: To be selected from manufacturer's full range.

E. Sound Rated Doors:

1. Performance Criteria:
   a. Grade: ANSI A250.8 Level 2, physical performance Level C, Model 2, seamless.
   b. STC Rating of Assembled Door, Frame, and Seals: 35, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
   d. Interior Doors, Sound Rated:
e. Exterior Doors, Sound Rated:
   1) Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
   2) Insulating Value: U-value of 0.29, when tested in accordance with ASTM C1363.

2. Features:
   a. Door Top and Closures: Steel, Flush with top of faces and edges.
   b. Door Edge Profile: Beveled on both edges.
   c. Face Texture: Smooth.
   d. Sound Seals: Integral, concealed in door or frame.
   e. Glazed Lights: Sizes and configurations as indicated on drawings. Provide secure glazing stops on secure side of door.
   f. Color: To be selected by Architect from manufacturer's full range.
   g. Finish: Factory primed for field finishing.

F. Bullet Resistant Doors.

1. Performance Criteria:
   b. Grade: ANSI A250.8 Level 2, physical performance Level C, Model 2, seamless.
   d. Interior Doors, Bullet Resistant:
   e. Exterior Doors, Bullet Resistant:
      1) Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
      2) Insulating Value: U-value of 0.29, when tested in accordance with ASTM C1363.

2. Features:
   a. Door Top and Closures: Steel, Flush with top of faces and edges.
   b. Door Edge Profile: Beveled on both edges.
   c. Face Texture: Smooth.
   d. Glazed Lights: Sizes and configurations as indicated on drawings. Provide secure glazing stops on secure side of door.
   e. Color: To be selected by Architect from manufacturer's full range.
G. Non-Fire Rated Frames:
   1. Performance Criteria:
      a. Comply with the requirements of grade specified for corresponding door.
      b. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 2.
      c. Frames for Glass: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage.
   2. Features:
      a. Size: 2” where indicated on Drawings.
      b. Assembly: Fully welded.
      c. Finish: Factory primed, for field finishing.

H. Fire Rated Frames:
   1. Performance Criteria:
      a. Comply with the requirements of grade specified for corresponding door.
      b. Fire Rating: Same as door, labeled, tested in accordance with UL 10C ("positive pressure").
      c. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 2.
      d. Frames for Glass: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage.
   2. Features:
      a. Size: 2” where indicated on Drawings.
      b. Assembly: Fully welded.
      c. Finish: Factory primed, for field finishing.

I. Exterior Frames:
   1. Performance Criteria:
      a. Comply with the requirements of grade specified for corresponding door.
      b. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
      c. Provide with true thermal break.
   2. Features:
      a. Assembly: Fully welded.
      b. Finish: Factory primed, for field finishing.
2.5 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B. Glazing: As specified in Section 08 80 00 - Glazing, factory installed.

C. Mineral Fiber Insulation: For filling frame cavities.

2.6 FINISHING

A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

C. Field Finish: In accordance with Section 09 90 00 - Painting and Coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

B. Coat inside of frames to be installed in masonry, with bituminous coating, prior to installation.

C. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch.

3.3 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

B. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.

C. Install fire rated units in accordance with NFPA 80.

D. Seal seam at top closures after finish is applied to create a smooth surface without groove or pits.
   1. Seal with sealant Per Section 07 90 05 - Joint Sealers.

E. Pack all frames with insulation.

F. Coordinate installation of hardware.

G. Coordinate installation of electrical connections to electrical hardware items.
3.4 TOLERANCES

A. Clearances Between Door and Frame: As specified in ANSI A250.8.

B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.5 ADJUSTING

A. Adjust and lubricate hardware for proper operation.

B. Adjust for smooth and balanced door movement in accordance with manufacturer's instructions.

3.6 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.7 SCHEDULE

A. Refer to Door and Frame schedule on Drawings.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Fire rated and non-fire rated wood doors.

1.2 RELATED REQUIREMENTS
   A. 08 11 13 - Hollow Metal Doors and Frames: For frames.
   B. 08 71 00 - Door Hardware: For hardware installed in wood doors.
   C. 09 90 00 - Painting and Coating: For field painting.

1.3 SUBMITTALS
   A. Qualification Data: For manufacturer.
   B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
   C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles.
   D. Sample: Submit two samples face material, manufacturer's standard size showing factory finishes, colors, and surface texture.
   E. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
   F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
   G. Maintenance Data: For user's operation and maintenance of system including:
      1. Methods for maintaining system's materials and finishes.
      2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
      1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
1.6 WARRANTY

A. Interior Doors: Provide manufacturer's warranty for the life of the installation.
   1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Wood doors for fire rated and new non-fire rated openings.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Accessibility Requirements: For doors required to be accessible, comply with applicable provisions in the Accessible and Usable Building Facilities ICC A117.1 and 2010 ADA Standards for Accessible Design – Department of Justice.

B. Quality Level: Custom Grade, Extra Heavy Duty performance, in accordance with WDMA I.S. 1A for all doors with the following exceptions.

C. Construction: Flush.

D. Vertical Edges: Same species as face veneer.

E. Edge type (AWI "E" type) edge set in between door face veneers.

F. Door Edge Profile: Beveled on both edges.

G. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

H. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

I. Source Limitations: For doors and frames, obtain products from single source from single manufacturer.

J. Provide hardware preparation in accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard. Coordinate with Section 08 71 00 - Door Hardware.

2.3 MANUFACTURERS

A. Specification is based on doors and frames by one of the following:
B. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.

2.4 MATERIALS

A. Solid Core Wood Doors, Interior Use: AWI custom grade, 1-3/4-inch thick, PC-5 construction, solid hardwood edge stiles to match face veneers without finger jointing. Premium grade maple veneer, slip matched.

B. Interior Wood Doors for Fire Rated and Non-Fire Rated: Premium grade, heavy duty performance in accordance with WDMA I.S. 1A.

1. Basis of Design: Lynden Doors, Simpson Door Co., ReCore Door, or comparable regional manufacturer.

2. Glazing:
   a. For Typical Doors: Fully tempered glass as specified in Section 08 80 00 - Glazing.
   b. For Fire-Rated Doors: Provide Fire Resistive Glazing as specified in Section 08 80 00 - Glazing.

3. Transparent Finish: Maple plain sliced, slip veneer match, balance assembly matched.
   a. Finish: Stain and conversion varnish.

4. Opaque Finish: Paint grade veneer faced; factory primed.

C. Glazing:

1. Types in accordance with Section 08 80 00 - Glazing.
   a. Monolithic tempered glass with decorative window film per 08 80 00. Extent and location within door per Drawings.

2.5 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

2.6 FINISHING

A. Field Finish: In accordance with Section 09 90 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer’s requirements before starting work.

3.2 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

B. Field-Finished Doors: Trimming to fit is acceptable.
1. Adjust width of non-rated doors by cutting equally on both jamb edges.
2. Trim maximum of 3/4 inch off bottom edges.

C. Coordinate installation of hardware.
D. Touch up damaged finishes.

3.3 TOLERANCES
A. Conform to specified quality standard for fit and clearance tolerances.
B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING
A. Adjust and lubricate hardware for proper operation.
B. Adjust for smooth and balanced door movement in accordance with manufacturer's instructions.

3.5 PROTECTION
A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.6 SCHEDULE
A. Refer to Door schedule on drawings.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Fiberglass doors.
B. Fiberglass door frames.
C. Door hardware.

1.2 RELATED REQUIREMENTS
A. Section 08 12 13 - Hollow Metal Frames: Metal frames.
B. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Obtain hardware templates from hardware manufacturer prior to starting fabrication.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer’s standard details, installation instructions, hardware and anchor recommendations.

C. Shop Drawings: Indicate layout and profiles; include assembly methods.
   1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
   2. Indicate wall conditions, door and frame elevations, sections, materials, gauges, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on drawings to identify details and openings.

D. Selection Samples: Submit two complete sets of color chips, illustrating manufacturer’s available finishes, colors, and textures.

E. Verification Samples: Submit door surface samples for each finish specified, 10 inches by 10 inches in size, illustrating finishes, colors, and textures.

F. Door Corner Sample: Submit corner cross sections, 10 inches by 10 inches in size, illustrating construction, finish, color, and texture.

G. Test Reports: Submit certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

H. Manufacturer’s Qualification Statement.

I. Installer’s Qualification Statement.

J. Maintenance Data: Include instructions for repair of minor scratches and damage.

K. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner’s name and registered with manufacturer; include detailed terms of warranty.

L. Maintenance Materials: Furnish the following for Owner’s use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Doors: Quantity equal to two percent of number installed, from same production run as products installed.
   3. Package products with protective coverings and identify with descriptive labels.
1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

B. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
   1. Store at temperature and humidity conditions recommended by manufacturer.
   2. Do not use non-vented plastic or canvas shelters.
   3. Immediately remove wet wrappers.

C. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4 inch space between doors.

1.8 FIELD CONDITIONS

A. Do not install doors until structure is enclosed.

B. Maintain temperature and humidity at manufacturer’s recommended levels during and after installation of doors.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 - PRODUCTS

2.1 DOOR AND FRAME ASSEMBLIES

A. Basis of Design: Corrim Company FRP Door.

B. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
   1. Screw-Holding Capacity: Tested to 890 pounds, minimum.
   2. Surface Burning Characteristics: Flame spread index (FSI) of 0 to 25, Class A, and smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84.
   3. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
   5. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4 inch clearance to threshold.
2.2 COMPONENTS

A. Doors: Fiberglass construction with reinforced core.
   2. Core Material: Manufacturer's standard core material for application indicated.
   3. Construction:
   4. Face Sheet Texture: Smooth.
   5. Door Panel: As indicated on drawings.
   7. Waterproof Integrity: Provide factory fabricated edges, cut-outs, and hardware preparations of fiberglass reinforced plastic (FRP); provide cut-outs with joints sealed independently of glazing, louver inserts, or trim.
   8. Hardware Preparations: Factory reinforce, machine, and prepare for door hardware including field installed items; provide solid blocking for each item; field cutting, drilling or tapping is not permitted; obtain manufacturer's hardware templates for preparation as necessary.

B. Door Frames: Provide type in compliance with performance requirements specified for doors.
   1. Type: Factory assembled with chemically welded joints.
   2. Profiles: As indicated on drawings.

2.3 PERFORMANCE REQUIREMENTS

A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.

B. Forced Entry Resistance: Pass in accordance with AAMA 1304 test method.

C. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 7.5 psf.

D. Air Leakage: Maximum of 0.1 cfm per square foot at 6.27 psf differential pressure, when tested in accordance with ASTM E283.

E. Structural Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.

F. Acoustical Performance: Sound Transmission Class (STC) of 25, minimum, when tested in accordance with ASTM E90.

G. Fiberglass Reinforced Plastic (FRP) Face Sheet Properties:
   1. Izod Impact Resistance: ASTM D256, 7 foot-pound force per inch of width, minimum, with notched izod.
   2. Tensile Strength at Break: ASTM D638, 13,250 psi, minimum.
3. Water Absorption: ASTM D570, 0.16 percent, maximum, after 24 hours at 74 degrees F.
4. Flexural Strength: ASTM D790, 27,000 psi, minimum.
5. Barcol Hardness: ASTM D2583, minimum of 40 units.

2.4 FINISHES

A. Painted:
   3. Color: As selected by Architect from manufacturer's full line of colors.

2.5 ACCESSORIES

A. Glazing: See Section 08 80 00.
B. Door Hardware: Non-metal hardware per Section 08 71 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.
B. Do not begin installation until substrates have been properly prepared.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
B. Clean and prepare substrate in accordance with manufacturer’s directions.

3.3 INSTALLATION

A. Install in accordance with manufacturer’s instructions; do not penetrate frames with anchors.
B. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.
C. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.

3.4 ADJUSTING

A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.
B. Adjust hardware for smooth and quiet operation.

C. Adjust doors to fit snugly and close without sticking or binding.

3.5 CLEANING

A. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance.

3.6 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall access doors and panels.
B. Ceiling access doors and panels.
C. Floor access doors and panels.

1.2 RELATED REQUIREMENTS

A. 09 21 16 - Gypsum Board Assemblies: Openings in partitions and finishing of recessed access doors.
B. 09 90 00 - Painting and Coating: Field paint finish.

1.3 SUBMITTALS

A. Qualification Data: For manufacturer.
B. Sample: Submit one of each access unit, 12 x 12 inch in size illustrating frame configuration.
C. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
D. Maintenance Data: For user's operation and maintenance of system including:
   1. Methods for maintaining system's materials and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
E. Closeout Submittals: Project record documents recording actual locations of all access units.

1.4 MAINTENANCE MATERIAL

A. Any special tools to operate access doors and panels.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Fire rated and non-rated hinged doors and non-hinged panels in walls, ceilings, and floors for access to concealed building components.

2.2 MANUFACTURERS

A. Specification is based on products listed below.

1. Comparable products by one of the following are also acceptable. See Section 01 25 00 - Substitution Procedures for submittal requirements.
   a. Babcock Davis.
   b. JL Industries/Activar.
   c. Nystrom, Inc.

2. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.

2.3 MATERIALS

A. Wall access doors and panels.

1. Recessed Non-Fire Rated Door and Frame Units:
   a. Basis of Design Product:
      1) In Gypsum Board on Steel Studs:
         a) Model RW-Series manufactured by Nystrom, Inc.
         b) B-RW by Babcock Davis.
         c) CTWB by JL Industries/Activar.
      b. Features:
         1) Frame: Drywall bead.
         2) Hinges: Concealed.
         3) Handle: No Handle.
         4) Latch/Lock: Screw driver slot for quarter turn cam latch.
         5) Gasketing: Manufacturers' standard.
         6) Material: Galvanized Steel.
         7) Finish: Prime painted for field finish.
         8) Size(s): As indicated.

2. Recessed Fire Rated Door and Frame Units:
   a. Basis of Design Product:
      1) In Cast-In-Place Concrete or Tile:
         a) Model U-Series manufactured by Nystrom, Inc.
2) In Gypsum Board on Steel Studs:
   a) Model RW-Series manufactured by Nystrom, Inc.
   b) Model KRP350 FR manufactured by Karp Associates.

b. Performance Criteria:
   1) Provide required options to maintain fire rating of assembly.

c. Features:
   1) Frame: Drywall bead.
   2) Hinges: Concealed.
   3) Handle: No Handle.
   4) Latch/Lock: Screw driver slot for quarter turn cam latch.
   5) Gasketing: Manufacturers' standard.
   6) Material: Galvanized Steel.
   7) Finish: Prime painted for field finish.
   8) Size(s): As indicated.

B. Ceiling access doors and panels.

1. Recessed Non-Fire Rated Door and Frame Units:
   a. Basis of Design Product:
      1) In Gypsum Board on Steel Studs:
         a) Model RW-Series manufactured by Nystrom, Inc.
         b) B-RW by Babcock Davis.
         c) CTWB by JL Industries/Activar.

   b. Features:
      1) Hinges: Concealed.
      2) Handle: No Handle.
      3) Latch/Lock: Screw driver slot for quarter turn cam latch.
      4) Gasketing: Manufacturers' standard.
      5) Material: Galvanized Steel.
      6) Finish: Prime painted for field finish.
      7) Size(s): As indicated.

2. Recessed Fire Rated Door and Frame Units:
   a. Basis of Design Product:
      1) In Cast-In-Place Concrete or Tile:
         a) Model U-Series manufactured by Nystrom, Inc.

      2) In Gypsum Board on Steel Studs:
         a) Model RW-Series manufactured by Nystrom, Inc.
b) Model KRP350 FR manufactured by Karp Associates.

b. Performance Criteria:
   1) Provide required options to maintain fire rating of assembly.

c. Features:
   1) Hinges: Concealed.
   2) Handle: No Handle.
   3) Latch/Lock: Screw driver slot for quarter turn cam latch.
   4) Gasketing: Manufacturers' standard.
   5) Material: Galvanized Steel.
   6) Finish: Prime painted for field finish.
   7) Size(s): As indicated.

C. Floor access doors and panels.

1. Floor Access Door and Frame Unit:
   a. Basis of Design Product: J-AL by Bilco. Comparable and substituted products will
      be judged based on the following performance criteria, features, warranty, and
      qualifications.
   b. Performance Criteria:
   c. Features:
      1) Frame: Extruded aluminum channel frame with anchors at the perimeter.
      2) Hinges and Latch: Type 316 stainless steel.

2.4 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the
installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on
conditions present.
B. Install frames plumb and level in openings.

3.4 ADJUSTING

A. Adjust and lubricate hardware for proper operation.

3.5 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.6 SCHEDULE

A. Typical: Recessed Non-Fire Rated Door and Frame Unit.

B. Fire Rated Assemblies: Recessed Fire Rated Door and Frame Units.

C. Storm Water Retention Tank: Floor Access Door and Frame Unit.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Commercial grade mechanical and electrified door hardware for:
   1. Swinging Doors
   2. Field verification, preparation and modification of existing doors and frames for the installation of new hardware.

B. Exclusions:
   1. Permanent cylinders for door hardware are N.I.C. and shall be provided by Owner.
   2. Unless specifically listed in hardware sets, hardware is not specified in this section for:
      a. Windows
      b. Cabinets (casework), including locks for cabinets.
      c. Signage
      d. Toilet Accessories

1.2 REFERENCES

A. American National Standards Institute – ANSI 156.18 – Materials and Finishes.
B. ANSI A117.1 – Accessible and Usable Buildings and Facilities.
C. ADA – Americans with Disabilities Act of 2010, or most recent version
D. BHMA – Builders Hardware Manufacturers Association
E. NFPA – National Fire Protection Association
F. UL – Underwriters Laboratories
G. WHI – Warnock Hersey Incorporated
I. NFPA 70 - National Electrical Code.
J. NFPA 80 - Fire Doors and Windows.
L. NFPA 105 - Installation of Smoke Door Assemblies.
M. State Building Codes, Local Amendments.

1.3 SUBMITTALS

A. Reference Division 1 section “Submittal Procedures” for Confirmation Notice Submittal requirements, if applicable, in lieu of product literature and samples.

B. Product Data: For each product indicated.

C. Samples: For each exposed finish.
D. Door Hardware Schedule: Organized into door hardware sets indicating type, style, function, size, label, hand, manufacturer, fasteners, location, and finish of each door hardware item. Include description of each electrified door hardware function, including sequence of operation.

E. Product certificates.

1.4 QUALITY ASSURANCE

A. Supplier Qualifications: Person who is or employs a qualified DHI Architectural Hardware Consultant, who is available at all reasonable times during the course of the Work to meet with the Owner, Architect or Contractor for project hardware consultation. Door Hardware shall be supplied by a recognized builder's hardware supplier who has been furnishing hardware in the same area as the project for a period of not less than five (5) years. The supplier shall maintain an inventory of replacement parts for future service to the Owner.

B. 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. Keying Schedule: Keying schedule by Owner; not required for this project.

D. Templates: Obtain and distribute templates for doors, frames, and other work specified to be factory prepared for installing door hardware.

E. Standards: Comply with BHMA A156 series standards, Grade 1, unless Grade 2 is indicated.

F. Certified Products: Provide door hardware that is listed in BHMA directory of certified products.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within warranty period.
   1. Warranty Period for locksets and panic devices: 3 years from date of Substantial Completion.
   2. Warranty Period for Manual Closers: 30 years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Except as otherwise indicated, products named for each door hardware item indicated in Door Hardware Groups schedule establish the basis of design. Provide the named product.

2.2 DOOR HARDWARE

A. Scheduled Door Hardware: Provide door hardware according to door hardware groups indicated.
   1. Reference “Hardware Sets” schedule at end of this Section.

2.3 PIVOTS AND HINGES

A. General: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

B. Hinge Base Metal: Unless otherwise indicated, provide the following:
   1. Exterior Hinges: Stainless steel, with stainless-steel pin.
   2. Interior Hinges: Stainless steel, with stainless-steel pin.

C. Non-removable Pins: Provide set screw in hinge barrel that prevents removal of pin while door is closed.

D. Screws: Phillips flat-head screws; screw heads finished to match surface of hinges.

E. Quantity: Provide hinges as scheduled, or if not scheduled provide as follows:
   1. Provide 1-1/2 pair butts for doors up to 3’-6” wide and 7’-0” tall.
   2. Provide 2 pair butts for doors 3’-6” and wider, and for doors taller than 7’-0”.

F. Scheduled Manufacturer and Product: Ives 5BB series.

2.4 MECHANICAL LOCKS AND LATCHES

1. Manufacturers and Products:

2. Requirements:
   a. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3 hour fire doors.
b. Indicators: Where specified, provide indicator window measuring a minimum 2 inch x 1/2 inch with 180 degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.

c. Provide indicator above cylinder or emergency release for visibility while operating the lock that identifies the occupied/unoccupied status of the lock or latch.

d. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.


f. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

g. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.

h. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and comply with the following requirements:

   1) Universal input voltage – single chassis accepts 12 or 24V DC to allow for changes in the field without changing lock chassis.

   2) Universal input voltage – single chassis accepts 12 or 24V DC to allow for changes in the field without changing lock chassis

   3) Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electronically unlocked (fail secure) is field selectable without opening the lock case.

   4) Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.

   5) Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.

   6) Request to Exit Switch (RX) –

      a) Modular Design – Provide electrified locks capable of using, adding or changing a modular RX switch without opening the lock case.

      b) Connections – provide quick-connect Molex system standard.

   7) Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

      a) Lever Design: Schlage 17

   8) Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.5 EXIT DEVICES

   A. Manufacturers:

      1. Specified: VON DUPRIN 98 Series
B. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.

C. Cylinders: Refer to “KEYING” article, herein.

D. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.

E. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.

F. Provide flush end caps for exit devices.

G. Provide exit devices with manufacturer’s approved strikes.

H. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.

I. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.

J. Provide cylinder or hex-key dogging as specified at non fire-rated openings.

K. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.

L. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.

M. Provide electrified options as scheduled.

N. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

O. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.6 CLOSERS

A. Manufacturers: Specified: LCN 4040XP Series

B. Specified closers shall be provided with adjustable latch speed at 15 degrees.

C. Standards: Comply with the following:

D. Closers: BHMA A156.4.

2.7 ARCHITECTURAL TRIM

A. Manufacturers:

1. Specified: IVES
2. Approved: TRIMCO

B. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
   a. 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.
   b. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:
      c. Stainless Steel: 300 series, 050-inch thick, with countersunk screw holes (CSK).
   d. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
   e. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.

C. STOPS AND HOLDERS

1. Stops and Holders: Provide floor stops for doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
   a. Specified: IVES
   b. Approved: TRIMCO

D. OVERHEAD STOPS AND HOLDERS

1. Overhead Door Stops and Holders: ANSI/BHMA A156.6, 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.
   a. Specified: GLYNN-JOHNSON
   b. Approved: ROCKWOOD

E. DOOR GASKETING AND THRESHOLDS

1. Door Gasketing: Provide continuous or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
   a. Specified: GLYNN-JOHNSON
   b. Approved: ROCKWOOD

2. Manufacturers: As indicated per hardware groups on the drawings.
3. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
4. Sound-Rated Gasketing: Assemblies that are listed and labeled, based on testing according to ASTM E 1408.


6. Thresholds: Of type scheduled or indicated.

7. Manufacturers:
   a. Specified: ZERO
   b. Approved: NATIONAL GUARD PRODUCTS

F. CYLINDERS AND KEYING
1. Cylinders: All locks shall be provided with construction cylinders.
2. All permanent cylinders and keys shall be provided by, and installed by, UW Facilities Services.
3. All construction cylinders to be returned to the Door Hardware supplier.

G. FABRICATION
1. Base Metals: Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials if different from specified standard.
2. Fasteners: Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated. Provide steel machine or wood screws or steel through bolts for fire-rated applications.
3. Spacers or Sex Bolts: For through bolting of hollow metal doors.
4. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Finishes: Comply with BHMA A156.18.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine doors and frames, 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Steel Doors and Frames: Comply with DHI A115 series.
   B. Surface-Applied Door Hardware: Drill and tap doors and frames according to SDI 107.
   C. Wood Doors: Comply with DHI A115-W series.
3.3 INSTALLATION

A. 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." Install each door hardware item to comply with manufacturer's 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.

3. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

4. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

5. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant.

3.4 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.

B. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

C. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall perform the following:

1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

2. Consult with and instruct Owner's personnel on recommended maintenance procedures.

3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.
## 3.6 SCHEDULE OF FINISH HARDWARE

A. The hardware sets represent the design intent and direction of the owner and architect. They are not to 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.

B. Hardware Sets

### Hardware Group No. 1

For use on Door #(s): 193 2299A

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>613</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>CD-98-L-17</td>
<td>313</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>690</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>613</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CVX</td>
<td>613</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

PERMANENT CYLINDER and CORE (PROVIDED BY UW FACILITIES SERVICES)

### Hardware Group No. 2

For use on Door #(s): 194A

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>L9080L 17A</td>
<td>613</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>690</td>
<td>LCN</td>
</tr>
</tbody>
</table>

BALANCE OF HARDWARE (EXISTING) 00 BYO

PERMANENT CYLINDER and CORE (PROVIDED BY UW FACILITIES SERVICES)

### Hardware Group No. 3

For use on Door #(s): 194

NOTE: ALL HARDWARE (NON-METAL) PROVIDED BY OTHER
Hardware Group No. GATE

For use on Door # (s):
180

Provide each SGL door(s) with the following:
NOTE: ALL HARDWARE PROVIDED BY GATE MANUFACTURER

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior glazing, including door glazing and accessories installed as monolithic glazing within framing systems and support structures specified elsewhere.

1.2 RELATED REQUIREMENTS

A. 08 11 13 - Hollow Metal Doors and Frames: For assembly requiring components from this section.

B. 08 14 16 - Flush Wood Doors: For assembly requiring components from this section.

1.3 SUBMITTALS

A. Qualification Data: For installer, fabricator and design engineer.

B. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Include the following:
   1. Signed and stamped design calculations showing glazing thickness and clip layout/sizing compliance with guardrail strength and loading requirements found in 2015 IBC.

C. Product Data:
   1. Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
   2. Glazing Compounds & Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements and identify available colors.

D. Shop Drawings: For any glazing installed with components from this section alone.
   1. Submit shop drawings for glazing installed within other systems in accordance with the system submittal requirements.

E. Sample: Submit two samples in manufacturer's standard size of glass type units, showing coloration and design.

F. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

H. Maintenance Data: For user's operation and maintenance of system including:
   1. Methods for maintaining system's materials and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

A. Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

B. Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Glass glazing, accessories installed as monolithic glazing within framing systems and support structures specified elsewhere.

2.2 MATERIALS

A. Float Glass:
   1. Performance Criteria:
      a. By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
      b. Roll Wave Maximum Distortion Tolerance: 0.003 inch target with 0.005 inch maximum peak to valley measurement.
      c. Bow and Warp Maximum Tolerance: 50 percent of the maximum allowed in ASTM C1048.
      d. Tinted Types: Performance and features to match basis of design product.
   2. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
   3. Heat-Strengthened in accordance with ASTM C1048.
   4. Fully Tempered in accordance with ASTM C1048.
      a. Safety Glazing: Comply with 16 CFR 1201 test requirements for Category II.

B. Monolithic Tempered Glass:
   1. Applications: All interior door glazing.
   2. Glass: Clear, fully tempered.
3. Lite Thickness: As required by panel size indicated when designed in accordance with performance criteria.

C. Fire Resistant Glazing: For glazing in fire rated assemblies as indicated on drawings.
   1. Specification is based on SuperLite II-XL 45 by SaftiFirst.
      a. Comparable products by one of the following are also acceptable. See Section 01 25 00 - Substitution Procedures for submittal requirements.
         1) Pyrostop Series by Technical Glass Products.
      b. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.
   2. Performance Criteria:
      a. Type, thickness, and configuration as required to maintain indicated ratings of fire rated assemblies.
      b. Provide products not requiring surface applied films to maintain their performance criteria. Surface applied films can be easily damaged and performance criteria compromised.
      d. Positive Pressure Test: UL 10C, UBC 7-2 and 7-4; passes.
      e. Labeling: Provide permanent label on each piece giving the IBC rating and other information required by the applicable code.
   3. Features:
      a. Surface Finish: Ground and polished on both sides.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION
   A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION
   A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 PROTECTION
   A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.
3.5 SCHEDULE

A. Interior Vision Glazing:

1. Monolithic Tempered Glass (Door Glazing):
   a. Applications: All interior applications requiring safety glazing.
   b. Basis of Design: Oldcastle or approved equal.
   c. Glass Lite 1: Clear, fully tempered.
   d. Lite Thickness: By manufacturer to meet performance and code requirements of application.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Gypsum Board.

1.2 RELATED REQUIREMENTS
   A. 06 10 00 - Rough Carpentry: Building framing and sheathing.
   B. 07 21 00 - Thermal Insulation: for acoustic insulation.
   C. 07 84 00 - Firestopping: Top-of-wall assemblies at fire rated walls.
   D. 07 90 05 - Joint Sealers: Acoustic sealant.
   E. 09 22 19 - Non-Structural Metal Framing: Blocking product and execution requirements.

1.3 SUBMITTALS
   A. Qualification Data: For Installer and design engineer.
   B. Product Data: Provide data on gypsum board, glass mat faced gypsum board, accessories, joint finishing system, and cement board.
   C. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
   D. Test Reports: For all stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.4 QUALITY ASSURANCE
   A. Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.
   B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.6 WARRANTY
   A. Manufacturer’s Finish Warranty: Correct defective work within a 20 year period after Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
B. Installation Warranty: Contractor shall correct defective Work within a 2 year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Includes Gypsum wallboard finishing, metal trim and accessories, and acoustical sealants and insulation.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Provide completed gypsum board assemblies complying with ASTM C840 and GA-216.

B. Fire Rated Assemblies: Provide completed assemblies complying with UL listed assemblies indicated and ratings indicated on life safety drawings.
   1. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
   2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL Fire Resistance Directory.

C. Interior Partitions Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.3 MANUFACTURERS

A. Specification is based on one of the following manufacturers:
   1. CertainTeed Gypsum, Inc.
   2. Georgia-Pacific Gypsum.
   3. Custom Building Products.
   4. USG Corporation.
   5. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.

2.4 MATERIALS

A. Gypsum Board:
   1. Gypsum Board: Type-X boards, 5/8" x 48" x length required to minimize cross joints.
      a. Basis of Design: CertainTeed or approved equal.
      b. Location: Walls and soffits.
b. Location: Walls below 6 feet where indicated on drawings and assemblies.

3. Gypsum Sheathing:
   b. Location: Roof Curb.

4. All gypsum board products installed prior to dry in must have a mold resistant score of 10 per ASTM D3273.

B. Shaft Liner Panels:
   1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
      a. Application: Elevator shafts, stair cores and other assemblies that span floors.
      b. Type X Thickness: 1 inch.
      c. Edges: Beveled long edges and square cut ends.
      d. Products:
         1) Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant).

2.5 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B. Trowel-In Metal Edge Reveal Trim:

C. Acoustic Sealant:
   1. As specified in Section 07 90 05 - Joint Sealers.

D. Clay Pad: Acoustic putty pad used to acoustically seal outlets.

E. Finishing Accessories:
   1. ASTM C1047, galvanized steel or rolled zinc, unless otherwise indicated.
      a. Types: As detailed or required for finished appearance.
      b. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges.

F. Joint Materials:
   1. ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
a. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.


c. Exterior Soffits: Chemical hardening type compound.

G. High Build Drywall Surfacer:
   1. Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

H. Anchorage to Substrate:
   1. Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

B. Comply with ASTM C840 and GA-216. Install to minimize butt end joints, especially in highly visible locations.

C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.

E. Exterior Soffit Board: Install perpendicular to framing, with staggered end joints over framing members or other solid backing.

F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.
B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.5 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.


C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings typical.
   2. Level 4: For flat paint, a light final paint texture, or with lightweight wall covering.
   3. Level 3: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
   5. Level 0: Temporary partitions and surfaces indicated to be finished in later stage of project.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.6 FIELD OBSERVATION AT "PUNCH"

A. Finish will be judged from a viewing difference of 4 feet.

B. Ceilings will be viewed from a standing position.

C. Finished lighting system or temporary lighting similar to proposed finished lighting should be used for judging the wall.

D. Eye catching discrepancies and or blemishes, including “fuzzy” wall board surfaces, will be rejected.
3.7 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Delegated design of non-structural metal framing.

B. Metal partition, ceiling and soffit framing.

C. Blocking and backing panels.

1.2 RELATED REQUIREMENTS

A. 07 21 00 - Fiber Insulation: Rigid insulation board used as protection board.

B. 09 21 16 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.

1.3 SUBMITTALS

A. Qualification Data: For installer and design engineer.

B. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

D. Shop Drawings: Indicate required flashings, sealing at openings.

   1. Indicate acoustic details.

   2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.

E. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

A. Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.5 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Non-structural metal support framing for gypsum board assemblies and other finishes.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Perform Work in accordance with ASTM C754.

B. Coordinate the placement of components to be installed within stud framing system.

C. Suspended Assemblies: Coordinate with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

D. Design and install framing and furring to limit deflection to the following under point loads of 100 lbs and uniform loads as noted below except where required to withstand greater load (pressurized shafts and stairwells for example).

1. Maximum Deflection of Vertical Assemblies:
   b. Assemblies spanning multiple floors: Sustained loads of 7.5 lbf/sq ft with a maximum mid span deflection of 1:240.


3. Maximum Deflection for assemblies under applied plaster finishes (Portland Cement or Gypsum) and ceramic tile is 1:360.

4. Use The SSMA Product Technical Information Book to look up the appropriate stud size, spacing and thickness.

E. Ceiling and Soffit Framing:

1. Seismic Requirements:
   a. Classification: Conform to ASTM C635/C635M, Heavy Duty Classification.
   b. Code Compliance: FBC, American Society of Civil Engineers ASCE 7 Section 13 and CISCA (AC) Guidelines.

F. Acoustic Attenuation for Interior Partitions: STC's are calculated in accordance with ASTM E413 and based on published tests conducted in accordance with ASTM E90.

1. Provide materials and construction identical to those tested in assembly indicated according to ASTM E90. See Section 09 21 16 for STC requirement.

G. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
2.3 MATERIALS

A. Metal partition, ceiling, and soffit framing.

1. Framing System Components: ASTM C645; galvanized sheet steel, of size and properties as shown on the Architectural plans and "SSMA Product Technical Information" book for the spacing indicated.
   a. Minimum Framing Component thickness is 20 Gage.
   b. Studs: C shaped.
   c. Runners: U shaped, sized to match studs.
   d. Ceiling Channels: C shaped or T shaped.
   e. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
   f. Steel Stud Framing Connectors:
      1) Products:
         a) Simpson Strong Tie, Bridging Connectors; DBC Bridging Connector: www.strongtie.com.
      g. Single leg Resilient channels.
      h. "Z's": Used for several different members.
      i. Shaftwall framing CH and other sections as required for complete framing system.

2. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   a. Basis of Design: USG Interiors RC-1, Dietrich "RCSS" or "RCSN" or approved equal.
   b. Suspended Assemblies: Coordinate with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   a. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
   b. Material:
      1) Typical: ASTM A653/A653M steel sheet, SS Grade 50, with G40/Z120 hot dipped galvanized coating.
      2) Areas Subject to Moisture: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating. Areas include exterior or non-conditioned space, shower rooms, locker rooms or other locations subject to regular wetting or high humidity.
   c. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems.
4. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.

5. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.


   a. Also acceptable "Danback" flexible wood blocking system from Dietrich.
   b. See backing schedule on architectural drawings.

8. Anchorage Devices: Power actuated or Drilled expansion bolts.


10. Acoustic Sealant: As specified in Section 07 90 05.

11. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

B. Blocking and backing panels.

1. Sheet Metal Backing (Blocking): 0.036 inch thick, galvanized. 4 inch minimum width
   a. See backing schedule on architectural drawings.

2. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

3. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

4. Specifically, provide the following non-structural framing and blocking:
   a. Cabinets and shelf supports.
   b. Wall brackets.
   c. Handrails.
   d. Grab bars.
   e. Towel and bath accessories.
   f. Wall-mounted door stops.
   g. Chalkboards and marker boards.
   h. Wall paneling and trim.
   i. Joints of rigid wall coverings that occur between studs.

2.4 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that rough-in utilities are in proper location.

B. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 INSTALLATION OF STUD FRAMING

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

B. Comply with requirements of ASTM C754.

C. Extend partition framing to structure where indicated and to ceiling in other locations.

D. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

E. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

F. At partitions indicated with an acoustic rating:
   1. Provide components and install as required to produce STC ratings as indicated.
   2. Place two beads of acoustic sealant (one on either side) between runners and substrate, studs, and adjacent construction.
   3. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
   4. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

H. Backing and Blocking: Use steel channels or flat sheets secured to studs minimum 4" wide. Provide blocking for support of all wall hung items and equipment.
   1. Use sheet metal backing for reinforcement of 16 ga. min.

I. Install supplementary framing and bracing at openings and terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer.
J. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement:
   1. Where edges of suspended ceilings abut building structure at ceiling perimeters and at penetrations of structural elements.
   2. Where partition and wall framing abuts overhead structure.
   3. Where studs are installed directly against exterior walls of masonry or concrete, install asphalt felt strips between studs and wall.

3.3 CEILING AND SOFFIT FRAMING

A. Comply with requirements of ASTM C754.

B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

C. Install furring independent of walls, columns, and above-ceiling work.

D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

E. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

I. Laterally brace suspension system.
   1. Sway-brace suspension systems with hangers used for support.

3.4 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

C. Level ceiling to a tolerance of 1/1200. For tilted ceilings maintain this tolerance as a "flatness" tolerance.

3.5 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.
3.6 SCHEDULE


END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A . Suspended metal grid ceiling system.

B . Acoustical units.

C . Suspension system for drywall ceilings.

D . Supplementary acoustical insulation above ceiling.

1.2 RELATED REQUIREMENTS

A . 07 90 05 - Joint Sealers: Acoustical sealant.

B . 09 21 16 - Gypsum Board Assemblies: Acoustical insulation.

1.3 ADMINISTRATIVE REQUIREMENTS

1.4 SUBMITTALS

A . Qualification Data: For manufacturer and installer.

B . Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, mechanical and electrical items installed in the ceiling, and perimeter molding and suspension/bracing details.

C . Product Data: Provide data on suspension system components, acoustical units, and perimeter molding/seismic connections.

D . Samples: Submit two samples 48 x 48 inch in size illustrating material and finish of acoustical units.

E . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

F . Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

G . Maintenance Data: For user's operation and maintenance of system including:

1. Methods for maintaining system's materials and finishes.

2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.5 QUALITY ASSURANCE

A . Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum of 5 years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING
A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.7 WARRANTY
A. Provide 10 year manufacturer warranty on all acoustical panels for sagging and warping, grid system, rusting, and manufacturer’s defects.
B. Provide 15 year warranty for all products using additional "Humidity and Sag resistance" control systems.

PART 2 - PRODUCTS

2.1 DESCRIPTION
A. Suspended metal grid ceiling systems with seismic edge clips and manufactured edge trim at changes in plane.

2.2 PERFORMANCE AND DESIGN CRITERIA
A. Seismic Requirements:
   1. Classification: Conform to ASTM C635/C635M, Heavy Duty Classification.
B. Components: Lock together in a positive manner.
C. Pull out tension:
D. Seismic Lateral Design: Conform to IBC and ASCE 7 especially requirement for independent support from structure above for light fixture and mechanical services installed into acoustical lay-in panel ceiling systems.
E. Install to conceal plenum space above acoustical ceiling system and to allow access.
F. Make provisions for vertical as well as horizontal suspension systems.

2.3 MANUFACTURERS
A. Specification is based on products listed in Part 3 Schedule below.
   1. Comparable products by one of the following are also acceptable. See Section 016000 - Alternates for submittal requirements.
2. Substitutions for products by manufacturers other than those listed above: See Section 016000 - Alternates.

2.4 MATERIALS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. Features:
      a. Size and Thickness: Refer to Part 3 Schedule below.
      b. Composition: Water felted.
      c. Joint: Kerfed and rabbeted.
      d. Edge: Beveled tegular.
      e. Surface Color: White.
      f. Surface Pattern: Match Basis of Design indicated in Part 3 Schedule below.
      g. Suspension System: Concealed grid.

2.5 SUSPENSION SYSTEM(S)

A. Manufacturers:
   1. Same as for acoustical units.
   2. Substitutions: See Section 016000 - Alternates.

B. Suspension Systems - General: ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Profile as specified in Finish Legend on the drawings.

2.6 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B. Support Channels and Hangers:
   1. Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

C. Perimeter Moldings at Changes in Elevation:
   1. Same material and finish as grid.

D. Seismic Suspension Edge Clips:
   1. Manufacturer’s approved, to meet code required movement without 2 inch wall angles.
a. Basis of Design: Seismic RX BERC2 clip components by Armstrong or ACM7 seismic clips components by USG.

E. Demountable Ceiling Grid Clips:
   1. C1430 variable placement hook clip by Armstrong.

F. Acoustical Sealant For Perimeter Moldings: Refer to Section 07 90 05 - Joint Sealers.

G. Touch-up Paint:
   1. Type and color to match acoustical and grid units.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer’s requirements before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with manufacturer’s instructions.

3.3 INSTALLATION

A. General: Install all materials in accordance with manufacturer’s instructions based on conditions present.

B. Suspension system:
   1. Install suspension system in accordance with ASTM C636/C636M and manufacturer’s instructions and as supplemented in this section.
   2. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
   3. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
      a. See also reflected ceiling plans. Where 50 percent unit cannot be achieved, consult Architect before installation.
   4. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
   5. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
   6. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
   7. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
8. Do not support components on main runners or cross runners if weight causes excess deflection.

9. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

10. Do not eccentrically load system or induce rotation of runners.

11. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

C. Acoustical Units:

1. Install acoustical units in accordance with manufacturer’s instructions.

2. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

3. Lay directional patterned units with pattern parallel to longest room axis if not shown on reflected ceiling plans.

4. Fit border trim neatly against abutting surfaces.

5. Install units after above-ceiling work is complete.

6. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

7. Cutting Acoustical Units:
   a. Cut to fit irregular grid and perimeter edge trim.
   b. Make field cut edges of same profile as factory edges.
   c. Double cut and field paint exposed reveal edges.
   d. Seal cut edges of ceiling panels to encapsulate edges to same level as factory finish using manufacturer’s recommended touch up materials.

8. Where obstructions occur, provide preformed closures to match perimeter molding.

9. Install hold-down clips on panels within 20 ft of an exterior door.

3.4 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.5 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.6 SCHEDULE

A. (ACT-1):
   2. Size: 3/4 x 24 x 24 inches.
3. NRC Rating: 0.75.
4. Suspension System Type: 15/16 inch Exposed Tee.
5. Location: Ceilings where indicated.

B . (ACT-2):
1. Basis of Design: Match existing USG Sheet Lay-In Ceiling.
2. Size: 1/2 x 24 x 48 inches.
3. UL Type FC-CB.
4. Suspension System Type: Match existing.
5. Location: Second floor ceilings where indicated.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Resilient sheet flooring.
   B. Resilient tile flooring.
   C. Resilient base.
   D. Resilient installation accessories.

1.2 RELATED REQUIREMENTS
   A. 03 54 00 - Cast Underlayment.

1.3 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 33 00 - Submittal Procedures.
      1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS
   A. Qualification Data: For installer.
   B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
   C. Shop Drawings: Indicate seaming plan.
   D. Flooring Sample: Submit two samples, 6 x 6 inch in size illustrating color and pattern for each resilient flooring product specified; heat weld rod samples for selection.
   E. Accessory Samples: Submit manufacturer's complete set of color samples for initial selection.
   F. Certificate: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
   G. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
   H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
   I. Maintenance Data: For user's operation and maintenance of system including:
      1. Methods for maintaining system's materials and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

3. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.5 MAINTENANCE MATERIAL

A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Flooring Material: 10 square feet of each type and color.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.8 WARRANTY

A. Provide minimum Manufacturers Limited 5 year commercial warranty for manufacturing defects.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Resilient sheet flooring, resilient tile flooring, resilient base and installation accessories for transition to other flooring types.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

2.3 RESILIENT SHEET FLOORING

A. Specification is based on one of the following manufacturers:
   1. Manufacturers:
      a. Armstrong.
      b. Forbo.
      c. Johnsonite, a Tarkett Company.
      d. Noraplan.
e. PRF USA, Inc.

f. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.

2. Features:
   a. Finish: to match existing color and patterns.
   b. Provide integral base with flooring.

3. Locations: Hallways and where indicated on floor plans.

B. Vinyl Composition: Infill at hallway to match adjacent existing finish, color and size.

1. Performance Requirements:
   b. Minimum Requirements: Comply with ASTM F1913, without backing.
   c. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

2.4 RESILIENT TILE FLOORING

A. Vinyl Composition Tile: ASTM F1066

1. Performance Requirements:
   a. Homogenous sheet good with color extending throughout thickness.
   b. Thickness: 0.125 inch.
   c. Minimum Requirements: Comply with ASTM F1913, without backing.
   d. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

2.5 RESILIENT BASE

A. Resilient Base: ASTM F1861, top set cove base, and as follows:

2. Type: Thermoset Rubber Base.
3. Thickness: 0.125 inch thick.
5. Length: Roll (4 foot sections are not acceptable except as maintenance stock).
6. Locations: Floor to wall transitions, architectural casework, and where indicated on drawings.

B. Comparable products by one of the following or other approved equal are also acceptable. See Section 01 25 00 - Substitution Procedures for submittal requirements.

4. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.

2.6 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B. Tier Edge Banding: See Section 05 50 00 Metal Fabrications.

C. Subfloor Filler:
   1. White premix latex; type recommended by adhesive material manufacturer.

D. Primers, Adhesives, and Seaming Materials:
   1. Waterproof; types recommended by flooring manufacturer.

E. Moldings, Transition and Edge Strips:
   1. Same material as flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.

B. Verify existing conditions meet the manufacturer's requirements before starting work, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

C. Verify that wall surfaces are smooth and flat within the tolerances specified, are dust-free, and are ready to receive resilient base.

D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. General:
   1. Install all materials in accordance with manufacturer's instructions based on conditions present.
   2. Starting installation constitutes acceptance of subfloor conditions.
   3. Fit joints tightly.
4. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

5. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   a. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
   b. Resilient Strips: Attach to substrate using adhesive.

6. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

7. Install flooring in recessed floor access covers, maintaining floor pattern.

8. At movable partitions, install flooring under partitions without interrupting floor pattern.

9. Turn sheet flooring up 4 inches to create integral cove base. Heat weld corner seams.

3.4 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Initial cleaning and finishing is the responsibility of the contractor.
   1. Follow manufacturer's recommendations for initial cleaning and finishing procedures.
   2. Not all types of flooring require finishing.

3.5 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.6 SCHEDULE

A. (VCT-1) Vinyl Tile:
   1. Basis of Design: Armstrong Imperial Texture Standard Excelon, to match existing.
   3. Size: 12 x 12 inches.

B. (VCT-2) Sheet Vinyl:
   2. Location: Room 194 as indicated on drawings.

C. (RB-1) Resilient Base:
   1. Basis of Design: Match existing.
   2. Color: Match existing.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Section includes epoxy resinous flooring systems.

1.2 RELATED REQUIREMENTS
A. Section 079200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.3 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene one week before starting work of this section.

1.4 SUBMITTALS
A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Samples: Submit two stone samples illustrating minimum and maximum stone sizes, color range, texture, and markings.
C. Samples: Submit mortar color samples.

1.5 QUALITY ASSURANCE
A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

1.6 PROJECT CONDITIONS
A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Comparable products by one of the following are acceptable.
   1. BASF Construction Chemicals, Inc.; BASF Building Systems.
   2. DUDICK Inc.
   4. PPG Industries, Inc.
   5. Sherwin-Williams Company; General Polymers.
   6. Stonhard, Inc.

B. Substitutions for products by manufacturers other than those listed below: See Section 01 25 00 Substitution Procedures.

2.2 RESINOUS FLOORING

A. Epoxy Flooring: Abrasion-, impact- and chemical-resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base.

B. Integral Base: See Section 09 65 00 Resilient Flooring.

C. Materials:
   1. Resin: Epoxy.
   2. Formulation Description: High solids or better.
   3. Application Method: Architect to select from manufacturer’s standard range.
   4. Aggregates: Manufacturer’s standard.
   5. Topcoat: Sealing or finish coats.
   6. Resin: Epoxy or Urethane.
   7. Formulation Description: High solids or better.
   8. Type: Pigmented.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
   1. Compressive Strength: 5,000 psi after 7 days per ASTM C 579.
   2. Tensile Strength: 1,000 psi per ASTM C 307.
   3. Flexural Modulus of Elasticity: 2,000 psi per ASTM C 580.
   4. Water Absorption: 1 percent, maximum, per ASTM C 413.
   5. Flammability: Self-extinguishing per ASTM D 635.
   6. Critical Radiant Flux: 0.45 W/sq. cm or greater per NFPA 253.
7. Hardness: .80 to .84, Shore D per ASTM D 2240.

2.3 ACCESSORIES

A. Primer: Type recommended by manufacturer for substrate and body coats indicated.

2.4 FORMULATION DESCRIPTION: HIGH SOLIDS OR BETTER.

A. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.

2.5 FORMULATION DESCRIPTION: HIGH SOLIDS OR BETTER.

A. Provide fiberglass scrim embedded in reinforcing membrane.

B. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

3.2 ROUGHEN CONCRETE SUBSTRATES AS FOLLOWS:

A. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

B. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

3.3 REPAIR DAMAGED AND DETERIORATED CONCRETE ACCORDING TO RESINOUS FLOORING MANUFACTURER'S WRITTEN INSTRUCTIONS.

3.4 VERIFY THAT CONCRETE SUBSTRATES ARE DRY AND MOISTURE-VAPOR EMISSIONS ARE WITHIN ACCEPTABLE LEVELS ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS.

A. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft.of slab area in 24 hours.

B. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.

C. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
3.5  ALKALINITY AND ADHESION TESTING: VERIFY THAT CONCRETE SUBSTRATES HAVE PH WITHIN ACCEPTABLE RANGE. PERFORM TESTS RECOMMENDED BY MANUFACTURER. PROCEED WITH APPLICATION ONLY AFTER SUBSTRATES PASS TESTING.

A. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

B. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

C. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.6  APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

3.7  COORDINATE APPLICATION OF COMPONENTS TO PROVIDE OPTIMUM ADHESION OF RESINOUS FLOORING SYSTEM TO SUBSTRATE, AND OPTIMUM INTERCOAT ADHESION.

3.8  CURE RESINOUS FLOORING COMPONENTS ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS. PREVENT CONTAMINATION DURING APPLICATION AND CURING PROCESSES.

3.9  AT SUBSTRATE EXPANSION AND ISOLATION JOINTS, COMPLY WITH RESINOUS FLOORING MANUFACTURER'S WRITTEN INSTRUCTIONS.

A. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

B. Apply reinforcing membrane to entire substrate surface.

C. Apply self-leveling slurry body coats in thickness indicated for flooring system.

3.10  BROADCAST AGGREGATES AT RATE RECOMMENDED BY MANUFACTURER AND, AFTER RESIN IS CURED, REMOVE EXCESS AGGREGATES TO PROVIDE SURFACE TEXTURE INDICATED.

A. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.

B. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.

C. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

D. Protect resinous flooring from damage and wear during the remainder of construction period.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Interior paint systems.

1.2 RELATED REQUIREMENTS
   A. 01 31 10 - Submittal Procedures.

1.3 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 10 - Submittal Procedures.
      1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS
   A. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
   B. Sample: Submit three paper chip samples, 8.5 x 11 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
   C. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
   D. Maintenance Data: For user's operation and maintenance of system including:
      1. Methods for maintaining system's materials and finishes.
      2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
      3. Recommendations on maintenance schedule.

1.5 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in the manufacture of paint and coating products used in the work of this section with minimum ten years of experience.
   B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Surface preparation and field application of paints.

2.2 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; unless noted otherwise below.

B. Paints:
   1. Pkr: Comex Group (Color Wheel, Frazee, General Paint, Kwal, or Parker): www.thecomexgroup.com
   6. MDC wall coverings distributor of Idea Paint.

C. Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.

2.3 MATERIALS

A. Interior paint systems:
   1. Ceilings: 3 coat system; primer and minimum 2 color coats.
      a. System: Epoxy, Low-VOC.
      b. Sheen: Flat.
      c. Color: Match existing.
   2. Walls: 3 coat system; primer and minimum 2 color coats.
      a. System: Epoxy, Low-VOC.
      b. Sheen: Eggshell.
      c. Color: Match existing.
   3. Hollow Metal Doors, Frames and Trim:
      c. Color: Match existing.
d. Locations:
   1) Reference Door Schedule.

4. Fiberglass Doors: See Section 081613.

5. Gypsum Board:
   a. System: Epoxy. Provide one of the following:
      b. Benjamore Moore:
         1) Primer: Ultra Spec 500 Interior Latex Primer.
         2) Intermediate Coat: Same as top coat.
         3) Top Coat: Corotech Pre-Catalyzed Waterborne Epoxy.
         4) Sheen: Semi-gloss, unless indicated otherwise.
      c. Sherwin Williams:
         1) Primer: Promar 200 Zero VOC Interior Latex Primer.
         2) Intermediate Coat: Same as top coat.
         3) Top Coat: Pro Industrial VOC WB Epoxy B73 Series.
         4) Sheen: Semi-gloss, unless indicated otherwise.
      d. PPG:
         1) Primer: Speedhide Zero VOC Latex sealer.
         2) Intermediate Coat: Same as top coat.
         3) Top Coat: Pitt Glaze WB1 Pre Catalyzed Water Borne Epoxy.
         4) Sheen: Semi-gloss, unless indicated otherwise.

2.4 ACCESSORIES
   A. All accessory materials required by the manufacturer for a warrantable installation of the
      installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION
   A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION
   A. General: Install all materials in accordance with manufacturer's instructions based on
      conditions present.
3.4 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.5 SCHEDULE

A. Colors:

1. Assume three colors in each room, one each for:
   a. Walls
   b. Ceiling
   c. Accent and Trim

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Signage and supports.

1.2 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 10 - Submittal Procedures.
      1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.3 SUBMITTALS
   A. Qualification Data: For fabricator and design engineer.
   B. Product Data: Provide product criteria, characteristics, accessories, jointing and attachment methods.
   C. Shop Drawings:
      1. Show sign mounting heights, locations of supplementary supports, and accessories.
      2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
   D. Sample: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
      1. Acrylic Sheet: 8 by 10 inches for each color required.
      2. Accessories: One of each, for each type.
   E. Manufacturer’s Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
   F. Maintenance Data: For user’s operation and maintenance of system including:
      1. Methods for maintaining system’s materials and finishes.
      2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
      3. Include manufacturers’ brochures and parts lists describing the actual materials installed.

1.4 QUALITY ASSURANCE
   A. Manufacturer Qualification: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
   B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.
1.5 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Signage as required by code and to facilitate wayfinding.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Tactile and Braille Characters: Text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Produce precisely formed characters with square-cut edges free from burrs and cut marks. Text shall be accompanied by Grade 2 Braille. Braille dots with domed or rounded shape produced using Raster Method.
   1. Raised-Copy Thickness: Not less than 0.7 mm and not more than 3 mm.

2.3 MATERIALS

A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

2.4 FABRICATION

A. Panel Signs - Acrylic: Match existing UW building standard.
   1. Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner signs.
   2. Edge Condition: Square.
   3. Corner Condition: Square.
   4. Mounting: Unframed, as indicated.
      a. Wall or Projection mounted with concealed attachment.
      b. Manufacturer's standard anchors for substrates encountered.
   5. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.

2.5 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.
3.2 PREPARATION
   A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION
   A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 ADJUSTING
   A. Adjust and lubricate hardware for proper operation.

3.5 PROTECTION
   A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Corner guards.

1.2 SUBMITTALS

A. Product Data: Provide product criteria, characteristics, accessories, jointing and methods, and termination details for curtains, track and accessories.

B. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

C. Maintenance Data: For user's operation and maintenance of system including:
   1. Methods for maintaining system's hardware, operation, materials and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
   3. Recommendations on maintenance schedule.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Surface applied wall protection including corner guards.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.3 MATERIALS

A. Corner guards.

1. Stainless Steel Corner Guards:
1) Comparable products by one of the following are also acceptable. See Section 01 25 00 - Substitution Procedures for submittal requirements.
   a) CO-08 Series by Construction Specialties Inc.
   b) GS Series by Korogard.

2) Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.
   c. Finish: #4 Satin.
   d. Height: 4 feet, as noted on drawings.
   e. Leg Length: 1 inch.
   f. Mounting: Surface mounted, installed with adhesive.

2.4 ACCESSORIES
   A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify existing conditions meet the manufacturer’s requirements before starting work, including location of blocking.

3.2 PREPARATION
   A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION
   A. General: Install all materials in accordance with manufacturer’s instructions based on conditions present.
   B. Install components plumb, level, square, and in proper alignment with drawings.

3.4 ADJUSTING
   A. Repair minor damages to finish in accordance with manufacturer’s instructions and as approved by Architect.

3.5 PROTECTION
   A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.
B. Fire extinguisher cabinets.

1.2 RELATED REQUIREMENTS

A. 09 21 16 - Gypsum Board Assemblies: Roughed-in wall openings and blocking.

1.3 SUBMITTALS

A. Qualification Data: For manufacturer.
B. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.
C. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, wall bracket mounted measurements, and location.
D. Manufacturer’s Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
E. Maintenance Data: For user's operation and maintenance of system including:
   1. Test, refill or recharge schedules and re-certification requirements.
   2. Methods for maintaining system's materials and finishes.
   3. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Fire extinguishers, fire rated and non-rated cabinets, surface or recess mounted with accessories for proper use.
2.2 PERFORMANCE AND DESIGN CRITERIA

A. Portable fire extinguishers shall be selected and installed in accordance with this section and NFPA 10.
   1. 2012 IBC.906.2.

2.3 MATERIALS

A. Fire Extinguishers:
   1. Multi-Purpose Dry Chemical Extinguisher:
      a. Specification is based on MP Series by Larsen's Manufacturing Co.
         1) Other approved equal products by one of the following are also acceptable. See Section 01 25 00 - Substitution Procedures for submittal requirements.
         2) Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.
      b. Performance Criteria:
         1) Complying with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
         2) Labeled by UL for the purpose specified and indicated.
         3) Class: A:B:C.
         4) UL Rating: 4A-80B:C.
         5) Extinguisher Model: Larsen's #MP10.
         6) Size: 10 pound.
      c. Features:
         1) Finish: Baked polyester powder coat.
         2) Color: Red.

B. Fire extinguisher cabinets:
   1. Recess Mounted Cabinets in Fire Rated Walls:
      a. Specification is based on FS Series by Larsen's Manufacturing Co.
         1) Other approved equal products by one of the following are also acceptable. See Section 01 25 00 - Substitution Procedures for submittal requirements.
         2) Substitutions for products by manufacturers other than those listed above: See Section 01 25 00 - Substitution Procedures.
b. Performance Criteria:
   1) Sized to fit specified fire extinguisher.
   2) Provide Flame Shield option to maintain fire rating of assembly.

c. Features:
   1) Door and Trim Material: Cold steel sheet with recoatable white polyester finish.
   2) Door Style: Convex, clear plastic bubble window.
   3) Trim Style: Flat with square corners.
   4) Glazing: Clear Acrylic.
   5) Finish of Cabinet Exterior Trim and Door: Red enamel.

2. Surface Mounted Cabinets:
      1) Comparable Products:
         a) Ansul, Inc.
         b) JL Industries, Inc.
   b. Performance Criteria:
      1) Sized to fit specified fire extinguisher.
   c. Features:
      1) Door and Trim Material:
         a) Stainless steel.
      2) Door Style: Convex, clear plastic bubble window.
      3) Trim Style: Flat with square corners.
      4) Glazing: Clear Acrylic.
      5) Finish of Cabinet Exterior Trim and Door: White enamel.

2.4 ACCESSORIES

   A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

   B. Manufacturer's accessories required by the project:
      1. Extinguisher Brackets: Formed steel, galvanized and enamel finished.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Verify existing conditions meet the manufacturer's requirements before starting work.
3.2 PREPARATION
   A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION
   A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 ADJUSTING
   A. Adjust and lubricate hardware for proper operation.

3.5 PROTECTION
   A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.6 SCHEDULE
   A. Typical Cabinets:
      1. Material: Steel.
      2. Type: Recessed.
   B. Concrete and Masonry Walls:
      1. Material: Stainless Steel.
      2. Type: Surface Mounted.

END OF SECTION
PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies requirements for the selection, installation, and testing of laboratory fume hoods. The scope of work includes, but is not limited to, the following:

1. Bench-top laboratory fume hoods and bench-top laboratory A.D.A. accessible fume hoods as indicated.

2. The installation of all specified accessories such as air flow safety monitors, cup sinks, fixtures (including petcocks), lighting, electrical receptacles, dry chemical fire suppression systems, base cabinets, work surfaces, and filler panels.

3. Fume Hood internal plumbing and wiring.

B. The Contractor shall provide all miscellaneous parts and labor required to provide a complete and functioning fume hood.

C. Conduct onsite commissioning of fume hoods to verify proper installation and operation of fume hoods and accessories.

1.2 RELATED SECTIONS

A. 11 53 43, "Service Fittings and Accessories"

B. 12 35 53.13, “Modular Steel Laboratory Casework”

C. Divisions 22 & 23, “Plumbing” and “Heating Ventilation and Air Conditioning (HVAC)”

D. Division 26, “Electrical”

1.3 INSTALLER QUALIFICATIONS

A. Fume hoods shall be installed by skilled electricians and mechanics, all of whom are properly trained and qualified for this work. Installers must be certified by the manufacturer, and have three years’ experience with installation of this manufacturer’s equipment. As a minimum, the system must conform to all codes and manufacturers’ instructions and recommendations.

1.4 SUBMITTALS

A. Prepare and submit in 11 inch by 17 inch electronic PDF format CAD Shop Drawings and product data. Include:

1. Plans, elevations, sections, and details illustrating shop fabrication, field assembly, and installation.

   a. Show size and location of all cutouts.
2. Fume hood data including all components and accessories
   a. Identify all manufacturer standard components with catalog numbers, and identify all materials of custom-fabricated items.
3. Air Flow Monitor manual with calibration instructions
4. Manufacturer’s test and certification data
5. Manufacturer’s installation manual

B. For Owner’s Final Inspection, prepare and submit fume hood FPT documentation
C. For Substantial Completion, submit O&M Manual information required by Section 01 77 00.

1.5 WARRANTY

A. Warrant for a period of one year from the date of Substantial Completion that the fume hood(s) installation shall be free of defects in material and workmanship and that it will not fail, or otherwise fail to perform as required.

PART 2 – PRODUCTS

2.1 FUME HOOD MANUFACTURERS AND MODELS

A. The following CAV fume hoods are approved for this Project:
   1. Mott: SafeGuard TM
   2. Kewaunee: SupremeAir Venturi LX Series
   3. Labconco: XStream

B. No substitutions permitted.

2.2 FUME HOOD ACCESSORIES

A. Fume hoods shall be pre-piped to a single point connection at top of hood, insulate pipes as required by code. Unions not acceptable. Piping shall comply with the Uniform Plumbing Code (UPC).

B. Fume hoods shall be pre-wired to a junction box on top of the hood. Wiring shall comply with the National Electric Code (NEC).

C. Vacuum breakers: Provide “in-line” style vacuum breaker concealed in side post of hood.

D. Gas fittings shall be AGA rated.

E. Interior liner material shall be constructed of Fiberglass Reinforces Polyester Components.
F. Work surfaces shall be constructed of epoxy resin material (1.25 inches thick) and be dished a nominal 1/2 inch to contain spills.

G. Cup sinks: Solid epoxy resin fabrication. Cove inside corners and pitch bottom to threaded drain outlet. Provide 1/4 inch lip at opening to prevent spill runoff. Locate cup sinks next to a side wall not less than 203 mm nor more than 356 mm beyond the interior of the vertical sash. Center under tips of cold water faucets. Provide access to cup sink trap.

H. Base cabinets: Provide base cabinets under fume hoods in size, material, and configuration as shown on the Drawings. Metal cabinets shall be same brand as the fume hood and wood cabinets shall be same brand as casework specified in “Laboratory Casework.”

   1. Base cabinet storage units for flammable materials shall be constructed to comply with requirements of the Uniform Fire Code as adopted by the local jurisdiction. Cabinets shall be UL rated. DO NOT exhaust flammable cabinets.

   2. Base cabinet storage units for acids and bases shall be constructed of appropriate corrosion-resistant materials. Exhaust the cabinet into the fume hood plenum using appropriate materials.

I. Furring panels: Where called for, provide matching finish furring panels to enclose the space between top edge of fume hoods and the finished ceiling and/or adjacent walls.

   1. Panels shall be flanged, notched and reinforced to form a well-fitted enclosure, free from oil-canning.

   2. Panels shall be removable for maintenance purposes.

2.3 MONITORS

A. Provide fume hood manufacturer’s recommended CAV face velocity monitor with a local audible and visual alarm, capable of detecting a drop or rise in airflow (not static pressure) through the hood.

B. The monitor shall be digital with a LDC screen.

C. All parts of the system which are apt to be in contact with vapors or gases in the fume hood shall be chemically resistant, such as the controller, sensing device, and wiring.

D. Provide a means to mute the audible alarm. The silence device shall not turn off the warning light.

E. Provide a means for setting the alarm set point to the exhaust level desired. This adjustment shall be “internal” so that it is not readily adjustable by operating personnel.

F. The low level alarm point is 80 feet per minute (fpm).

2.4 TESTING EQUIPMENT
A. Testing equipment must be maintained and calibrated in accordance with manufacturer’s specifications and have been calibrated within the past year. Indicate calibration dates and equipment type on test data form.

PART 3 – EXECUTION

3.1 DELIVERY AND IDENTIFICATION

A. Deliver fume hoods to the job-site, clearly identified in plain view with easy to read lettering specifying fume hood manufacturer, size and type of fume hood, sash type and any special features included. In addition, both the shipping container and the fume hood shall be clearly labeled in plain view with the serial number.

3.2 INSTALLATION

A. Make all field measurements, and verify all dimensions and that required utilities are roughed-in and ready for hook-up prior to installation.

B. Install fume hood base cabinets plumb and level and parallel to walls and in accordance with manufacturer’s instructions.

C. Install monitors in accordance with manufacturer’s instructions.

D. Final connections are work of Divisions 22, 23 and 26.

E. Adjust sash, fixtures, accessories and other moving or operating parts to function smoothly.

F. Fume hood Installation shall meet seismic support and anchorage requirements of the local AHJ. Coordinate the installation of all supplementary framing and backing plates.

G. Repair or remove defective work upon completion of installation. Touch up as required.

H. Remove all packing materials, tags, tape, and shipping materials.

3.3 CLEANING AND PROTECTION

A. Clean all exposed interior and exterior surfaces and protect from damage by work of other trades.

3.4 CONTRACTOR FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Pre-test meeting: The Contractor shall coordinate its FPT activities of fume hoods, including test procedures and FPT documentation, with the Owner’s confirmation testing activities. Attendees shall include the Contractor and the fume hood(s) Subcontractor, the responsible TAB engineer, and (working through the Owner’s Representative) Owner’s EH&S personnel responsible for confirmation testing.

   1. This meeting shall include a face velocity test of at least one fume hood by the TAB Subcontractor with a representative of the Owner’s EHS department present. B.
Contractor face velocity testing shall not start until the following is complete: 1.

Pre-test meeting

2. Verification that all specified fume hood components and accessories are provided.

3. Start-up and functional performance testing of all fume hood accessories and utilities is complete and in accordance with manufacturer’s specifications and the HVAC system has been balanced.

4. Ceiling tiles are in place and laboratory doors are closed (the space is contained).

C. For each fume hood, the Contractor shall perform and document the following FPT requirements:

1. Face velocity
   a. The operational target air velocity with the sash height at 18 inches is 100 feet per minute (fpm) +/- 10%.
   b. Conduct second test with the target air velocity with the sash height at 18 inches is 70 fpm +/- 10%.
   c. Face velocity shall be tested using a VelGrid probe by Shortridge instruments, or an anemometer.

2. Sound level
   a. Sound level must be at or below 65 dBA measured with the sash height at 18” and the sound level meter located 3 feet from the sash and 5 feet above the floor.
   b. Sound level shall be tested using a Type 2 sound level meter manufactured to meet the American National Standards Institute (ANSI) S1.4 “Standard for Sound Level Meters” capable of measuring decibels in dBA.

3. Monitor functionality
   a. The CAV fume hood monitor is verified to be functioning and properly calibrated.
   b. Verify that the face velocity is displayed.
   c. Raise the sash to reduce the face velocity. Confirm that both the visible and audible alarm signals function when the velocity drops below 80 fpm.
   d. Test the monitor’s mute function and the reset button.
   e. This test fails if the monitor does not alarm, is more than 10 fpm out of calibration, or if it fails any functional test or is damaged.
4. CAV tracking
   
a. The average face velocity, when the sash is located at half of the optimized sash height (typically 9 inches), must be +/- 20 fpm of the average face velocity measured at 18” sash height.

b. This test fails if the system does not adjust to meet this requirement within 30 seconds.

D. Fume Hood FPT Documentation

   1. Record all test data on FPT data field forms for each fume hood.

3.5 OWNER’S FINAL INSPECTION REQUIREMENTS

A. Owner’s fume hood confirmation testing is an activity of Owner’s final inspection. The Contractor shall provide Owner ten (10) working days advance notice to schedule Owner’s fume hood confirmation testing. This activity shall be included in the construction Progress Schedule.

   1. Include:

      a. Complete fume hood FPT documentation.

      b. For each fume hood type, the manufacturer’s installation and operation manual.

      c. For each monitor type, the manufacturer’s manual with calibration instructions.

B. The EH&S Department, on behalf of the Owner, will review the Contractor’s FPT documentation. If the documentation meets the performance requirements of these specifications, then the Owner will conduct confirmation testing of each fume hood in accordance with the Scientific Equipment and Furniture Association (SEFA) standard 1 for face velocity, sound level, and monitor functionality.

C. The Owner will notify the Contractor if any fume hoods fail confirmation testing. Any fume hoods that do not meet the performance requirements shall be repaired and re-tested by the Contractor. The Contractor shall submit new FPT documentation for review and additional confirmation testing until each fume hood passes the Owner’s confirmation testing.

   1. Once the final testing is accepted and complete, the Owner will place appropriate UW labels on the fume hoods allowing use and this Work shall be substantially complete.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water, laboratory gas, and electrical service fittings.

B. Laboratory sinks.

1.2 RELATED REQUIREMENTS

A. Section 12 35 53.13 “Metal Laboratory Casework” for laboratory casework, including base cabinets and wall cabinets.

B. Section 11 53 13 “Laboratory Fume Hoods”

C. Division 22, “Plumbing”

D. Division 26, “Electrical”

1.3 SUBMITTALS

A. Product Data: For each type of laboratory fitting, fixture, and sink.

B. Shop Drawings: Refer to Section 12 35 53.13 “Metal Laboratory Casework” for laboratory casework and fittings showing plan layout, elevations, ends, cross-sections, service run spaces, location and type of service fittings, together with associated service supply connection required.

1. Submit shop drawings as one complete submittal that includes all items specified in this section. Submittals that include only part of the specified items of this section are not acceptable and will be rejected.

2. Coordinate shop drawings with other work involved.

3. Samples: Submit the following:

   a. One sample of each mechanical and electrical service fitting specified, complete with fittings and accessories and in specified finish.

   b. Sample units will be used to demonstrate aesthetic effects as well as functional performance of materials and execution. Sample units may not be incorporated in work.

4. Submit All Shop Drawings in 11” x 17” PDF Format.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Laboratory casework manufacturer shall coordinate locations and installation of tops, sinks, and service fittings for single responsibility within the laboratory areas and rooms.

B. Catalog Standards:

   1. Manufacturer’s catalog numbers may be indicated for convenience in identifying certain laboratory service fittings. Unless modified by notation on drawings or otherwise specified, catalog description for indicated number constitutes requirements for each item.
2. The use of catalog numbers and specific requirements set forth in drawings and specifications are not intended to preclude the use of comparable products of other acceptable manufacturers, but are given for purpose of establishing standard of design and quality for materials, construction, and workmanship.

C. Provide laboratory service fittings in conformance with SEFA 7, "Recommended Practices for Fixtures."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver laboratory fittings and fixtures only after building is enclosed, weather tight, and wet operations in building are completed.

B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.6 PROJECT SITE CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory service fittings until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not begin installation of fittings and fixtures until installation of adjacent and supporting laboratory casework is complete.

1.7 WARRANTY

A. Furnish a written warranty covering the work and materials of this section for a period of 2 years from the date of acceptance of the work by the Owner against defects or non-conforming materials and/or workmanship.

1.8 COORDINATION

A. Coordinate installation of laboratory service fittings with installation of laboratory casework, fume hoods and other laboratory equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Epoxy Sinks:
   a. Durcon Incorporated.
   b. Kewaunee
   c. Prime Industries.

2. Laboratory Service Fittings:
2.2 SINKS, GENERAL

A. Sizes: As indicated or manufacturer's closest stock size of equal or greater volume, as acceptable to Laboratory Planner.

B. Drain Outlet and Tail Piece: 1-1/2 inch diameter, 6 inch minimum length, fabricated of same material as sink wherever possible, or as otherwise acceptable to Architect.

C. Overflows: For each sink, except cup sinks, provide overflow of standard beehive or open top design with separate strainer; height 2 inch less than sink depth; same material as sink.

2.3 CAST EPOXY RESIN SINKS

A. Nonspecular, integrally molded in one piece with surfaces smooth, corners coved and bottom sloped to outlet. Minimum physical properties and chemical resistance as specified for case epoxy resin tops; 0.5 inch minimum thickness.

   2. Sink Style: Drop-in type.

2.4 LABORATORY SERVICE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

   1. Water Saver Faucet Co.
   2. Chicago Faucet
   3. Broen

B. Laboratory Service Fittings: Provide units that comply with SEFA 7, "Laboratory and Hospital Fixtures - Recommended Practices." Provide fittings complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.

C. Laboratory service fixtures including those provided as an integral part of other laboratory equipment (e.g., fume hoods), shall be the product of one manufacturer, unless otherwise noted.

D. Service fixtures are identified by manufacturer model number indicated in the "Fixture Types" schedule shown on the Drawings.

E. Provide units complete with washers, locknuts, unions, nipples and other accessories for positive mounting to supporting laboratory units. Include wall and deck flanges, escutcheons, panel mounted valves-front loaded, and similar items required.
F. Factory-assemble service fixtures including assembly of valves and shanks to turrets, flanges, and other mounting accessories.

G. Testing: Test valves individually at the following pressures:

1. Standard Needle Valves: 190 psi air pressure for working pressure of 125 psi.
2. Needle Valves: 300 psi helium pressure for working pressure of 200 psi.
3. Needle Point Cock Valves: 100 psi air pressure for working pressure of 60 psi.
4. Laboratory Ball Valves: 125 psi air pressure for working pressure of 75 psi.

H. Materials: Fabricate laboratory service fittings from cast or forged brass containing a minimum of 85 percent copper. Fabricate replaceable seats, needle cones, valve disc screws, and other accessories from monel or stainless steel alloy of a type suitable for intended use.

I. Hose Ends:

1. Provide ten serration tapered hose ends with 3/8-inch dia. IPS thread and 1/8-inch diameter where indicated.
2. Provide 0.75 inch hose threaded outlet where indicated.
3. Refer to “Lab Fixture Type Legend”.

J. Turrets: Furnish with 3/8 inch IPS female inlet thread, brass shanks, brass locknuts, and washers.

K. Flanges: Furnish with 3/8 inch IPS female inlet, unless otherwise indicated.

L. Mounting Shanks: 3/8 inch IPS mounting shank with locknut and washer.

M. Goosenecks: Where goosenecks are indicated to swing, swivel point shall be at turret if deck mounted or at valve level if wall or panel mounted; swing joints shall have heavy teflon packings; “O” rings in swing joints are not acceptable.

N. Handles: Provide 3 arm or 4 arm forged brass or molded nylon handles for valves, stops, faucets, remote controls, and cocks; except for ground key cocks, and micro-adjustable needle cocks.

1. Blade handles at ADA accessible sink where shown. Refer to “Lab Fixture Type Legend”.

O. Hand of Fittings: Furnish right hand fittings unless indicated otherwise.

P. Finish: Provide exposed surfaces, including fittings, escutcheons, and trim with acid- and solvent-resistant finish.

1. Polished Chrome with Clear Epoxy Coating: Polish and buff exposed surfaces, then electroplate with one layer of nickel and one layer of chrome. Each layer of plating shall cover all visible areas. Following plating, thoroughly clean and degreases surfaces to be coated; apply clear epoxy coating and cure by baking. Minimum coating thickness: 2.0 mils.

Q. Chemical Resistance of Finishes: Subject coated samples to the following tests:
1. **Fume Test:** Suspend coated samples in a container of at least 6 cubic ft capacity, approximately 12 inches above open beakers, each containing 100 cc of 70% nitric acid, 94% sulfuric acid and 38% hydrochloric acid, respectively. After exposure to these fumes for 150 hours, finish shall not show discoloration, disintegration, or other defect.

2. **Direct Application Test:** Subject coated samples to direct action of the reagents and solvents listed below at a temperature of 25 deg C dropping from a burette at the rate of 60 drops per minutes. Finish shall not rupture; slight discoloration or temporary softening is permitted.

3. Acetic acid (98 %), acetone, ammonium hydroxide (28%), benzene, carbon tetrachloride, ether, ethyl acetate, ethyl and other alcohol, formic acid, hydrochloric acid (38%), hydrofluouric acid (48%), methanol, methyl ethyl ketone, naphthalene, nitric acid (70%), phosphoric acid (75%), sulfuric acid (87%), toluene, xylene.

### R. Service Outlet Identification:

1. Provide plastic index discs with identification letters at each service fitting handle or knob. Identify services as follows:

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>COLOR</th>
<th>CODE</th>
<th>LETTER COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Orange</td>
<td>AIR</td>
<td>Black</td>
</tr>
<tr>
<td>Vacuum</td>
<td>Yellow</td>
<td>VAC</td>
<td>Black</td>
</tr>
<tr>
<td>Gas</td>
<td>Dark Blue</td>
<td>Gas</td>
<td>White</td>
</tr>
<tr>
<td>Lab Hot Water</td>
<td>Red</td>
<td>LHW</td>
<td>White</td>
</tr>
<tr>
<td>Lab Cold Water</td>
<td>Dark green</td>
<td>LCW</td>
<td>White</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>Pink</td>
<td>CO2</td>
<td>Black</td>
</tr>
<tr>
<td>DI Water</td>
<td>White</td>
<td>DI</td>
<td>Black</td>
</tr>
<tr>
<td>Argon</td>
<td>Violet</td>
<td>AR</td>
<td>White</td>
</tr>
<tr>
<td>Helium</td>
<td>Black</td>
<td>HE</td>
<td>White</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>Pink</td>
<td>HYD</td>
<td>White</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Brown</td>
<td>NIT</td>
<td>White</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Light green</td>
<td>OXY</td>
<td>Black</td>
</tr>
</tbody>
</table>

### S. Standard Needle Valves:

1. Provide standard needle valve of brass or Type316 stainless steel construction with floating stainless steel needle that self-centers on valve seat and forms a matched fit with the seat, improving with use; replaceable stainless steel seat threads into valve body. Molded TFE stem packing with adjustable packing nut that permits take-up of wear; fine stem threads provide good metering of flow.

2. Valve travels from closed to fully open in 2 full revolutions of handle; four-arm style handle of forged brass or molded nylon.

3. Where used for pure gases, valves shall be cleaned, lubricated, and packed to maintain purity of media.

4. Where used for oxygen and other pure gases, valves shall be cleaned, lubricated, and packed to maintain purity of media.

### 2.5 WATER FAUCETS AND VALVES
A. Forged or cast brass valve body; provide units with renewable barrel locked in valve body. Barrel shall contain all wearing parts; with renewable discs; molded TFE stem packing; self-lubricating, high durometer, thermoplastic valve disc.

1. Metal-to-metal or ground type of sealing is not acceptable.

B. Provide Units That Are:

1. Readily converted from compression to self-closing (or the reverse) without disturbing faucet body.

2. Readily converted from steam valve to water valve or needle valve (or the reverse) with outside packing gland without disturbing faucet body.

C. Valve travels from closed to open in 120 deg rotation of handle; double-acme stem thread; forged brass four-arm handle.

D. Provide adjustable volume control to regulate flow of water through valve. Volume control can conserve water, compensate for high water pressure, and minimize splashing.

E. Vacuum Breakers: Provide vacuum breakers on all water fittings (laboratory hot and laboratory cold). Provide the following types:

1. Integral atmospheric vacuum breakers.

2. Remote atmospheric vacuum breakers.

F. Handles: Provide handles as noted on Fixture Schedule.

2.6 REMOTE CONTROL VALVES (FOR FUME HOODS)

A. Mount remote control valves on the front panel of fume hood, with components subject to wear accessible from the exterior of the hood. Mount with valve stem parallel to side wall of the fume hood. The centerline of the valve inlet and outlet shall be parallel. Valves shall have a threaded collar to hold valve in place, and a forged brass body and forged brass four-arm handle with a full view color-coded type index disc.

1. Valves for gas, air, vacuum, and special gas service shall be needle type design either fine control or standard construction, as indicated in Lab Fixture Type Legend, with a self-centering replaceable stainless steel floating cone and replaceable stainless steel valve seat. Valves for water and steam service shall have a renewable flat valve disc and replaceable stainless steel seat.

B. For fittings inside fume hoods, coat with acid and solvent resistant baked on plastic OR epoxy coating in manufacturer's standard color as acceptable to Architect.

2.7 ELECTRICAL SERVICE FITTINGS

A. If required, electrical service fittings are specified in Division 26 - ELECTRICAL.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine roughed-in mechanical and electrical services, installation of floors, walls, columns, and ceilings, and other conditions affecting installation of fittings and fixtures.
   Verify dimensions and locations of services and substrates before fabricating work.

B. Notify Architect of unsatisfactory conditions preventing proper installation of fittings and fixtures.
   Do not proceed with fabrication and installation until unsatisfactory conditions have been corrected in manner satisfactory to Architect and Owner.

C. Start of work shall indicate acceptability of related work.

### 3.2 INSTALLATION OF SERVICE FITTINGS, WATER FAUCETS AND VALVES

A. Comply with requirements in other Sections for installing laboratory service fittings, water faucets and valves, and electrical devices.

B. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

### 3.3 FIELD QUALITY CONTROL

A. Testing: Coordinate use of fittings and fixtures after service lines have been tested and balanced, and pressure, voltage, and similar requirements have been properly adjusted. Do not operate service lines until they have been cleaned and sanitized.

B. Test each item to demonstrate that it is operating properly and that controls and safety devices are functioning. Repair or replace fittings or fixtures found to be defective in operation, including units that are operating below capacity or with excessive noise or vibration.

### 3.4 CLEANING AND PROTECTING

A. After testing remove protective coverings and clean equipment. Restore exposed and semi-exposed finishes; remove abrasions and other damage, polish bare metal surfaces and touch-up painted surfaces.

1. Buff exposed stainless steel finishes lightly, using power buffer and polishing rouge or grit of No. 400 or finer.

2. Touch-up minor abrasions and imperfections in painted finishes with coating which matches factory-applied finish.

B. Clean and sanitize equipment, and repair or replace deteriorated or defective equipment to a condition free of damage and deterioration at time of Owner's final acceptance of the equipment.

END OF SECTION
PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Bench-top laminar flow polypropylene fume hood.
   2. Laboratory sinks and cup sinks in fume hood.
   3. Water, laboratory gas, and electrical service fittings in fume hood.
   4. Piping and wiring within fume hood for service fittings, light fixture, blower switches, and other electrical devices.
   5. Onsite commissioning of fume hood to verify proper installation and operation of fume hood and accessories.

B. Related Section include the following:
   1. Section 12 35 53.23 Modular Polypropylene Laboratory Casework
   2. Section 22 Plumbing
   3. Section 23 Heating, Ventilation and Air Conditioning
   4. Section 26 Electrical
   5. Section 01-6000 Product Requirements

1.2 REFERENCES

A. NFPA 45: Standard on fire protection for laboratories using chemicals; chapter 6 Ventilating System, Chapter 9-2.8 Laboratory Hoods.

B. NFPA 56C: Safety standard for laboratories in health-related institutions, chapter 3-3.5: Fume Hoods.


F. SEFA: Scientific Equipment and Furniture Association 1.

G. ANSI standard for laboratory ventilation: ANSI/AIHA Z9.5


I. International Building Code with local amendments; including DPD Director's Rules.

J. International Building Code with local amendments; including SFD Administrative Rulings.

K. Local rules and interpretations required by the authority having jurisdiction, including City
Building and Fire Codes.

1.3 DESIGN REQUIREMENTS

A. Limited Bypass Exhausted Polypropylene Fume Hood: Function as ventilated, enclosed workspace, that captures, confines and exhausts fumes, vapors and particulate matter produced or generated in the enclosure within the performance parameters specified when tested in accordance with ASHRAE 110-2016 including modifications specified herein. Fume Hood shall function as Constant Air Volume (CAV) operation at an average face velocity 100 FPM.
   1. Fume hood shall function as ventilated, enclosed workspaces, designed to capture, confine and exhaust fumes, vapors and particulate matter produced or generated within the enclosure.
   2. Provide uniform airflow through the hood face for any sash position.
   3. Maintain essentially constant exhaust volume at any baffle position.
   4. Size and Configuration Required: As indicated on lab furnishings drawings.
   5. Flammable Storage Cabinets: Comply with NFPA 30, and Uniform Fire Code Section 7902.5; conform to local fire department certification requirements. Cabinet listed by an organization acceptable to the local fire department as complying with identified standards and has been tested and found suitable for storage of flammables.
   6. Hood Size: Configurations and dimensions as indicated LF drawings.
   7. Complete one-piece bench top PVC hood with minimum use of metal parts. All metal parts are totally enclosed in plastic, HEPA filter is separator-less, and the adjustable window is 3/8” polycarbonate material to access the nonmetal work zone.
   8. Standard fitted bases to accommodate the width, depth and desired work surface height.
   9. Safety Monitors: Provided for minimum and maximum air volume, produce local visual and audible alarm signal. Set points easily adjusted with a high degree of sensitivity.

1.4 DELIVERY, STORAGE AND HANDLING

A. PVC fume hoods and related materials require the interior building temperature not to exceed 90°F to avoid undue structural fatigue and damage.

B. Finished surfaces will be protected from soiling or damage during handling. The equipment comes with a protective film that should be left in place while handling, and then removed only where pieces are mated during installation.

C. When ambient temperatures are below 30°F, careful handling is required to prevent PVC from cracking.

1.5 SUBMITTALS

A. Shop Drawings: Submit in 11 inch by 17 inch electronic PDF format; fully dimensioned scale drawings; large scale plans indicating equipment locations, elevations, cross sections, casework details, required clearances, rough-in and anchor placement dimensions and tolerances.
   1. Templates: Obtain as necessary for shop preparation of fume hoods to receive components installed by others and field installed components. Coordinate mounting heights for standard fume hoods and A.D.A. fume hoods and, installation requirements.
B. Product Data: For each component and item of equipment. Include technical and performance characteristics, dimensions, construction details, and attachments.
   1. Include all information necessary for coordination of mechanical systems and building services to accommodate installation of fume hood.

C. Approved Substitution / Approved Equal: In addition to the items required in Division 1, all substitution requests shall include item-by-item comparison of the proposed substitution to this project specification. A copy of the project specification shall be submitted, with each item and subsection of the project specification marked as “Comply” or “Not Comply.” In any cases where “Not Comply” is indicated, an explanation of the relative advantages of the proposed design shall be provided.

D. Samples: Three of each, one sample will be returned.
   2. Cabinet Hardware, service fixtures, and exposed accessories.

E. Submit detailed seismic anchorage and attachment drawings and calculations complying with all IBC requirements and regulations for seismic restraint (where applicable).

F. Miscellaneous Submittals:
   1. Operation and Maintenance Manuals: Complete information on operation procedures under all conditions, emergency shutdown, trouble-shooting, and replacement parts listing, and maintenance procedures and requirements.
   3. Quality Control: Source and Field Quality Control test reports for each hood type and configuration; demonstrate conformance design and performance requirements.

G. ASHRAE 110 test report completed within the last 12 months.

H. Submit the manufacturer’s installation manual & equipment specific startup documents as a part of the initial equipment submittal.

I. Submit the manufacturer’s operating and maintenance manual as a part of the initial equipment submittal.

1.6 QUALITY ASSURANCE

A. Manufacturer's and Installer’s Qualifications: Ten years successful experience in the manufacture and installation of equipment of the type specified.
   1. Five installations similar in scope and nature to the work required. At least two of these shall have been installed by the entity proposed to perform installation for this Project.
   2. Manufacturer: Provide a single point of supply for work of this Section and Section 12 35 53.23.
   3. Installer: Certified by the manufacturer, three years experience with installation of this manufacturer's equipment.
      a. Foreman: Employed by this firm at least five years and shall be on site at all times installation work is being performed.

B. Factory Testing: Prior to delivery to the job site every hood shall be tested to manufacturer’s
specifications for performance and safety and a copy of the “Inspection Report” report shall accompany each hood. One representative sample hood of each type shall have been tested according to the test procedures outlined below to verify that subsequent production models meet the “Personnel Protection Factor”. The test facility (emulating actual operating conditions), samples, apparatus and instruments to be supplied by the manufacturer.

C. ANSI/ASHRAE 110-2016: A tracer gas is introduced 6-inches behind the sash at a rate of 4 liters per minute. A sensor located outside the work zone monitors for gas leakage from the hood face. The “Personnel Protection Factor” shall be less than 4.0 AM at less than 0.1 PPM, in the center, right and left sides of the work access opening.

1.7 SITE CONDITIONS

A. The Contractor is expected to provide all miscellaneous parts and labor required to install a complete workable system.

B. The Contractor shall coordinate with the Owner’s representative to define areas the installer can store tools, equipment and other materials for this project.

C. The area is to be keep clean and neat at all time; construction debris shall be removed daily.

D. The Contractor will be responsible for the security of all items stored in this area.

1.8 DELIVERY AND IDENTIFICATION

A. Deliver fume hoods to the jobsite, clearly identified in plain view with easy to read lettering specifying hood manufacturer, size and type of hood and any special features included. In addition both the shipping container and the fume hood shall be clearly labeled in plain view with the serial number. Include installation manual with each hood.

1.9 WARRANTY

A. Provide a written warranty that work shall be free from defects in materials (structural failure, warping and finish integrity) and workmanship for a period of 2 years from the date of acceptance or Substantial Completion (whichever is later). Stipulate that defects that develop within the warranty period shall be removed, repaired and replaced at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with Project requirements provide products of Nuaire Corporation, or pre-approved equal, for limited bypass exhausted polypropylene fume hoods. The basis of design for the polypropylene fume hood is the Nuaire FumeGuard NU156 manufactured by Nuaire Corporation. Each fume hood shall have a completely welded shell assembly.
(case), which shall be rigid and self-supporting, requiring little or no field assembly.

2.2 FUME HOODS

A. All cabinets of size and type as indicated in the construction documents shall be a bench style, single pass flow-through design in which air is drawn over the hood’s internal work surface, pulled behind rear adjustable interior exhaust baffles, to a single exit point at the top of the hood.

B. Minimum average inflow velocity through the work access opening shall be 100 LFPM with the sash full open. Working sash heights shall vary between fully closed and fully open without a loss of the “personnel protection factor”.

C. The exhaust volumes and negative static pressures required per cabinet size shall not exceed the following based on an average inflow velocity of 100 FPM at a sash height of fully open.

| Hood width | 30-inch depth work surface | 6 foot | 1,402 CFM @ 0.5” w.g. |

D. The work zone shall be illuminated by a “roof mounted”, fluorescent light fixture and shall provide an average of 100 footcandles, as measured at the work surface. The lamp shall use two T8 bulbs and use listed electronic ballast. All lamps shall be easily replaceable using simple tools (flathead screwdriver).

E. All electronic controls shall be housed in a separate gastight PVC enclosure and shall be accessible from the top of the cabinet.

F. The polypropylene workspace shall be enclosed on both sidewalls by a 4.25-inch wide plumbing chase. The chase shall extend the full height and width of the cabinet’s exterior sidewall. Access panels are provided on the interior sides of the chase. Exterior access panels are available upon request. All panels shall be mounted flush to the surrounding material using ¼-20 x ½" long flat head polycarbonate screws and provide sufficient access for maintenance and repair of plumbing, electrical and sash components.

2.3 MATERIALS

A. The hood plumbing chase, structural support members and primary superstructure shall be constructed from 3/8-inch fully stress relieved, refrigerator white, polypropylene sheet stock. All sections are to be reinforced where necessary and continuously heat seam welded to form a rigid structure with all exterior welds finished flush with the surrounding surfaces. Rear exhaust duct and the perforated, removable work surface shall use ¼" inch material.

B. The hood work surface shall be constructed using ¼" polypropylene material of the same color and grade as the structure of the hood itself. The work surface is integral, being completely welded to the hood using 5/32-inch diameter welding rod on the interior of the hood. The bottom side of the hood work surface is free of welds and is flush for easy connection to base construction.

C. The air foil located at the hood work space opening, shall be constructed using 3/8-inch thick polypropylene, and is lifted 1-inch above the front spill lip, allowing air flow across hood work surface when sash is fully closed. Air foil is mounted using ¼-inch polypropylene blocks which
are drilled and tapped for 3/8-13 inch FRP bolts to be bolted from below the front of hood work surface.

D. The sash material shall be 3/8-inch polycarbonate (LEXAN™ or similar brand). Margard™ is available upon specific request. The sash is suspended within polyethylene glide channels by a 1/8-inch polyester cable routed over front and rear HDPE pulleys connected to a completely enclosed polypropylene enclosed counter balanced weight located in the plumbing chase.

E. All internal electrical wiring shall be enclosed in flexible, UL Listed or Listed fittings. All internal junction boxes and enclosures shall be constructed from PVC and shall be liquid-tight construction and gasketed where required. All exposed controls and visual indicators shall be constructed from non-metal corrosive-resistant materials or protected by non-metal, gas-tight enclosures with a clear viewing lens.

F. Supply mains to the cabinet shall be connected to a UL Listed junction box of suitable size to accommodate required circuits as indicated on the hood schedule. The junction box shall be non-metallic and require nonmetallic liquid-tight connections.

G. Closure panels, where specified, shall be constructed from materials to match the ELF hood and shall use 3/8-inch polypropylene. The panels shall enclose the top of the cabinet to the ceiling and/or the plumbing chase to the wall in the rear. Panels shall be finished to match hood type. For ceiling enclosures, the panels shall be louvered (or slotted) to obtain supply air for the down flow, unless otherwise specified. The side panels shall fasten to the top of the cabinet and the rear wall. The front panel shall fasten only to the side panels and easily removable to provide access to the top for maintenance purposes.

2.4 MANUFACTURED COMPONENTS

A. Services shall be provided in each hood as indicated in the construction documents. Hood shall not have any pre-punched holes on the hood post except for services per the construction documents. Where multiple services are scheduled, provide one on each side.

B. Service fixtures and fittings mounted inside of hood shall consist of labeled hose nozzle outlets remotely controlled from the hood post with color-coded index handles. The fixtures (valves and nozzles) shall be constructed from polypropylene unless otherwise noted. The valve body shall be easily removed from the front of the repair.

C. Service fixtures shall be provided with piping, from the outlet/valve to the exterior. Where services are scheduled on both sides of the hood, piping shall be connected for a coordinated single point connection to the building services.

D. Not used.

E. Sinks of size per the construction documents and/or cup sinks (nominal 6" by 3") shall be under mounted and flush with the bottom of the work surface. Other custom sinks and integral sinks shall be mounted according to the specifics given by the designer.

F. Service for flammable gas shall be installed per local codes using approved piping methods. Where metallic (black pipe) is required, the pipe shall be epoxy coated, including the remove valve and all internal piping.
PART 3 - EXECUTION

3.1 APPROVAL

A. No equipment shall be provided at the job site until project submittals have been reviewed and approved by the Owner's Representative.

3.2 INSTALLATION

A. Installation: Coordinate with requirements for Section 12 35 53.23.
   1. Install fume hoods and equipment in accordance with manufacturer's instructions.
   2. Install equipment plumb, square, and straight with no distortion and securely anchored as required. Fasten fume hood to bases from inside the base cabinet, through perimeter base cabinet strips, using polycarbonate screws or capped steel.
   3. Secure hood superstructure to solid wall support at top of cabinet.
   4. Ensure ceiling closure is tightly sealed and will prevent air leaks from plenum space via top of cabinet which may alter the intended route of air flow through front of the hood and compromise performance.

B. Utility Connections: Make final connection between utility services in fume hood and building services.

C. Accessories: Install accessories and fittings in accordance with manufacturer's recommendations.

3.3 CONTRACTOR TESTING

A. Field Test Requirements:
   1. Perform tests in field to verify proper operation of the fume hood before they are put in use.
   2. Perform tests after installation is complete, the building ventilation system has been balanced, all connections have been made, and written verification from the General Contractor has been submitted that the above conditions have been met.
   3. Verify that the buildings make-up air system is in operation, the doors and windows are in normal operating position, and that all other hoods and exhaust devices are operating at the designed conditions.
   4. Correct any unsafe conditions disclosed by these tests before request of test procedures.
   5. Test and certify each fume hood in accordance with ASHRAE 110-2016 As Installed (AI) for Flow Visualization and Face Velocity Testing requirements. Fume hood testing shall be performed by a qualified independent testing company on each hood to determine face velocity and air flow patterns. Fume hood shall achieve an AI performance rating equal or better than .10ppm with 4.0Lpm tracer gas release rate when tested in accordance with ASHRAE 110-2016.

B. On-site testing shall not start until the following is completed: testing, adjusting and balancing
of the air and water systems; calibration and tuning of controls systems; ceiling tiles are replaced, laboratory doors are closed, and other aspects of building commissioning that affects fume hood performance are completed.

C. Each cabinet shall be subjected to field certification per manufacturer procedures and performance criteria, after the cabinets are completely installed and all exhaust/supply systems fully operational and balanced as intended. The field tests shall be conducted by an independent certifying agency, selected by the manufacturer and approved by the Owner, at no expense to the Owner. The owner or his representative may witness the tests. In the event that cabinets cannot be certified, a detailed report shall be prepared outlining deficiencies.

D. Record Keeping and Submittals:
   1. Record all field data on test data field forms.
   2. Submit copy of tests reports for each individual fume hood to the Owner's Representative for review and acceptance.

3.4 ADJUSTING

A. Repair or remove and replace defective work, as directed by Owner's Representative upon completion of installation.

B. Adjust sash, doors, hardware, fixtures, accessories and other moving or operation parts to function smoothly

3.5 CLEANING

A. Prior to installation of hoods clean areas that will not be accessible after installation, vacuum damp mop, and wipe down all surfaces to remove dust, dirt and debris.

B. After Installation and Field Testing: Clean equipment, and surfaces as recommended by manufacturer; remove dust, debris and dirt. Touch up as required, wipe down and vacuum the interior of the equipment.

3.6 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent damage to equipment from exposure to other construction activity.

B. Advise contractor of procedures and precautions for protection of material and installed fume hoods from damage by work of other trades.

3.7 EQUIPMENT MANUFACTURER'S AND CONTRACTOR'S PARTICIPATION IN PROJECT COMMISSIONING

A. Assist in developing the final functional test procedures as specified in Sections 019100, 220800, 230800, 260810 and related sections.

B. Provide authorized startup technician to perform functional performance testing as specified in Sections 019113, 220800, 230800, 260800 and related sections.
C. Provide building commissioning support as specified in Sections 019113, 220800, 230800, 260800 and related sections.

3.8 DEMONSTRATION

A. Demonstrate operation, function, maintenance, and safety of equipment in the presence of the Owner. Provide instruction on operation, maintenance and safety for each type of equipment to Owner’s operating personnel.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for modular, sheet steel casework with flush overlay door and drawer fronts. Casework includes base cabinets, full height and wall-mounted cabinets, cantilevered shelving, work-surfaces, countertops and similar components manufactured and finished off site, as indicated on LF drawings.

1. Coordinate casework, umbilicals and utility chases with building services, required configuration of laboratory furniture and laboratory equipment to ensure each service fixture is located as required and is connected to the appropriate utility. Prevent the need for alteration to installed work due to ineffective and untimely coordination among work of different trades.

2. Final Connection of Service Fittings to Building Services: Work of Divisions 22, 23 and 26 Sections regardless of whether component is installed as work of this Section or others.

3. Heavy Gage Formed Metal Framing Components: Provided as work of this Section for utility service chases, gas cylinder racks and applications shown of LF series drawings.

B. Products Furnished But Not Installed Under This Section:

1. Service Fittings: Furnish as work of this section for installation as work of Divisions 22 and 26; except for epoxy resin sinks which shall be provided as work of this Section.

C. Related Sections include the following:


1.2 SUBMITTALS

A. Product Data: Submit as required for each material, manufactured product, fixture, accessory, and finish to be incorporated into the Work.

B. Shop Drawings: Prepare and submit in 11 inch by 17 inch electronic PDF format CAD Shop Drawings and product data. Plans, elevations, and large scale details (including mounting, supports and backing) of casework, work surfaces, cantilevered shelves, cabinet shelves and open shelves and accessory components. coordination of casework with electrical and plumbing work.

1. Accessory Components: Include but are not limited to drying racks, tack boards, and marker boards similar.

2. Coordination Drawings: Document utility service runs at umbilicals and chases, final connection points to building services, and coordination for laboratory fume hoods, specialized storage cabinets, and equipment.

C. Samples: Three of each, one sample will be returned. Panel material, provide 1 foot by 1 foot, linear material, 1 foot length.

1. Finished Steel Sheet: Form two side with 1 inch return on edges and one corner; finish as required for the work.
2. Service Fixtures: One of each type required, indicate those components to be installed as work of other Sections.
3. Work Surfaces: Each finish surface and type required.
4. Shelves: Each shelf type include "seismic guards".
5. Hardware: Each component type and finish required for approval of function and appearance.

1.3 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications: Demonstrate successful experience in the manufacture and installation of modular laboratory casework similar to that required for this Project by submitting documentation for five installations in the State of Washington, and similar in scope and nature to the work of this Project. At least two of these projects shall have used the same fabricator and installer team proposed to perform installation for this Project.

1. Manufacturer: Member of the Scientific Equipment & Furniture Association. Provide a single point of supply for work of this Section and Sections 11 53 13 and 12 35 53.
2. Installer: Certified by the manufacturer, three years' experience with installation of this manufacturer's equipment.
3. Foreman: Employed by this firm at least five years, and have worked in this capacity on at least two of the Projects submitted per paragraph above.

B. Fabricator and Installer Certification: Five recent jobs similar to this Project, include project and contact name, location, and date.

C. Pre-Installation Conference: Prior to delivery of the Work. Review coordination with services, installation sequence and protection.

1.4 SEQUENCING

A. Coordinate installation of laboratory casework with building services, fume hoods, laboratory equipment and architectural finishes.

1. Sequence laboratory casework, including installation of utility chase frames, to permit installation of finish flooring prior to work of this Section. Coordinate casework installation with work of Division 9.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Casework Manufacturer: Subject to requirements provide Work by one of the following. For accessory components, provide only components of the specified manufacturer regardless of whether they are typically utilized by the casework manufacturer.
1. Saxton & Bradley, Inc. – Mott Manufacturing
   Mr. Dennis Purcell or Mr. Ray Near
   6718 South 216th St.
   Kent, WA 98032
   (800) 643.3512

2. ISEC, Inc. – Kewaunee
   Mr. Keith Mohr
   11807 North Creek Parkway South, Suite 103
   Bothell, WA 98011
   (425) 488-1333

B. Service Fittings: WaterSaver or approved

C. Epoxy Sinks: Durcon or approved.

2.2 MATERIALS

A. Steel Shapes: High quality, cold rolled, mild steel meeting requirements of ASTM A 36.

B. Sheet Steel: ASTM A 366 furniture grade, conform to flatness tolerances for stretcher leveled material in ASTM A 568 as a minimum.

C. Stainless Steel: ASTM A 240, AISI 300 Series having necessary physical properties for chemical resistance and strength in the gages required.
   1. Sheet: conform to flatness tolerances for stretcher leveled material in ASTM A 568 as a minimum.
   2. Cable: ASTM A 368, 7 strand, 0.125 inch diameter.

D. Glazing: laminated Safety glass composed of two layers of ASTM C 1048 clear glass, tempered by horizontal method with rollwave distortion parallel to bottom edge; Kind FT, Condition A, laminated to a 0.030 inch thick clear polyvinyl butyryl interlayer in manufacturers standard thickness, but not less than 0.2188 inch thick.

E. Epoxy Resin Components: Specifically for laboratory use, in the thicknesses required. Solid, homogeneous modified epoxy resin not dependent on finish or coatings for performance characteristics. Products of Laboratory Tops, Inc. shall establish the acceptable performance standard for this material. Polyester fabrications are not acceptable.
   1. Color: Integral and homogeneous; color: Graphite.

F. Cabinet Hardware: Comply with ANSI-BHMA A156.9. Provide cabinet hardware and accessories standard with manufacturer and complying with the following level of performance and quality; modify manufacturer’s standard types where necessary to comply with these requirements.
   1. Finishes: Comply with BHMA 1301 unless otherwise required.
      a. 630 (Satin stainless steel finish and Base Metal).
2. Wire Type: Stainless steel; provide two pulls on drawers over 24 inches wide. Provide Baldwin 4993 with 4989 base, 4 inch center, 0.312 inch constant diameter pull with 0.625 inch diameter bases, or approved.

3. Shelf Supports for Adjustable Shelves in Cabinet Case: Manufacturer's standard integrated, adjustable support system allowing adjustment on 1.5 inch centers. Support each shelf at not less than four points, ensure shelf remains stable under any loading condition, including uplift but not less than four points. Shelves shall be adjustable without the need of tools.

4. Shelf Support Standards and Supports for Open, Wall-Mounted Shelves and Reagent Shelves: Custom fabrication; Top suspension, gusset plate type providing end closure on shelf with a return edge to support underside of shelf in direct bearing and allow for mechanical attachment of shelf to support. Epoxy painted, 16 gage steel with 500 pound load rating. Coordinate bracket mounting with standards.

5. Hinges: For inset casework, heavy duty, 2.75 inch, five knuckle, fixed pin with hospital tips. Provide one pair for doors up to 48 inches high, one-and-one-half pair for doors over 48 inches. Each leaf shall have three anchors; Rockford Process Control Model 376.

6. Catches: Adjustable type standard with manufacturer providing a range of 3 to 6 pounds pull resistance (nominal).

7. Drawer Slides: Manufacturer's standard integrated assembly complying with the following; provide full extension with stop, allow drawer removal without tools. Self-closing on drawers 4 inches and deeper. 100 pound capacity for drawers up to 32 inches wide; 150 pound capacity drawers over 32 inches wide.

8. Locks: Removable interchangeable core, 5 pin tumbler for keying as directed; allow for 3 keying levels. Capacity for 2000 primary key changes. Kenstan Lock Company
   a. Core: Provide as required for work of Section 08710.

9. Keys: Stamped brass; Provide 3 for each lock and for each system, Grandmaster, and Master.

G. Heavy Gage Steel Framing: Cold rolled steel, 16 gage and heavier, factory fabricated tubular sections and other shapes as required; Unistrut® P1000 series components or approved. Provide manufacturer's standard steel components channels, struts, columns, tubing, specialized fittings runners and accessories modified where necessary and acceptable to comply with Project requirements.

1. Channels: ASTM A 570 Grade 33 or ASTM A 653 Grade 33
2. Fittings: ASTM A 575, ASTM A 576, or ASTM A 635
3. Galvanize all components and accessories after fabrication: Electrolytically coated per ASTM B 633 Type III SC 1, or hot-dipped galvanize per ASTM A 123 or 153
4. Painted Finish: Pretreat galvanized substrate and provide two coats shop-applied thermally cured epoxy finish.

H. Peg Boards (Drying Racks): Epoxy resin (color - Graphite) with removable molded polypropylene pegs and stainless steel drip trough with 0.25 inch diameter drain outlet and clear flexible rubber tubing drain line to sink.

I. Laboratory Gas Cylinder Racks: Bolted assembly of cold formed framing components indicated complying with Section 05450 in configuration required with angle fittings and cylinder strap holders.

1. Strap Holders: Nylon webbing with over-center cam buckles; McMaster-Carr for 1 inch wide nylon webbing safety belt with 8870T9 end fitting, and quick disconnect buckle, or other approved components.
J. Adjustable Laboratory Tables: Free standing, adjustable height, with epoxy resin top capable of supporting suspended base cabinets; provide height, size and configuration indicated.

1. Height adjustment: 28 to 37 inches except 31 to 40 inches on tables with casters.
2. Legs: Cold rolled steel in configuration and sizes indicated.
   a. Outer: 11 gage channel
   b. Telescoping Inner: 16 gage rectangular tube.
3. Casters: heavy-duty lockable, 4 inch diameter, with solid rubber tire for hard finish floor.

2.3 FABRICATION

A. Requirements Common to all Components: Self-supporting modular casework; fabricate to dimensions, profiles, and configurations indicated with openings and mortises prefabricated to receive hardware, services, and other work. Shop fabricate and assemble, disassemble only as necessary for shipping and installation. Modify manufacturer's standard assemblies as necessary to comply with Project requirements. Provide flush inset construction with flush face-frame reveal and surface-mounted drawer and door pulls. Break and return sheet metal edges to form a channel at exposed and semi-exposed locations; unfinished sheet edges are not acceptable. Casework indicated to be accessible shall comply with all requirements for barrier free access in the applicable Building Code and recommendations of the ADA Accessibility Guidelines; including but not limited to clearances, component heights, reach ranges, and hardware configuration.

1. Welded Joints: Finish and grind smooth and flush at all exposed and semi-exposed locations.
2. Reinforcements and Gussets: 12, 14 and 16 gage steel as standard with manufacturer. Provide at all case corners, leveling bolts, hinges drawer suspensions, aprons and similar locations.

B. Base Cabinet, Doors, and Drawers:

1. Case Panels and Bottom: 18 gage steel sheet with integral channel edges. Sides and back of bottom panel shall be turned-up 1 inch to form a pan to contain spills. Grind all exposed welds smooth and flush for seamless appearance.
2. Face Rails: 16 gage front rail and intermediate rail. Rails integral with case panels shall be same gage as panel.
3. Removable Back Panels: 18 gage steel sheet, completely removable for access to utility chase; provide at cabinets enclosing utility chase except at drawer units.
4. Fixed Back Panels: 20 gage steel sheet, provide behind drawers and locations where removable backs are not required.
5. Drawer Boxes and Sub-fronts: 20 gage steel sheet, one-piece welded construction with fully coved bottom. Provide double-walled, sound deafened drawer front 0.75 inch thick. Reinforce for pulls and shop-prep for locks at required locations.
6. Doors and Drawer Fronts: 20 gage steel sheet; double walled with sound deafening; match drawer front thickness and provide flush assembly in completed cabinet. One-piece fully welded assembly. Reinforce for pulls and hinges; shop prep for locks at required locations.
   a. Door Glazing and Solid Glass Doors: Clear laminated safety glass in size and configuration required.
7. Filler Panels: Provide as required for case panels in the configuration necessary for closure of casework to building lines, exposed-to-view areas, and between back of cabinets and walls, peninsula and island bench chase ends. Fabricate to fit abutting surfaces and edges.
8. Base Rail (Toe Kick): 3 inches deep by height indicated (but not less than 4 inches). Configure for fully closed sanitary installation and to accommodate leveling screws. Reinforce to support required dead loads per SEFA performance tests.

C. Wall Cases, Uppers and Full Height Cabinets: As required for similar components of Base Cabinets.

D. Shelves: Coordinate with case requirements for fixed and adjustable shelves.
   1. Modify manufacturer's standard assemblies and fabrication methods as necessary to conform to required configurations.
   2. Exposed Faces:

E. Umbilicals: 18 gage steel sheet. Provide removable sections as indicated for access to services. Exposed fasteners are not acceptable. To support freestanding umbilicals, provide Unistrut channel frame welded to fixed enclosure section.

F. Pre-Cut Openings: For hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Reinforce openings with required gage of material.

G. Frame for Service Chase: 2 by 0.25 inch flat steel bar stock, and P1000 Unistrut® posts as required for casework assemblies and configurations indicated. Provide connection of flat bar and post assembly and anchorage of complete frame to floor structure as indicated. Provide frame dimensions and configurations indicated and as necessary for required chase.

H. Reagent Shelving: Custom fabricated steel frame to support stock shelving standards and open shelving; provide 14 inch and 16 inch deep units as indicated in 36, 42 and 48 inch widths in the configurations indicated. Provide flush and normal surfaces at joints and hair-line tight joinery.
   1. Frame: Fabricate of 2.5 by 2.5 by 0.25 inch, hot rolled steel tube posts and rails in configuration indicated. Provide for bolted connection of sub-frame posts to floor structure.
   2. Shelves: Metal with stainless steel seismic retaining bar as indicated. Provide shelf lengths necessary for shelving configurations required.
   3. Standards and Supports: Heavy duty, slotted steel, double slotted at paired shelves; mechanically attach to sub-frame posts.

2.4 COUNTERTOPS

A. Epoxy Resin: 1 inch thick, provided in 8 ft - 1 inch lengths with 0.125 inch drip set-back 0.5 inch from edge. Manufacturer’s standard edge finish.
   1. Curbs: 4 inches tall, field installed where tops abut walls and fume hoods
   2. Color: Integral and homogeneous; Graphite unless otherwise required.

B. Stainless Steel: 16 Gage with sinks and back splashes integrally welded as indicated. Provide 0.375 Inch formed edge to contain spills, turn edges down to match adjacent tops, but not less than 1 inch and return 0.5 inch, provide mastic coating or other acceptable sound deafening.
1. Reinforce with 16 gage channels for rigidity and sound dampening.
2. Seams and Joints: Welded, ground smooth and flush for seamless appearance without discoloration.
3. Provide perimeter backing or other acceptable means for simplified mounting to cabinet case.

2.5 LABORATORY SERVICE FITTINGS

A. Fittings and Accessories: Cast brass with a minimum copper content of 85 percent, except forged and bar stock items. Specifically designed for laboratory use and products of a single manufacturer. Parts subject to wear and moving parts shall be easily replaceable. Provide a uniform, well ordered appearance for all types of components.

1. Assembly Components, Replaceable and Operating Parts, Valve Stems, Packing Nuts, Outlet Nozzles and Straight Serrated Hose Ends: Solid brass, except as otherwise required.
2. Replaceable Seats, Needle Cones, Valve Disc Screws and Accessories: Monel or stainless steel alloy designed for the use required.
3. Flanges: Brass forging of approved design with 0.375 inch IPS female inlet and outlet.
4. Serrated Tip: 0.375 inch IPS thread, 0.125 inch diameter tapered hose end with 10 serration.
5. Turrets: Brass drop forging in configuration indicated, with brass shanks, locknuts and washers having 0.375 inch IPS female inlet thread for connections. Provide one or two type as required.
6. Integral Vacuum Breaker: Required on all domestic water fixtures.
7. Fittings Located on Same Plane: Handles shall project the same distance from plane of reference regardless of valve type construction.

B. Faucets, Valves and Fittings for Gases and Fluids: Certified to have passed pressure testing to 100 psi, except 80 psi for water fittings.

1. Units for Use With Gases: Tested under water.

C. Hot and Cold Water Goosenecks: Swivel type mixers, with swivel point at turret or valve level for wall and panel mounted units. Provide heavy Teflon packings and full thread attachment of antisplash outlet fittings.

1. Cupsink Fixtures: Fixed

D. Water Valves: Replaceable unit containing all working parts subject to wear, including seats, screw, seat disk and Teflon packing. Provide integral or external adjustable volume control.

1. Convertible, without disturbing faucet body, between compression and self-closing operation, and from water to needle or stem valve construction with outside packing gland.
2. Sealed in valve body with special composition gasket. Metal-to-metal and ground-joint type sealing not acceptable.

E. Fine Control Needle Valves: Self-centering, replaceable, stainless steel, floating cone. Slow compression valve action for fine control under pressure up to 100 psi.

2.6 SINKS
A. Provide epoxy resin sinks and stainless steel sinks in the sizes and configurations indicated on LF series drawings. Bond epoxy sinks to countertops with seams filled and finished smooth.

1. Interior Corners: Coved to 1.5 inch radius with bottom pitched to outlet.
2. Outlet: 1.5 inch diameter (38 mm) with similar sized overflow 2 inches shorter than depth of sink.
3. Swivel Strainer: Complete with gasket, R&G Sloane No. 7218.

B. Cup Sinks: Minimum 3 inches by 9 inches and 4.25 inches deep; minimum wall thickness of 0.625 inch.

2.7 EMERGENCY EYEWASH

A. Eye and Face: Deck mounted swivel and swing down emergency eyewash with auto-flow with integral vacuum breaker: WaterSaver FE774 (at ADA sinks) and FE779 or approved equal.

2.8 FINISHES

A. Steel: Manufacturer's standard zinc phosphate and chromic acid rinse pretreatment, and electrostatically applied, baked enamel finish with primer coat and two finish coats (surfaces not exposed to view at any time may have one finish coat over primer).

2. Color: Selected by Architect from manufacturer's complete range of color options.

B. Stainless Steel: No. 4.

C. Service Fittings: Three-coating process of chrome over nickel over copper over the base metal with transparent protective over-coating. Provide uniform coverage free of defects and imperfections. Finish components prior to assembly and testing.

1. Coating Thickness: Copper 0.000050 inch, Nickel 0.000350 inch, Chromium 0.000015 inch, Protective Coating 2.5 mils.
2. Protective Coating: 2 mil dry film thickness, transparent, acid and solvent resistant, spray applied and baked.
3. Colors shall correspond to index disc colors.

D. Service Fitting Color Indexing: Integrally colored plastic discs.

<table>
<thead>
<tr>
<th>Service Name</th>
<th>Disc Color Letters</th>
<th>Letter Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nitrogen:</td>
<td>Grey</td>
<td>N2</td>
</tr>
<tr>
<td>2. Vacuum:</td>
<td>Yellow</td>
<td>VAC</td>
</tr>
<tr>
<td>3. Gas:</td>
<td>Dark Blue</td>
<td>GAS</td>
</tr>
<tr>
<td>4. Ind. Cold Water:</td>
<td>Dark Green</td>
<td>ICW</td>
</tr>
<tr>
<td>5. Ind. Hot Water:</td>
<td>Red</td>
<td>IHW</td>
</tr>
<tr>
<td>6. R.O. Water:</td>
<td>White</td>
<td>DI</td>
</tr>
<tr>
<td>7. Air:</td>
<td>Orange</td>
<td>AIR</td>
</tr>
</tbody>
</table>

2.9 SOURCE QUALITY CONTROL
A. Fabrication Tolerances: Plus or minus, except where total deviation is stated.

1. Epoxy Countertops: Thickness 0.0313 inch; Warpage, maximum deviation of 0.0625 inch in any 36 inches, and 0.0938 inch in any 96 inches when measured unrestrained on Grade B Tool Room plate.
2. Stainless Steel Countertops: Length, 0.125 inch, width 0.0625 inch, square 0.0156 inch for each 12 inches but not more than 0.0625.
3. Cut Outs: Location, 0.125 inch; Size 0.125 inch plus, minus 0.

B. Casework Tests:

1. Wall Cabinet: 48 inches square by 13 inches deep with three shelves anchored to framed wall with studs 16 inches on center and 0.625 inch gypsum board with three No. 10, 1.75 inch screws located 3 inches from top and bottom of cabinet and driven into studs. Cabinet shall stand a 600 pound horizontal load pulling away from the wall at the side corner of the case while simultaneously loaded with a total weight of 1200 pounds. There shall be no sign of stress or failure to the case or shelves.
2. Shelf: 46.5 inches long, 12 inches deep shall be supported and restrained at each end and loaded to 400 pounds without failure.
3. Drawer: 24 by 5 by 21 inches load uniformly with 75 pounds and operated through 50,000 cycles opening 75 percent each time at 20 cycles per minute. Drawer shall operate freely at all times and shall operate normally at the conclusion of the test.

C. Fume Tests for Service Fitting Quality Control: After exposure for 150 hours to fumes, finish and protective coating on fittings samples suspended in a 6 cubic foot container 12 inches above beakers containing 199 cc of 75 percent nitric acid, 94 percent sulfuric acid, and 37 percent hydrochloric acid shall show no effect beyond slight discoloration or softening.

1. Fittings located in fume hoods shall comply with requirements of Section 11610.

D. Drip Tests for Service Fitting Quality Control: After ten minutes exposure to the following reagents, dropping from a burette at the rate of 60 drops per minute, finish and protective coating shall show no effect beyond slight discoloration or softening.

- Hydrochloric Acid 37 percent solution
- Nitric Acid 70 percent solution
- Sulfuric Acid 94 percent solution
- Glacial Acetic 99.5 percent solution
- Ethyl and Other Alcohols
- Toluene and Other Hydrocarbons
- Carbon Tetrachloride
- Mineral Oil USP

E. Test for Quality Control of Finishes for Steel: Highly resistant to acids alkalis, salts and solvents; tested with ten drops of the listed reagents covered with a watch crystal, and allowed a one hour dwell time. Rinse test area with soap and water and clean with naphtha; record test effect 24 hours later. Test shall cause no effect other than slight discoloration or dulling of gloss, with only temporary softening of film and no reduction in adhesion nor substrate protection.

1. Reagents:
2. Solvents:

- Ethyl Alcohol
- Ethyl Ether
- Acetone
- VM and P
- Chloroform
- Toluene
- Carbon Tetrachloride
- Ethyl Acetate

3. Lacquer Thinner

a. Physical Test: Pass the following, test surface clean and dry for evaluation.

1) Abrasion: 9 mg maximum weight loss per 100 cycles, Taber tester E4010 with 1000 GM wheel and calibrated number CS 10 wheels.
2) Hardness: 5H.
3) Bend: ASTM D522, 180 degree bend over a 0.375 inch diameter Gardner Conical Mandrel Number 1620; no chipping nor flaking of finish

d. Impact: using a Gardner Number 167 Impact Tester with a 5/8" diameter spherical punch providing 6.4 pounds of impact with no chipping nor crazing

e. Salt Spray: ASTM-B117, 200 hours salt spray exposure.

f. Humidity Resistance: Finish shall withstand 1,000 hours exposure in saturated humidity at 100 degrees F.

g. Moisture Resistance: Five minute boiling water test on 45 degree slopped surface.

F. Tests (Spot Tests) for Chemical Resistance of Epoxy Fabrication: Cover test with wide mouth bottle to prevent evaporation of chemical agents, and allow a 16 hour dwell time. Following required duration of exposure wash surface with soap and water, rinse and dry for evaluation. For nonvolatile reagents use 0.5 cc applied directly to test surface. For volatile reagents saturate a 1 inch glass wool ball and cover as required. Evaluate as A No Effect, B Slight Spotting, C Pronounced Spotting.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic Acid, Glacial</td>
<td>A</td>
</tr>
<tr>
<td>Ammonium Hydroxide 28%</td>
<td>A</td>
</tr>
<tr>
<td>Benzene</td>
<td>A</td>
</tr>
<tr>
<td>Chromic Acid 40%</td>
<td>B</td>
</tr>
<tr>
<td>Cottonseed Oil</td>
<td>A</td>
</tr>
<tr>
<td>Diethyl Ether</td>
<td>A</td>
</tr>
<tr>
<td>Distilled Water</td>
<td>A</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>A</td>
</tr>
<tr>
<td>Ethyl Alcohol 50%</td>
<td>A</td>
</tr>
<tr>
<td>Ethyl Alcohol 95%</td>
<td>A</td>
</tr>
<tr>
<td>Glacial Acetic Acid</td>
<td>A</td>
</tr>
<tr>
<td>Nitric Acid 30 percent solution</td>
<td>A</td>
</tr>
<tr>
<td>Phosphoric Acid 75 percent solution</td>
<td>A</td>
</tr>
<tr>
<td>Sodium Hydroxide 40 percent solution</td>
<td>A</td>
</tr>
<tr>
<td>Potassium Hydroxide 40 percent solution</td>
<td>A</td>
</tr>
<tr>
<td>Trisodium Phosphate</td>
<td>A</td>
</tr>
<tr>
<td>Acetone</td>
<td>A</td>
</tr>
<tr>
<td>Aniline Oil</td>
<td>A</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>A</td>
</tr>
<tr>
<td>Citric Acid 10%</td>
<td>A</td>
</tr>
<tr>
<td>Dichromate Cleaning Solution</td>
<td>B</td>
</tr>
<tr>
<td>Dimethyl Formamide</td>
<td>A</td>
</tr>
<tr>
<td>Detergent Solution 1/4%</td>
<td>A</td>
</tr>
<tr>
<td>Ethyl Alcohol 95%</td>
<td>A</td>
</tr>
<tr>
<td>Ethylene Dichloride</td>
<td>A</td>
</tr>
</tbody>
</table>
Heptane A (Dichloroethane)

Hydrochloric Acid 37% B Hydrochloric Acid 20% A
Hydrogen Peroxide 28% A Hydrogen Peroxide, 3% A
Iso-Octane A Kerosene A
Methyl Alcohol A Mineral Oil A
Nitric Acid 70% A Nitric Acid, 10% A

Oleic Acid A Olive Oil A
Phenol A Soap Solution, 1 A
Sodium Carbonate 20% A Sodium Carbonate 2% A
Sodium Chloride 10% A Sodium Hydroxide 10% A
Sodium Hydroxide 50% A Sodium Hypochlorite 5% A

Sulfuric Acid 96% B Sulfuric Acid 60% A
Sulfuric Acid 33% A Toluene A
Transformer Oil A Turpentine A
Acetic Acid 5% A 100-Hour Soaked Cellulose Sponge Test A

1. Boiling Water Resistance Test: Surface inclined at a 45-degree angle, and subject to a trickling of boiling water from condensation of steam blown against surface for five (5) minutes shall have no effect.

2. Heat Resistance Tests: The following shall have no effect on epoxy test surface.
   a. A 15 ml, high form porcelain crucible, heated until bottom attains a dull, red heat, and placed on the test surface and left to cool to room temperature.
   b. 5 minute exposure to 0.375 inch Bunsen burner, with a 1.5 inch inner cone quiet flame.

G. Test for Chemical Resistance of Stainless Steel: At 68 to 70 degrees F (20 - 22 C). Drip test; apply five drops of reagent to a suspended strip 0.75 inch wide and 12 inches long. Allow reagent to flow down the length of the strip. Fume test; 2 inch squares of metal placed over 100 milliliter beaker containing 25 ml of reagent. Expose to fumes for 24 hours (do not block beaker pouring lip). Rinse test area with water and clean with naptha and detergent. Examine test area under 100 foot candles illumination and record test effect as follows; No effect, No detectable change.

- **Excellent**, Slight detectable change in color or gloss, no reduction in performance.
- **Good**, Clear discernible change in color or gloss, but finish remains intact with no significant reduction in useful service life.
- **Fair**, Objectionable change in appearance and possible reduced service life.
- **Failure** Pitting, cratering or erosion of surface, obvious and significant deterioration. Reagents having an affect on the sample are specified with the acceptable affect. Other reagents and concentrations listed shall have no effect. Test the following reagents and concentrations (by weight).

1. Reagents Having no Affect:

   - Sodium Hydroxide Flake
   - Ammonium Hydroxide (28 %)
   - Carbon Tetrachloride
   - Ethyl Alcohol
   - Cresol
   - Dioxane
   - Toluene

   - Sodium Hydroxide (10, 20 & 40 %)
   - Methylene Chloride
   - MonoChlor Benzene
   - Butyl Alcohol
   - Sodium Sulfide, Saturated
   - Zinc Chloride (Saturated)
   - Xylene

   - Acetone
   - Chloroform
   - Methyl Alcohol
   - Phenol (85 %)
   - Furfural
   - Benzene
   - Gasoline

Project No.: 206825 12 35 53.13 - 11
2. Reagents Having Affect Specified:

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Drip Test</th>
<th>Fume Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenol 85 percent</td>
<td>No effect</td>
<td>Excellent</td>
</tr>
<tr>
<td>Furfural</td>
<td>Excellent</td>
<td>No effect</td>
</tr>
<tr>
<td>Dioxane</td>
<td>No effect</td>
<td>Good</td>
</tr>
<tr>
<td>Sulfuric Acid 33 percent</td>
<td>Fair</td>
<td>No effect</td>
</tr>
<tr>
<td>Sulfuric Acid 77 percent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Sulfuric Acid 93 percent</td>
<td>Good</td>
<td>No effect</td>
</tr>
<tr>
<td>Hydrochloric Acid 37 percent</td>
<td>Fair</td>
<td>Fair</td>
</tr>
<tr>
<td>Hydrofluoric Acid 48 percent</td>
<td>Fair</td>
<td>Good Fair</td>
</tr>
</tbody>
</table>

H. Verification of Performance: Owner reserves the right to require random testing of the work to verify compliance with required tests and performances.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean areas that will be concealed and areas where access will be obstructed once work is installed, vacuum, dust and mop as necessary to remove dust and debris.

3.2 MODULAR CASEWORK INSTALLATION

A. Install work plumb, level, true and straight with no distortions. Scribe and cut to fit to adjoining work including variations in finish floors, and refinish cut surfaces or repair damaged finish at cuts. Coordinate installation with electrical and plumbing work.

1. Provide filler strips where necessary for neat orderly fit. Use concealed fasteners where practicable.

B. Where required assemble units into one integral unit with joints flush, tight and uniform. Align similar adjoining doors and drawers.
C. Countertops: Abut top and edge surfaces in one true plane with hairline tight joints. Support joints to prevent any deflection.
   1. Field Joints: Factory prepared and identical to factory joints, locate only where indicated on approved shop drawings. Field processing of top and edge surfaces is not acceptable.
   2. Cut-Outs: Shop fabricated to the greatest extent possible; where field fabrication is acceptable, provide 0.125 inch radius at inside corners, rout and file cutouts. Prevent cracks and seal cut edges with waterproof coating recommended by countertop manufacturer.
   3. Anchorage: Z-Type, angle-type, or other acceptable fastening, spaced maximum of 36 inches on-center.

D. Tolerances:
   1. Plumb and Level: 0.125 inch in 8 feet for case and countertop.
   2. Flushness of Adjoining Surfaces: Zero.

3.3 METAL SUPPORT SYSTEMS

A. Coordinate installation with supporting structure, inserts, imbeds, anchors, supplementary framing, and blocking to develop full strength of metal support assembly, and comply with Project requirements.
   1. Furnish inserts, and imbeds to other trades for installations well in advance of time needed for coordination with other work.
   2. Wall Mounted Components: Contractor shall coordinate wall assembly and provide reinforcing and backing as necessary for durable and secure installation of metal support components.

B. Metal Support Assembly: Conform to approved submittals, and manufacturer’s recommendations, unless otherwise indicated. Install true to line and level, plumb and effectively anchored to building structure to resist required loads.
   1. Provide neat orderly appearance in installed assembly, fully integrated into ceilings, casework and other adjacent assemblies.

C. Installed metal support assembly shall provide for support and distribution of each type of building service required, in the configuration indicated with service outlets and connection points as required.

3.4 ADJUSTING AND PROTECTION

A. Repair damaged and defective work where possible to eliminate defects functionally and visually; where work can not be acceptably repaired, it shall be replaced.

B. Clean, lubricate and adjust hardware.

C. Clean exposed and semi-exposed surfaces.
D. Provide final protection and maintain conditions to ensure work will be without damage or deterioration at time of substantial completion. Do not use countertops as work nor standing surfaces. Tops that are scratched or otherwise damaged will be rejected.

1. Epoxy Resin Fabrications may be softer and more easily scratched than other plastic laminate. Contractor shall provide protection as necessary to ensure these surfaces are not scratched nor damaged.

END OF SECTION
PART 1 – GENERAL

1.1 WORK INCLUDED

A. This Section specifies the requirements necessary to furnish and install:
   1. Polypropylene casework with polypropylene drawer and door faces.
   2. Casework includes base cabinets, full height and wall-mounted cabinets, cantilevered
      shelving, work-surfaces, countertops and similar components manufactured and finished off
      site, as indicated on Lab Furnishings Drawings.
   3. Coordinate casework, umbilicals and utility chases with building services, required
      configuration of laboratory furniture and laboratory equipment to ensure each service fixture
      is located as required and is connected to the appropriate utility. Prevent the need for
      alteration to installed work due to ineffective and untimely coordination among work of
      different trades.
   4. Final Connection of Service Fittings to Building Services: Work of Division of the Contractor
      regardless of whether component is installed as work of this Section or others.
   5. Heavy Gauge Formed Metal Framing Components: Provided as work of this Section for
      utility service chases, gas cylinder racks and applications indicated on Lab Furnishings
      Drawings.

B. Products Furnished but Not Installed Under This Section:
   1. Service Fittings: Furnish as Work of this Section for installation as Work of the Contractor;
      except for epoxy resin sinks that shall be provided as Work of this Section.

1.2 RELATED WORK

A. Use this Section in conjunction with the following other Specifications and related Contract
   Documents to establish the total requirements for modular polypropylene laboratory casework:
   1. The Contract.
   2. Division 1 sections included in the Project Specifications.
   5. Section 116103 – PVC Perchloric Acid Fume Hoods.
   6. Section 123553.13 - Modular Metal Laboratory Steel Casework.

B. CAUTION: Use of this Section without including the above listed items results in the omission of
   basic requirements.

1.3 STANDARDS

A. Comply with all applicable trade standards, ordinances, building codes and regulations and those
   standards and references listed.

B. American Society for Testing and Materials (ASTM):
1. D-4101 Group 1, Class 1, Grade II.
2. E162-76.

C. National electrical manufacturers Association (NEMA)


E. American National Standards Institute (ANSI):

1.4 SUBMITTALS

A. Provide the following in sufficient time to allow review time by laboratory planner and time for Contractor to incorporate review comments, at a minimum of four week, prior to order of equipment, fabrication or construction.

B. Product Data: Submit as required for each material, manufactured product, fixture, accessory, and finish to be incorporated into the Work. Include component dimensions, configurations, construction details, joint details and attachments.

C. Shop Drawings: Plans, elevations, and details (including mounting, supports and backing) of casework, work surfaces, cantilevered shelves, cabinet shelves and open shelves and accessory components. Coordination of casework with electrical and plumbing work.
   1. Coordination Drawings: Document utility service runs at umbilicals and chases, final connection points to building services, and coordination for laboratory fume hoods, specialized storage cabinets, and equipment.
   2. Bench Top Joints: Indicate coordination of top joints with base cabinet module and utility chase.

D. Samples: Submit three 12” x 12” samples of each material.

E. Hardware Samples: Provide samples of door and drawer pulls and hinges.

F. Submit detailed seismic anchorage and attachment drawings and calculations complying with all IBC requirements for seismic restraint.

1.5 QUALITY ASSURANCE
A. Fabricator and Installer Qualifications: Demonstrate successful experience in the manufacture and installation of modular polypropylene laboratory casework similar to that required for this Project by submitting documentation for five installations similar in scope and nature to the work of this Project. At least two of these projects shall have used the same fabricator and installer team proposed to perform installation for this Project.

1. Manufacturer: Member of the Scientific Equipment & Furniture Association. Ten years experience in manufacture of polypropylene casework.
2. Installer: Certified by the manufacturer, five years experience with installation of this manufacturer's equipment.
3. Foreman: Employed by this firm at least five years, and have worked in this capacity on at least two of the Projects submitted per paragraph A above.

B. Fabricator and Installer Certification: Five recent jobs similar to this Project, include project and contact name, location, and date.

C. Pre-Installation Conference: Prior to delivery of the Work. Review coordination with services, installation sequence and protection.

1.6 SEQUENCING

A. Coordinate installation of laboratory casework with building services, fume hoods, laboratory equipment and architectural finishes.

1. Sequence laboratory casework, including installation of utility chase frames, to permit installation of finish flooring prior to work of this Section. Coordinate work with finishes work.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Casework Manufacturer: Subject to Project requirements provide Work by Nuaire, or approved equal. For accessory components, provide only components of the specified manufacturer regardless of whether they are typically utilized by the casework manufacturer.

1. Each casework unit shall have a completely welded shell assembly which shall be rigid and self-supporting for use interchangeability in a group of cases or for single unit use. Each unit shall be complete such that units can be relocated at any time with requiring application of finished ends and the like.

B. Service Fittings: WaterSaver non-metallic or approved equal.

C. Epoxy Sinks: Laboratory Tops or Durcon Products or approved equal.

D. Epoxy Resin Components: Specifically for laboratory use, in the thicknesses required. Solid, homogeneous modified epoxy resin not dependent on finish or coatings for performance
characteristics. Products of Durcon shall establish the acceptable performance standard for this material. Polyester fabrications are not acceptable.

1. Color: Color to match top color (Gray) from Section 123553.13, Modular Metal Laboratory Casework.

2.2 MANUFACTURED COMPONENTS

A. Heavy Gauge Steel Framing: Cold rolled steel, 16 gauge and heavier, factory fabricated tubular sections and other shapes as required; Unistrut P1000, or approved equal. Provide manufacturer's standard steel components channels, struts, columns, tubing, specialized fittings runners and accessories modified where necessary and acceptable to comply with Project requirements.

1. Channels: ASTM A570 Grade 33 or ASTM A653 Grade 33.
2. Fittings: ASTM A575, ASTM A576, or ASTM A635.
3. Galvanize all components and accessories after fabrication: Electrolytically coated per ASTM B633 Type III SC 1, or hot-dipped galvanize per ASTM A123 or 153.
4. Painted Finish: Pretreat galvanized substrate and provide two coats shop-applied thermally cured epoxy finish.

2.3 FABRICATION

A. Base, wall, tall and vented storage cases shall be constructed from fully stress relieved, homogeneous color polypropylene sheet material of dimensions specified in the drawings. All casework shall be manufactured to 1/32 inch dimensional tolerance and shall be square to within 1/16 inch in any dimension. Each case shall be self-supporting and accurately mate with the adjoining cases.

B. Top, bottom, sides, vertical, posts and front case surfaces shall be constructed from .5 inch thick polypropylene sheet material. V groove sides, back, and bottom pieces out of a single sheet to form a seamless, fold up exterior. All other surfaces shall be continuously welded where required using a 5/32 inch diameter wild rod material resulting in a totally enclosed case designed to protect the interiors from dust, vermin and spilled liquids.

C. Exterior surfaces shall be flat. There shall be no exposed exterior welds, when installed. Where welding is done on exterior panels, the protruding weld shall be shaved flush with the surrounding material’s surface. Interior welds to be finished in the same manner. All exposed ends, fronts and sides of base, wall, tall and vented storage cases must have a parent material finish. Exposed butt welds will not be accepted.

D. Base and vented cases shall have 3 inch wide full length front and rear stretchers at the top welded in place to support counter top and hood attachment.

E. Base and tall cases, unless otherwise specified shall have a 4 inch high by 3 inch deep toe kick. The toe space rail shall extend up and forward to engage the bottom rail to form a smooth fully enclosed all welded toe space.
F. The interior right and left sides of all base, tall, wall and vented storage cases shall have pre-drilled and counter bored holes to accept polypropylene plugs in each corner for fastening cases together. The pre drilled holes shall be offset from on the right side from the left. Wall cases shall have an additional pre drilled connection point provided every 12 inches on center, 2 inches from the inside top starting 2 inches from each side. A 1.5 inch stainless washer shall be used as a backer when fastening the case to the wall into the backer material. Polypropylene caps shall be provided to cover the fastening hardware.

G. For each door opening on all base cases, there shall be a removable access panel located on the back of the case to provide access to the utility chase. All access panels shall be 0.25 inch thick flush mounted polypropylene panels secured in place by #8-32 x .5 inch polypropylene flat head screws.

H. All exposed cut edges and corners shall be beveled, clean and deburred. All cabinet opening edges must be rounded over smooth.

I. Door Construction
1. Doors shall be constructed from 0.5 inch thick polypropylene sheet material.
2. Doors shall not require the use of mechanical devices to remain in the closed position. Provide .5 inch diameter magnets with a 2.0 mil PTFE based coating shall be flush mounted into the door and cabinet frame. Provide a polypropylene plug to cover magnet and to match the adjacent material in appearance. The magnets shall be aligned opposite each other on the inside top and bottom of each door and the inside top and bottom of each cabinet frame. Magnet to be held in place by adhesive and friction fit. Provide magnets at 24 inches on center for doors that exceed 30 inches in height.
3. Door hinges shall be mounted flush to the inside surface of the door and recessed flush into the front opening edge of the frame such that the only barrel is visible. All fasteners to be polypropylene countersunk screws; #8-32 x 3/8 inch attachment of hinge to door and 0.25 inch by 0.75 inch attachment of hinge to frame. For doors taller the 30 inches provide hinges at 24 inches on center. Welding is not acceptable.
4. Door wire type pulls shall be molded polypropylene, recessed 0.125 inches into the front and fastened from the inside with two #10-32 x 1 inch countersunk PTFE base coated screws.
5. All doors shall have a one inch reveal on the hinged side of door, 0.5 inch reveal on the top and bottom, and a 0.5 inch reveal between two opposing closing doors or the case edge for single door cases.
6. Framed Transparent Doors: 3/16 inch tempered glass; flush mounted into dado in back of door face. Glazing shall be welded into back side of frame and be finished smooth with surrounding frame. All inside corners to have a 1 inch radius.

J. Drawer Construction:
1. Drawers shall be constructed from 0.5 inch thick polypropylene sheet material with sides, back and bottom V-grooved out of a single sheet to form a seamless, square, fold up exterior. Apply adhesive to V-groove and tack weld to form a seamless interior surface. Mechanically attach ends while they meet the top of the sides with 0.25 inch by 1 inch PVC hex head screws to the back top ends of the drawer. The front of the drawer shall be seam welded from the outside.
2. Drawer slides shall consist of a full length 0.5 inch by 1.5 inch polypropylene runner, weld runner to sides or center support of case. Drawer slide to mate to 9/16 inch by 3/8 inch deep slotted track in each side of drawer. Runner and glide slot shall provide smooth non-binding operation.

3. Provide molded polypropylene flexible stops to prevent drawer from being withdrawn from the drawer slides; stops when squeezed against sides allow drawer to be removed. Stops shall be welded to the lower rear side of the drawer and permit full extension of the drawer.

4. Wire pulls; same as for door construction.

5. Drawer reveal overlay shall be 0.5 inch on each side and 0.5 inch on the top and bottom.

K. Accessories – Closure Panels

1. Provide closure and filler panels as indicated on drawings.

2. Provide full height closure panel at knee space as indicated. Closure panel shall be 0.25 inch thick polypropylene sheet material recess and flush mounted. Secure closure panel using #8-32 by 0.5 inch polypropylene flat head screws.

3. All closure and filler panels shall be fabricated using a minimum 0.5 inch thick polypropylene sheet material. Provide pre-drilled and counter bored holes for securing adjoining cases. At adjoining knee spaces and knee spaces greater than 48 inches wide provide a 1 inch thick support panel attached to the floor using 0.5 inch diameter polypropylene pegs embedded into the floor.

4. Sink attachment hardware shall be provided for all sink units as indicated and shall be integral part of the case. Provide 2 inch by 4 inch vertical bars welded to the side walls of the case full width of the case at the top, four inches from front and real walls. Pre-drill 1 inch diameter threaded holes on 1.5 inch centers. Provide 1 inch diameter threaded rods attach threaded rods to vertical bars.

L. Shelf Construction

1. Shelves shall be constructed from 0.5 inch thick polypropylene sheet material. All shelves shall have a 1 inch upward return to act as a seismic lip. Upward return to be formed by a folded V-groove.

2. Shelves shall be supported on both ends by two molded polypropylene pegs on each side wall and in the center for shelves over 30 inches in length.

M. Hardware:

1. All hardware shall be non-metallic, highly corrosive resistant and constructed from polypropylene, PVC, PVDF, TFE. Nylon, Delron or similar material is not acceptable. Where approved metallic hardware shall be coated with a minimum of 2.0 mils of TFE, or PTFE or other acceptable corrosive resistant material.

2. Provide polypropylene leveling shims for final field leveling of casework installation.

2.4 COUNTERTOPS

A. Same requirements as for countertops described in Section 123553.13, Modular Metal Laboratory Casework.

2.5 LABORATORY SERVICE FITTINGS
A. Same requirements as for service fittings described in Section 123553.13, Modular Metal Laboratory Casework except that internal parts shall be from PVDF material.

2.6 SINKS

A. Same requirements as for sinks described in Section 123553.13, Modular Metal Laboratory Casework.

2.7 FINISHES

A. Service Fitting Color Indexing: Integrimally colored plastic discs.

<table>
<thead>
<tr>
<th>Service Name</th>
<th>Disc Color</th>
<th>Letters</th>
<th>Letter Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nitrogen:</td>
<td>Grey</td>
<td>N2</td>
<td>Black</td>
</tr>
<tr>
<td>2. Vacuum:</td>
<td>Yellow</td>
<td>VAC</td>
<td>Black</td>
</tr>
<tr>
<td>3. Gas:</td>
<td>Dark Blue</td>
<td>GAS</td>
<td>White</td>
</tr>
<tr>
<td>4. Ind. Cold Water:</td>
<td>Dark Green</td>
<td>ICW</td>
<td>White</td>
</tr>
<tr>
<td>5. Ind. Hot Water:</td>
<td>Red</td>
<td>IHW</td>
<td>White</td>
</tr>
<tr>
<td>6. R.O. Water:</td>
<td>White</td>
<td>DI</td>
<td>Black</td>
</tr>
<tr>
<td>7. Air:</td>
<td>Orange</td>
<td>AIR</td>
<td>Black</td>
</tr>
</tbody>
</table>

2.8 SOURCE QUALITY CONTROL

A. Fabrication Tolerances: Plus or minus, except where total deviation is stated.
1. Epoxy Countertops: Thickness 0.0313 inch; Warpage, maximum deviation of 0.0625 inch in any 36 inches, and 0.0938 inch in any 96 inches when measured unrestrained on Grade B Tool Room plate.
2. Stainless Steel Countertops: Length, 0.125 inch, width 0.0625 inch, square 0.0156 inch for each 12 inches but not more than 0.0625.
3. Cut Outs: Location, 0.125 inch; Size 0.125 inch plus, minus 0.

B. Casework Tests:
1. Wall Cabinet: 48 inches square by 13 inches deep with three shelves anchored to framed wall with studs 16 inches on center and 0.625 inch gypsum board with three No. 10, 1.75 inch screws located 3 inches from top and bottom of cabinet and driven into studs. Cabinet shall with stand a 600 pound horizontal load pulling away from the wall at the side corner of the case while simultaneously loaded with a total weight of 1200 pounds. There shall be no sign of stress or failure to the case or shelves.

PART 3 – EXECUTION

3.1 PREPARATION
A. Clean areas that will be concealed and areas where access will be obstructed once work is installed, vacuum, dust and mop as necessary to remove dust and debris.

3.2 MODULAR POLYPROPYLENE CASEWORK INSTALLATION

A. Install work plumb, level, true and straight with no distortions. Scribe and cut to fit to adjoining work including variations in finish floors, and refinish cut surfaces or repair damaged finish at cuts. Coordinate installation with electrical and plumbing work.
   1. Provide filler strips where necessary for neat orderly fit. Use concealed fasteners where practicable.

B. Where required assemble units into one integral unit with joints flush, tight and uniform. Align similar adjoining doors and drawers.

C. Countertops: Abut top and edge surfaces in one true plane with hairline tight joints. Support joints to prevent any deflection.
   1. Field Joints: Factory prepared and identical to factory joints, locate only where indicated on approved shop drawings. Field processing of top and edge surfaces is not acceptable.
   2. Cut-Outs: Shop fabricated to the greatest extent possible; where field fabrication is acceptable, provide 0.125 inch radius at inside corners, rout and file cutouts. Prevent cracks and seal cut edges with waterproof coating recommended by countertop manufacturer.
   3. Anchorage: Z-Type, angle-type, or other acceptable fastening, spaced maximum of 36 inches on-center.

D. Tolerances:
   1. Plumb and Level: 0.125 inch in 8 feet for case and countertop.
   2. Flushness of Adjoining Surfaces: Zero.

3.3 ADJUSTING AND PROTECTION

A. Repair damaged and defective work where possible to eliminate defects functionally and visually; where Work cannot be acceptably repaired, it shall be replaced.

B. Clean, lubricate and adjust hardware.

C. Clean exposed and semi-exposed surfaces.

D. Provide final protection and maintain conditions to ensure Work will be without damage or deterioration at time of substantial completion. Do not use countertops as work nor standing surfaces. Tops that are scratched or otherwise damaged will be rejected.
   1. Epoxy Resin Fabrications may be softer and more easily scratched than other plastic laminate. Contractor shall provide protection as necessary to ensure these surfaces are not scratched nor damaged.
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.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. GPT; an EnPro Industries company.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.

D. 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. GPT; an EnPro Industries company.
   4. Metraflex Company (The).

B. Description:
   1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   2. Designed to form a hydrostatic seal of 20 psig minimum.
   3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
   4. Pressure Plates: Stainless steel, Type 316.
   5. Connecting Bolts and Nuts: Stainless steel, Type 316, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. GPT; an EnPro Industries company.
   4. Metraflex Company (The).

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink, 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

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow Corning Corporation.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. Polymeric Systems, Inc.
   d. Sherwin-Williams Company (The).

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Smooth-On.

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 or silicone sealant, seal 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.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier
   Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors
   at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply
   with requirements for firestopping and fill materials specified in Section 078413 "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-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. Use grout or silicone sealant, to seal the space around outside of sleeve-seal fittings.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair
      leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and
   inspections.

C. Prepare test and inspection reports.

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 pipe sleeves.
b. Piping NPS 6 and Larger: Cast-iron pipe sleeves.

2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6: steel pipe 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 pipe 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: Steel pipe 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 pipe 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:
   a. Piping Smaller Than NPS 6: [Steel pipe sleeves] [Stack-sleeve fittings].
   b. Piping NPS 6 and Larger: [Steel pipe sleeves] [Stack-sleeve fittings].

5. Interior Partitions:
   a. Steel pipe sleeves.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Escutcheons.
      2. Floor plates.

1.3 DEFINITIONS
   A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. BrassCraft Manufacturing Co.; a Masco company.
      2. Dearborn Brass.
      3. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS
   A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
   B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
   C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
   D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.3 FLOOR PLATES
   A. Split Floor Plates: Steel with concealed hinge.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

   1. Escutcheons for New or Relocated Existing Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
      c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
      d. Bare Piping in Unfinished Service Spaces and equipment rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
      e. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

   1. New Piping or Relocated Existing Piping: One-piece, floor plate.
   2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Two-piece ball valves with indicators.
   2. Check valves.
   5. Indicator posts.
   6. Trim and drain valves.

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
B. NRS: Nonrising stem.
C. OS&Y: Outside screw and yoke.
D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 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.

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 operating handles or stems as lifting or rigging points.
D. Protect flanges and specialties from moisture and dirt.

**PART 2 - PRODUCTS**

2.1 **GENERAL REQUIREMENTS FOR VALVES**

A. UL Listed: Valves shall be listed in UL’s "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Main Level: HAMV - Fire Main Equipment.
   a. Level 1: HCBZ - Indicator Posts, Gate Valve.
   b. Level 1: HLOT - Valves.
      1) Level 3: HLUG - Ball Valves, System Control.
      2) Level 3: HLXS - Butterfly Valves.
      3) Level 3: HMER - Check Valves.
      4) Level 3: HMRZ - Gate Valves.

   a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:
   a. Indicator posts.
   b. Valves.
      1) Gate valves.
      2) Check valves.
         a) Single check valves.
      3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:
   1. ASME B16.1 for flanges on iron valves.
   2. ASME B1.20.1 for threads for threaded-end valves.
   3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.
I. Valve Actuator Types:
   1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
   2. Handwheel: For other than quarter-turn trim and drain valves.
   3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ames Fire & Waterworks; A WATTS Brand.
   2. NIBCO INC.
   3. Victaulic Company.

B. Description:
   1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
   4. Body Material: Forged brass or bronze.
   5. Port Size: Full or standard.
   6. Seats: PTFE.
   7. Stem: Bronze or stainless steel.
   8. Ball: Chrome-plated brass.
   9. Actuator: Worm gear or traveling nut.
   10. Supervisory Switch: Internal or external.
   11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.

2.3 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ames Fire & Waterworks; A WATTS Brand.
   3. FEBCO; A WATTS Brand.
   4. Fivalco Inc.
   5. Globe Fire Sprinkler Corporation.
   6. Kennedy Valve Company; a division of McWane, Inc.
   7. NIBCO INC.
8. Reliable Automatic Sprinkler Co., Inc. (The).

B. Description:
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.

2.4 BRONZE OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Milwaukee Valve Company.
2. NIBCO INC.
3. Zurn Industries, LLC.

B. Description:
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.

2.5 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Clow Valve Company; a subsidiary of McWane, Inc.
2. Hammond Valve.
3. Kennedy Valve Company; a division of McWane, Inc.
4. **NIBCO INC.**
5. **Victaulic Company.**
6. **WATTS.**
7. **Zurn Industries, LLC.**

**B. Description:**
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.

**2.6 INDICATOR POSTS**

**A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. **Clow Valve Company; a subsidiary of McWane, Inc.**
2. **Kennedy Valve Company; a division of McWane, Inc.**
3. **NIBCO INC.**

**B. Description:**
2. Type: Underground or Wall.
3. Base Barrel Material: Cast or ductile iron.
4. Extension Barrel: Cast or ductile iron.
5. Cap: Cast or ductile iron.

**2.7 TRIM AND DRAIN VALVES**

**A. Ball Valves:**
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. **Apollo Flow Controls; Conbraco Industries, Inc.**
   b. **Fire-End & Croker Corporation.**
   c. **Flowserve Corporation.**
d. **KITZ Corporation.**

e. **Milwaukee Valve Company.**

f. **NIBCO INC.**

g. **Potter Roemer LLC.**

h. **Red-White Valve Corp.**
i. **Tyco by Johnson Controls Company.**
j. **Victaulic Company.**
k. **Zurn Industries, LLC.**

2. **Description:**


   b. Body Design: Two piece.

   c. Body Material: Forged brass or bronze.

   d. Port size: Full or standard.

   e. Seats: PTFE.

   f. Stem: Bronze or stainless steel.

   g. Ball: Chrome-plated brass.

   h. Actuator: Handlever.

   i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.

   j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

**B. Angle Valves:**

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

   a. **Fire Protection Products, Inc.**

   b. **NIBCO INC.**

   c. **United Brass Works, Inc.**

2. **Description:**


   b. Body Material: Brass or bronze.

   c. Ends: Threaded.

   d. Stem: Bronze.

   e. 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 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
   1. Section 21 13 13 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Labels.
   2. Pipe labels.
   3. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 and the proposed content for each label.

D. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, with predrilled holes for attachment hardware.


C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2- by 3/4-inch.

F. Minimum Letter Size: 1/4-inch for name of units if viewing distance is less than 24-inches, 1/2-inch for viewing distances up to 72-inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: Size letters according to ASME A13.1 for piping.

D. Pipe-Label Colors:
   1. Background Color: Safety Red.

2.3 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch thick, with predrilled holes for attachment hardware.
   2. Fasteners: Brass 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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.
3.2 GENERAL INSTALLATION REQUIREMENTS
   A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

3.3 PIPE LABEL INSTALLATION
   A. Piping: Painting of piping is specified in Section 099123 "Interior Painting.

   B. Pipe-Label Locations: 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. Where flow pattern is not obvious, mark each pipe at branch.
      3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
      4. At access doors, manholes, and similar access points that permit a view of concealed piping.
      5. Spaced at maximum intervals of 50-ft along each run. Reduce intervals to 25-ft in areas of congested piping and equipment.
      6. Label piping at least once in each room or space regardless of spacing distances listed above.

   C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.4 VALVE-TAG INSTALLATION
   A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Pipes, fittings, and specialties.
      2. Cover system for sprinkler piping.
      4. Sprinklers.
      5. Alarm devices.
      6. Pressure gages.
   B. Related Requirements:
      1. Section 21 11 19 "Fire Department Connections" for exposed-, flush-, and yard-type fire
         department connections.
      2. Section 21 05 23 "General-Duty Valves for Water-Based Fire-Suppression Piping" for
         ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.3 DEFINITIONS
   A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at
      working pressure of 175-psig maximum.

1.4 DESCRIPTION OF WORK
   A. This specification requires that the Fire Protection Contractor (FPC) shall be the Designer
      and Builder of the Fire Sprinkler System. Any required engineer's approval shall be the
      responsibility of the FPC.
   B. The FPC shall lay out and install a complete and approved hydraulically designed fire
      sprinkler system as indicated herein and on project Drawings equal or exceeding NFPA 13
      as currently adopted by the Authority Having Jurisdiction (AHJ).
   C. The sprinkler system shall be designed and installed in accordance with the Owner's
      insurance underwriter.
   D. These specifications provide minimum performance requirements. It remains the
      responsibility of the FPC to design the sprinkler system to the required performance criteria
      that will meet code requirements and satisfy all agencies at all levels of government that
      have influence on the design and performance of the system.
   E. The sprinkler system coverage shall include but not be limited to the following:
1. System(s) complete with equipment, piping and related appurtenances. In addition to items specifically indicated, provide miscellaneous items required to result in complete and operable system.

2. Verify electrical requirements of alarm valves, flow switches, valve supervision switches, with electrical contractor.


1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. HVAC hydronic piping.
   3. HVAC ductwork.
   4. Items penetrating finished ceiling include the following:
      a. Ceiling mounted communications devices
      b. Lighting fixtures including exit signs.
      c. HVAC Air outlets and inlets.
      d. Ceiling mounted owner furnished equipment.

B. Qualification Data: For qualified Installer and professional engineer.

C. Design Data:
   1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
   2. Hydraulic calculations to originate from the point of connection to the utility main and not at fire pump or alarm valve flange.
   3. Provide NFPA compliant 2-hydrant flow test dated not more than 120 prior to design submittals.
D. Welding certificates.

E. Field Test Reports:
   1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
   2. Fire-hydrant flow test report.

F. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.8 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.10 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Construction Manager and Owner no fewer than five days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Construction Manager and Owner's written permission.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   2. NFPA 13R.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design wet-pipe sprinkler systems.
   1. Sprinkler system design shall be approved by authorities having jurisdiction.
      a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
      b. Sprinkler Occupancy Hazard Classifications:
         1) Automobile Parking Areas: Ordinary Hazard, Group 1
         2) Building Service Areas: Ordinary Hazard, Group 1
         3) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
         4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
         5) Office, Residential Living Areas and Public Areas: Light Hazard.
   2. Minimum Density for Automatic-Sprinkler Piping Design:
      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.
      c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
      d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
   3. Minimum Density for Deluge-Sprinkler Piping Design:
      a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over entire area.
      b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over entire area.
      c. Special Occupancy Hazard: As determined by authorities having jurisdiction.
   4. Maximum Protection Area per Sprinkler: According to UL listing.
   5. Maximum Protection Area per Sprinkler:
      a. Light Hazard Spaces: 225 sq. ft.
      b. Storage Areas: 130 sq. ft.
      c. Mechanical Equipment Rooms: 130 sq. ft.
      d. Electrical Equipment Rooms: 130 sq. ft.
      e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A53/A53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Black-Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Thinwall Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.


F. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.


H. Malleable- or Ductile-Iron Unions: UL 860.


J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
   1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick, ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
      b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
   2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.


L. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Pressure Rating: [175-psig] [250-psig] [300-psig] minimum.
   2. Painted Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
   3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
M. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:
   2. Design: For horizontal or vertical installation.
   3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
   4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
   5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
   6. 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.

2.4 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
   4. Type: Mechanical-tee and -cross fittings.
   5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
   3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:
2. Pressure Rating: 300 psig.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:
2. Type: Flexible hose with stainless steel overjacket for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Residential Sprinklers: 175-psig maximum.

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
D. Automatic Sprinklers with Heat-Responsive Element:
   1. UL listed for specific use.
   2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for “Ordinary” temperature classification rating unless otherwise indicated or required by application.

E. Sprinkler Finishes: Chrome plated.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
   2. Type: Wire cage with fastening device for attaching to sprinkler.

2.6 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:
   3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   4. Type: Paddle operated.
   6. Design Installation: Horizontal or vertical.

C. Valve Supervisory Switches:
   2. Type: Electrically supervised.
   4. Design: Signals that controlled valve is in other than fully open position.
   5. 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.

2.7 PRESSURE GAGES

A. Standard: UL 393.
PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. [Comply with requirements for backflow preventers in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping."]

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building’s interior water-distribution piping. Comply with requirements for interior piping in Section 22 11 16 "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. [Comply with requirements for backflow preventers in Section 22 11 19 "Domestic Water Piping Specialties." ]

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

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.

2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 21 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they are not subject to freezing.

N. Fill sprinkler system piping with water.

O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 21 05 33 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 21 07 00 "Fire-Suppression Systems Insulation."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."
3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

I. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to “Quality Assurance” Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. Install valves in vertical position for proper direction of flow, in main supply to system.
   2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections[ with the assistance of a factory-authorized service representative]:
   1. Leak Test: After installation, charge systems 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire-alarm tests. Operate as required.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.
3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded or grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 10 and smaller, shall be one of the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   3. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   4. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   5. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
   4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential Sprinklers: Dull chrome.
5. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping materials and installation instructions common to most piping systems including but not limited to: dielectric fittings, sleeves/sleeve seals, escutcheons, grout, demolition, equipment installation requirements common to equipment sections, painting and finishing, concrete bases, supports and anchorages, general coordination, plumbing/electrical wiring and device coordination.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   1. The requirements of this Section apply to all the Work of Division 22 Plumbing.

1.3 REFERENCE STANDARDS

A. Perform work specified in Division 22 in accordance with the codes and standards listed below, including all applicable sections and/or subsections of any Referenced Standard as may be applicable to the Work.
   1. AGA - American Gas Standard.
   4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
   5. ASME - American Society of Mechanical Engineers.
   10. CISPI – Cast Iron Soil Pipe Institute
   11. FGI Guidelines - Facilities Guideline Institute
   18. OSHA - Occupational Safety & Health Administration (including local General Industry Safety Orders).
   19. PDI - Plumbing and Drainage Institute.
20. Rules & Regulations of local, state and national utility servicing and/or regulating entities.


22. UL - Underwriters Laboratories.

B. Where materials or methods specified fail to meet applicable code and standards, provide, replace or modify materials and/or methods to meet applicable standards or code requirements. Do not provide materials or employ methods that do not conform to applicable codes and standards. Contractor shall be responsible for all repair and/or replacement of all defective work, including but not limited to removal, replacement and repair of the Work and the work of others directly or indirectly impacted.

C. All applicable local, State and/or Federal laws, ordinances and regulations are hereby incorporated by reference into and made a part of this Specification. Where applicable, materials, and equipment shall bear stamps or seals of UL, ASME, NEMA, and other industry regulating groups. In the event of a difference or conflict between governing codes, laws, ordinances, regulations, industry standards, specifications or other provisions of the contract documents as to performance, the more stringent requirement shall apply, or as to quality, the highest quality provision shall apply and be included, each without cost or schedule impact. Contractor shall promptly notify Architect, in writing, of such differences and/or conflicts, and in all cases, prior to procurement, fabrication or installation of the work.

D. Comply with the Safety Orders issued by OSHA and any other safety, health or environmental regulations of the state in which the project is located and any districts having jurisdictional authority.

1.4 DEFINITIONS

A. Following is a list of abbreviations generally used in Division 22.

1. AHJ Authority Having Jurisdiction.

2. FM Factory Mutual Global.

3. HVAC Heating, Ventilating and Air Conditioning.


5. IFC International Fire Code.

6. IMC International Mechanical Code.


8. MSS Manufacturers Standardization Society.

B. The following are industry abbreviations for plastic materials:

1. ABS Acrylonitrile-butadiene-styrene plastic.

2. CPVC Chlorinated polyvinyl chloride plastic.

3. PE Polyethylene plastic.

4. PVC Polyvinyl chloride plastic.

C. The following are industry abbreviations for rubber materials:

1. EPDM Ethylene-propylene-dieneterpolymer rubber.
2. NBR Acrylonitrile-butadiene rubber.

D. Terms used on the drawings or in the specifications shall have the following meanings:

1. Approved Equal: An item suggested by the Contractor that is permitted, in writing by the Engineer to replace an item listed in the Specifications or Drawings. The burden of proof of equality is the responsibility of the Contractor.

2. Furnish: Supply and deliver, ready for installation, assembly or intended use, all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular work referred to.

3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at the project site as required to complete all items of work as required for the intended use/operation including all testing, certification, commissioning, and other requirements for final turnover to the Owner.

4. Provide: "Furnish" and "Install."

5. Owner Furnished, Contractor Installed: The Owner will furnish at his cost and the Contractor shall receive, protect, store and install in the performance of the Work.

6. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

7. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

8. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

9. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include installations above ceilings, in shafts, trenches, partitions, or other enclosures.

10. 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 embedded in or below masonry or concrete construction, earthwork/trenches, within unheated shelters, crawl spaces or enclosures.

11. Wiring: All wires, raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connectors, splices, and all other items necessary and/or required in connection with such work.

12. Raceway: All raceways, conduit, fittings, hangers, supports, sleeves, etc.

1.5 GENERAL REQUIREMENTS

A. Examine the drawings, specifications and other contract documents relating to the work and the work of all trades and become fully informed as to the extent and character of work required. Coordinate all work with that of others to ensure proper and complete installation of all materials, equipment and supports. It is the intent of the drawings, specifications and related Contract Documents to provide a complete working installation of all systems and equipment called for, in proper operating condition, finished, tested and ready for its intended use (hereinafter “Design Intent”). Provide all items not specifically shown on the drawings, called for in the specifications or related Contract Documents, but required to
conform to the Design Intent without additional cost or schedule impact. The scope of work shall include all labor, material and equipment to achieve the Design Intent and all necessary and required temporary and incidental equipment, connections, services, supports, hoisting and scaffolding, access provisions, tools, appliances, consumables, fees, permits and licenses, debris removal/disposal, supervision and labor, including required start-up, checkout and training to provide complete and fully operable systems in full compliance with the Contract Documents.

B. The drawings, specifications and related Contract Documents are intended to be complementary and interrelated; what is required by one is as if required by another. Similarly, information and/or requirements may be included in one and not another. Contractor is responsible to conduct a full and thorough review all Contract Documents to ascertain requirements of the Work before proceeding, including but not limited to all drawings and, specifications. Where there is a conflict in or between the drawings, specifications or other related Contract Documents as to performance, the more stringent requirement shall apply, or as to quality, the highest quality provision shall be applied and be included, each without cost or schedule impact. All such conflicts shall immediately be brought to the attention to the Architect.

C. Before submitting a bid and prior to the start of work, Contractor shall examine all conditions relating to the Work, including that associated with the work of other trades upon which Contractor’s work may rely or otherwise depend, to achieve the Design Intent, in accordance with the best trade practices, workmanship and highest quality product installation, taking into account the sequence of the work, delivery, storage and hoisting requirements, requirements for access, testing and temporary services and all other site limitations and project complexities. Report to the Architect/Engineer any conditions which might prevent installation of materials and/or equipment in the manner intended by the Contract Documents or contrary to applicable codes, standards or regulations.

D. No consideration or allowance will be granted for any alleged misunderstanding of materials, equipment or components to be furnished or work to be done; it being agreed that tender of proposal carries with it agreement to items, terms and conditions required by the Contract Documents.

E. Site Visit - Visit the site and verify the exact conditions relating to the work and obtain such information as may be necessary to present a complete and comprehensive bid. No allowance will be made for any extra expense due to Contractor’s failure to make such a visit and reasonably verify all actual/existing conditions. In the event of a conflict between existing conditions and the requirements of the Contract Documents, perform the necessary work to conform to Design Intent. The Owner or his representative will be the sole individual to interpret the intent of the Drawings in the event of a conflict between (1) existing conditions and those shown on the drawings, or (2) quality of existing material and quality of material indicated on the drawings or in the specifications. Wherever a conflict such as this occurs, the higher standard shall prevail.

1.6 SPECIAL REQUIREMENTS

A. When applicable, Contractor acknowledges the ongoing operations of the Owner at or in close proximity to the Project and agrees to coordinate the timing of the Work with the Owner’s ongoing operations; perform the Work in a manner that minimizes or eliminates any adverse impact upon the Owner’s ongoing operations; confine operations at the site to areas approved by Owner, permitted by law, permits and the Contract Documents; comply with the Owner’s standard security, health and safety policies and procedures; not unreasonably
encumber the site with any materials or equipment; and not place signs or advertising on or about the site without prior approval of Owner.

B. Where applicable, all seismic construction, restraints, bracing, mounts and hanging systems shall be in full compliance with the requirements of all Authorities Having Jurisdiction (AHJ’s), including but not limited to submission and review requirements as well as requirements for pre-approval, certification and engineering (including certified engineering calculations and stamps). Contractor shall be solely responsible for obtaining and complying with all requirements of the AHJ.

1.7 SUBMITTALS

A. Reference Division 01 for submittal requirements.

B. Submittal Schedule - Provide a detailed submittal schedule including all requirements of this Division 22 and its subdivisions to the Architect and Engineer within thirty (30) days of contract award.

1. Contractor shall submit for the Architect’s approval a Submittal Schedule for the performance of the work that is consistent with the requirements of the project schedule. The Submittal Schedule shall allow reasonable time for the Architect and other consultants review as specified in Section 013300 Submittal Procedures. If the time for Architects review is not otherwise specified, the review period (from date of receipt) shall be fifteen (15) days. Once approved by the Architect/Engineer, submittal dates and time limits established by the Submittal Schedule shall not, except for reasonable cause, be changed or exceeded by the Contractor.

2. For each submittal required by the Contract Documents the schedule shall include: specification section number, subsection/paragraph identification number, item description (as stated in the applicable specification section, subsection or other Contract Document) and the scheduled delivery date to the Architect/Engineer.

3. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project schedule resulting from any deviation to the approved Submittal Schedule, including but not limited to; payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer as may be required to perform out of sequence, stacked, critical, delayed, unscheduled or multiple reviews of required submittals necessitated by rejection of a prior submittal, (cumulatively and hereinafter, “Additional Review Costs”)

C. General:

1. Review is for general conformance with the Contract Documents and is not intended to otherwise approve or verify dimensions, quantities, or to coordinate the Work shown on shop drawings on or between Contactor and the work of other trades or Sections. Contractor is solely responsible for quantities, dimensions, means and methods. Dimensions shall be confirmed and correlated by Contractor at the jobsite prior to the start of the Work (procurement, fabrication, construction or other commencement activities). Contractor’s failure to fully verify conditions at the jobsite prior to commencement of the work shall not relieve Contractor of its obligations under the Contract Documents and Contractor shall be responsible for all damages caused by or related to its failure to comply with the requirements of this provision.

2. Submittal review shall be performed to show compliance with the design intent. Contractor shall specifically note any deviations from the Contract Documents and explain the reason and nature of the deviation. Such deviations will be reviewed or
rejected on the submittal. Deviations not so identified shall not relieve the Contractor from the requirements of the Contract Documents.

3. Resubmittals will be reviewed for compliance with comment(s) made on the original submittal only. Architect/Engineer shall not be responsible for changes made upon resubmittal that are not clearly identified (highlighted), and respond directly to the initial rejection. Resubmittals should not be packaged with non-related first time submittals, All resubmittals must be marked with the resubmittal number and date and must otherwise comply with all submittal requirements

4. Submit shop drawings, penetration locations, supplemental data, etc. as may be required by the Contract Documents for all materials, equipment and other components of the Work included in all Sections of this Division and other provisions of the Contract Documents in accordance with the requirements of this Division and Division 01.

5. All submittals must be reviewed by Contractor, and bear Contractors review stamp and signoff for conformity to the Contract Documents, prior to the submission of any required submittal to Architect/Engineer. Submittals that fail to meet this requirement will be considered incomplete, will not be reviewed by Architect/Engineer and will be returned to Contractor, without review and/or rejected and resubmittal will be required. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

6. Forward all submittals to Architect/Engineer in a coherent, organized fashion, complete and packaged as required herein. Unless approved by the Architect/Engineer in advance, all submittals for this division shall be submitted as a single package. Architect/Engineer may reject submittals that fail to comply with this or any other provision of the Contract Documents and Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

7. Subject to other provisions of the Contract Documents and in the absence of a more stringent requirement, Architect/Engineer will review a submittal not more than two (2) times. Contractor shall be solely responsible for any subsequent reviews and all Additional Review Costs and/or other project costs or schedule impact.

8. Resubmittals will be reviewed for compliance with comment(s) made on the original submittal only. Architect/Engineer shall not be responsible for changes made upon resubmittal that are not clearly identified (highlighted), and respond directly to the initial rejection. Resubmittals should not be packaged with non-related first time submittals. All resubmittals must be marked with the resubmittal number and date and must otherwise comply with all submittal requirements.

9. Identify each submittal item by reference to Specification Section paragraph in which item is specified, or drawing/detail number, as applicable. In addition, for equipment submittals include identification numbers appearing on the equipment schedule.

10. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words “as specified” are not sufficient identification.

11. Organize submittals in same sequence as they appear in specification sections, articles or paragraphs.

12. All materials and equipment submittals shall have a summary sheet at the front complete with catalog numbers. Where materials or equipment pertain to more than one building, submittals shall clearly indicate at which locations the materials or equipment is to be installed.
13. Submittals shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping and/or conduit entrance, access requirements for installation and maintenance, physical size and dimension, mechanical/electrical characteristics and requirements, foundations/curbs and all permanent and temporary support details as well as all information relating to weight, including but not limited to live and dead weights.

D. Catalog Cuts and Submittal Literature:

1. Catalog cuts, submittal literature and published material may be included to supplement scale drawings.

2. Prepare submittal material binders in accordance with the following and Section 01 33 00:
   a. Insert all literature in standard 3-ring binders for 8-1/2 inch by 11 inch pages with individual tabs. Do not staple literature on different products together.
   b. Number all binders on the outside of the cover and indicate the specification section. Mark binder no. 1 Architect's copy and no. 2 Engineer's copy. Both these binders shall contain original manufacturer's literature.
   c. Provide an index with each binder. This index shall follow the same sequence as the Specifications.
   d. Contractors Option: Provide submittals arranged with numerical index and bookmarks in PDF electronic format containing the total volume of material. All product data shall be submitted complete by system, partial submittals are not acceptable and may be returned unreviewed.

3. Submittal literature, drawings and diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item. Substitutions: Comply with Division 01 Product Substitution Procedures.

E. Shop Drawings:

1. Shop drawings shall include all significant Division systems, equipment and components, including but not limited to all terminal devices, connections and elevations. Include all related specialty rooms (i.e. mechanical, electrical, data/technology). Drawings shall be at a minimum scale of 1/4" per 1'-0" and shall be fully coordinated with the work of other trades and/or Sections.

2. Identify congested areas and clearly indicate solutions to space problems, developed in conjunction with the work of other trades and/or Sections. Identification of space problems without proposed solutions is not acceptable and is grounds rejection. For such areas indicate, superimposed, the work of all trades and/or Sections involved and:
   a. Clearly identify each area of congestion and deviations from the Contract Documents, and: proposed solution(s), clearly documented and signed-off by all other trades and/or Sections involved.

F. Anchorage and Supports: Submit details and calculations for support and anchors that are not specifically detailed on the drawings. All calculations must meet requirements of the AHJ.

1. Provide details and calculations for equipment per requirements of the AHJ:
   a. Having an operating weight over 400 pounds or more and mounted directly to the floor.
b. Having an operating weight over 20 pounds and suspended from the roof, floor, or wall or supported by vibration isolation devices.

c. Where pre-approved bracing systems will be employed, submit:
   1) System component brochure describing components used and detailed installation instructions.
   2) Loads to be transmitted to the structure at anchor points.
   3) Prove the systems meets requirements of the AHJ.

d. Where anchorage, support, and bracing are not detailed on the drawings, and pre-approved systems are not used, submit details and calculations of proposed systems. Include:
   1) Detailed drawings showing system to be installed, stamped by a Structural Engineer registered in the State of Washington.

e. Anchorage and Supports
   1) Where equipment substitutions change the weight, size, configuration, or other aspects of systems and equipment that will affect the performance of anchorages and/or supports, submit calculations for proposed anchors and supports, and install them as shown in these calculations. These calculations shall include the same certification and engineer's stamp as required above for seismic bracing.
   2) Where substitutions will have no effect on anchors and supports detailed on Contract Documents, submit information on sizes, weights, center of gravity and other relevant information to demonstrate this fact.

G. Shop Fabrication Drawings: Drawings are for the Contractor's use and shall be its responsibility. Do not submit shop fabrication documents unless specifically requested

H. Testing and Balancing: Coordinate Shop Drawings to include any additional components for proper system testing and balancing.

I. Certificates: Submit final inspection certificates signed by governing authorities.

J. Operating and Maintenance Instructions and Manuals.
   1. Instructions on major items, including but not limited to: switchgear, generators, pumps, air compressors, water heaters, water softeners, water treatment, medical gas and vacuum source equipment and alarms, plumbing fixtures, specialty units, fans, air handlers, AC units and temperature controls, shall be by representative of manufacturer of respective equipment.
   2. Submit as identified below and as directed in Division 01.
      a. Names, addresses and phone numbers of contractors and subcontractors. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
      b. Complete operating and maintenance instructions and parts lists of all equipment and component parts. Data sheets to show complete internal wiring, and electrical ratings and characteristics, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of
source of supply for parts subject to wear or failure, and description of operating, test, adjustment, and maintenance procedures.

c. Where data sheets included in manual cover equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.

d. Operating Instructions should include, but not be limited to:
   1) Normal starting, operational and shutdown procedures, including emergency procedures for each type of equipment/system.
   2) Equipment wiring diagrams.
   3) All other items as may be specified/required by this Section and the Contract Documents.

e. Maintenance Instructions
   1) All items as may be specified/required by this Section and the Contract Documents.

f. Manufacturers Data (each piece of equipment)
   1) Installation instructions
   2) Drawings and specifications
   3) Parts List, including recommended stock and long lead parts/components.
   4) Wiring and riser diagrams.
   5) Warranties and guarantees for all equipment, materials and components, including repair, replacement and labor from both Contractor and manufacturer as required by the Contract Documents.
   6) Certificates of Installation – manufacturer's certification of supervision during equipment installation and start-up procedures.
   7) Instruction certificates – certificates of compliance with Sections specific training and instruction programs.
   8) All other items as may be specified/required by this Section and the Contract Documents.

K. Record Documents:
   1. Maintain one (1) complete set of blueline prints and specifications at the job site exclusively for recording deviations from the drawings which are necessary because of job conditions, request for information and/or approved change orders. Record locations and depths of buried and concealed piping, conduits or other systems components from fixed, easily identifiable objects, such as building walls or other fixed physical objects. Where piping or conduits are concealed in walls or other fixed physical objects, indicate distances from building corners or other building features not likely to be disturbed by fixture alterations. Drawings, specifications (as-builts) and approved submittals.
   2. Where the project uses a BIM model the contractor shall keep the model updated in a similar fashion, maintaining the current project record as described in (a), above and submit, in addition to all other requirements of this Section and other provisions of the Contract Documents a complete and accurate BIM model for the project.
3. Prior to Substantial Completion, obtain from the Architect a complete set of electronic
CADD drawings. Record all revisions to these drawings to indicate as-built conditions.
Indicate all changes, Including RFIs, on this set of documents. Submit one set of
blueprints of these revised drawings for review. Make necessary changes and deliver to
Architect one set of reproducibles and one electronic copy, including any BIM model,
upon Final Completion and Acceptance. Refer to Division 01 for additional
requirements.

4. Provide full size copies of record one-line diagrams, in metal frames with glass front.
Obtain Record prints from Owner's Representative at Contractor's cost and have prints
framed by a firm normally engaged in this work. Locate diagrams as directed.

5. Three (3) control diagrams, suitably framed, with glass front. Diagrams shall show
complete equipment, controls, model numbers, etc., marked to correspond to
identification on equipment. Locate per Owner's direction.

6. Furnish six sets of valve charts for plumbing systems and HVAC systems. Tag all
valves with brass disc and chain. Use no duplicate numbers. Valve charts to indicate
valve number, size, location, function and normal position. Mount glazed frames
containing one set of valve charts in the building as directed. Bind remaining valve
charts with Operating and Maintenance Manuals.

7. All test reports, certifications, and inspection reports.

8. AHJ/Specialty AHJ Approvals (i.e. Fire Marshal and/or Fire Department system
approvals).

9. Substantial and Final inspection certificate signed by governing authorities.

10. All other items as may be specified/required by this Section and/or other provisions of
the Contract Documents.

1.8 EQUIPMENT DEVIATIONS AND SUBSTITUTIONS

A. See Division 01 for requirements and procedures related to Deviations and Substitutions.
Unless specified elsewhere in the Contract Documents, a minimum of two (2) weeks shall
be allowed for evaluation. The burden of all systems re-engineering/design, testing,
suitability and constructability is solely placed upon the Contractor for all deviations from the
basis of design as reflected in the Contract Documents.

B. No substitutions will be allowed and/or considered unless the description of a product
includes the phrase “approved equal” and then only upon a determination as to equivalency
and impact upon the project budget, schedule and the work of others, including any redesign
of the project or its system components by the Architect, Engineer or other trades. The final
determination as to sufficiency or acceptance of any such substitution and/or deviation
properly requested and submitted by Contractor will lie solely with the Architect/Engineer.
Contractor may not implement substitutions that have not been approved by
Architect/Engineer.

C. Where the Contractor proposes to use an item of equipment other than that specified or
detailed on the drawings which requires any redesign of any portion of the project, including
but not limited to the mechanical, electrical, plumbing, structure, or architectural design or
any of their respective subcomponents. Contractor shall be responsible to the
Architect/Engineer and/or Owner for all costs, expenses and impact to the project budget
and/or schedule resulting from any required investigation, analysis or redesign, including but
not limited to; payment for required overtime, out-of-house resources/consultants or other
higher cost resources of the Architect/Engineer, Owner or AHJ as may be required to
perform the investigation, analysis or redesign (cumulatively and hereinafter, “Deviation Review Costs”)

D . If approved by Architect/Engineer, all such redesign, including and all new drawings and detailing required will be prepared by the Architect/Engineer and their sub-consultants for Change Order documentation for approval by Owner and the Authority having Jurisdiction will be paid by the Contractor as part of the Deviation Review Costs.

E . Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit, supports, foundations, pads, curbs, or equipment from that specified or indicated on the drawings or other Contract Documents, Contractor shall be responsible for all such costs, including the work of other trades and shall be solely responsible to furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system at no additional cost or schedule impact to the project. (Cumulatively and hereinafter “Deviation Construction Costs”.

1.9 COORDINATION

A . Drawings and corresponding electronic media are diagrammatic and indicate the general arrangement of systems and work included in the Work. Consult the drawings, details and other electronic media, for locations of fixtures and equipment; where same are not definitely located, obtain this information from the Architect/Engineer.

B . The drawings and related electronic media have been made to scale with the best knowledge of conditions, dimensions and space requirements available at the time of design and shall be followed as closely as possible during performance of the Work and coordination with the work of others. The forgoing however shall not relieve Contractor from its responsibility to verify all conditions, dimensions and space requirements prior to commencement of the Work and to immediately report any errors or discrepancies to the Architect/Engineer.

C . Check drawings and related electronic media of other trades to verify spaces and conditions in which work will be performed prior to commencement of the work. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.

D . If directed by the Architect/Engineer or required for proper installation, execution and coordination of the work, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed.

E . Take all dimensions from Architectural and Structural Drawings, certified equipment drawings and from the actual field measurements before fabricating work. All conflicts shall immediately be reported to the Architect/Engineer. Contractor is solely responsible for conflicts known or which reasonably should have been known but not reported or resolved before commencement of the work.

F . Coordinate equipment furnished with all associated project requirements for controls, sequence of operation, and building automation system monitoring and alarms.

G . Equipment furnished shall fit in allocated space with due provision for manufacturer’s recommended access and proper maintenance requirements. Verify and coordinate space requirements with all trades and equipment which comprise the Work. Contractor shall locate equipment and products (specifically including but not limited to water heaters,
pumps, motor control centers, valves, traps, cleanouts, motors, water hammer arrestors, trap primers), which require service, operation, observation, or maintenance in fully accessible positions and so that at least the minimum clearance recommended by manufacture, standard or required by code is provided, even if such clearance is not indicated in the Contract Documents. If required for better accessibility, any change(s) of location shall be submitted to the Architect/Engineer for review and approval before relocation is made. Contractor shall provide access panels, even if not specifically shown on drawings, for concealed devices requiring service. Access panels shall be of a type and finish specified in the Contract Documents, or if not specified shall be of the quality and type acceptable to Architect.

H. Diagrams - Mechanical, plumbing and electrical riser and other such flow and/or riser diagrams that appear on the drawings and related electronic media are provided with the intent of showing equipment, pipe, valves, conduit, feeder and related specialties and other appurtenances in their proper interrelation. Provide and connect all additional equipment, specialties and appurtenances required by the manufacturer of the equipment furnished for proper operation of the product, whether or not shown, or as required elsewhere in the Contract Documents. In the event of discrepancies between the diagrams and the plans or elevations the diagrams shall govern. Notify the Architect/Engineer in writing of any discrepancies.

I. Prior to construction, coordinate the Work with that of other trades and building components. Prepare coordination drawings (or other specified electronic media) for all major trades, utilities and other primary systems routing in conjunction with the contract documents to maximize the pre-installation planning and coordination of trades, utilities and systems and minimize the requirement to manage field coordination through the RFI’s, ASI’s or other similar processes.

J. Coordinated drawings shall employ grid line identification as used by Architects and include, at a minimum major systems routing and locations and coordination of all graded plumbing lines, fire protection, HVAC equipment and components, ceiling appurtenances, lights, fixtures and devices, electrical services, structural systems, architectural walls, features and enclosures.

K. Coordinate the installation of all building chases, supporting devices, embedded sleeves, anchors and all other wall, floor and ceiling penetrations with structural engineer, Architect, and applicable trade contractors.

L. Coordinate connection of systems with interior/exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

M. Coordinate requirements for access panels, doors and security grabs where such items requiring access are concealed behind finished surfaces.

N. Coordinate installation of identifying devices after completing floor and wall covering where devices are applied to such surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment areas.

O. Before starting work, carefully examine the site and all Contract Documents. Become thoroughly familiar with new and existing conditions governing work on this project. Verify indicated elevations, building measurements, rough-in dimensions and equipment locations before proceeding with any of the work.
P. Drawings shall be accurately scaled to 1/4 inch = 1 foot or larger using the same version of AutoCAD or other electronic media as used by Architect/Engineer. Drawings shall include all Addenda and Change Order items.

Q. Contractor shall be solely responsible for coordination and shall bear the cost of its failure to coordinate installation or of failure to advise Architect/Engineer of installation conflicts.

R. Piping that must be graded shall have right-of-way over other piping or system components.

S. Sequence, coordinate, and integrate installations of systems materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to building enclosure.

1.10 ELECTRICAL WIRING AND COORDINATION

A. In general, power wiring will be provided under Division 26 - Electrical, and control wiring will be provided under Division 22 - Plumbing, unless otherwise specified.

B. Electric wiring shall be in accordance with the requirements of Division 26.

C. Except where noted otherwise, control wiring under Division 22 shall include all connections to control devices, interlock wiring, control relays, sensing devices, etc. incidental to the building automation system and the proper operation of equipment provided under Division 22.

D. Control Voltage:

   1. Maximum allowable control voltage shall be 120 VAC. Fully protect control circuit conductors in accordance with National Electrical Code. Control transformers shall be provided with two primary fuses and one secondary fuse.

   2. Fully coordinate the requirements of each Division with regard to providing a complete DDC Building Automation System. Junction boxes and control transformer connections shall be provided under Division 26.

      a. Carefully coordinate the interface between the Work of Division 22 (Plumbing), and Division 26 (Electrical) before submitting any equipment for review or commencing installation.

      b. The following schedule summarizes the division or work and material responsibilities between Division 22 and 26.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>FURNISHED UNDER</th>
<th>SET IN PLACE OR MOUNTED UNDER</th>
<th>WIRED AND CONNECTED UNDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment motors</td>
<td>MD 1</td>
<td>MD 1</td>
<td>ED 2</td>
</tr>
<tr>
<td>Resistance Heaters</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
</tr>
<tr>
<td>Fire Protection controls, including remote switches, flow switches</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
</tr>
<tr>
<td>Motor controls where specified as an integral package</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
</tr>
<tr>
<td>Motor controllers</td>
<td>MD</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>ITEM</td>
<td>FURNISHED UNDER</td>
<td>SET IN PLACE OR MOUNTED UNDER</td>
<td>WIRED AND CONNECTED UNDER</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----------------</td>
<td>-------------------------------</td>
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<tr>
<td>Resistance type heater controllers</td>
<td>MD 6</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>Magnetic contactors and magnetic starters with overload trip assembly</td>
<td>ED 4</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>integral control transformers</td>
<td>MD 6</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>Cover-mounted control devices</td>
<td>MD 6</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>Manual motor starters with overload trip assembly</td>
<td>ED 4</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>Motor starter switches</td>
<td>ED 4</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>Disconnect switches fused and unfused</td>
<td>ED 4</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>Thermal or thermal-magnetic circuit breakers</td>
<td>ED 4</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>Fuses</td>
<td>ED 4</td>
<td>ED 4</td>
<td>ED</td>
</tr>
<tr>
<td>Control power source for temperature</td>
<td>ED</td>
<td>ED</td>
<td>ED</td>
</tr>
<tr>
<td>Level and float switches</td>
<td>MD</td>
<td>MD 5</td>
<td>MD 5</td>
</tr>
<tr>
<td>Pipe mounted control devices such as flow</td>
<td>MD</td>
<td>MD 5</td>
<td>MD 5</td>
</tr>
<tr>
<td>Variable frequency drives (VFD) specified to</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
</tr>
<tr>
<td>VFD specified to be mounted separately from</td>
<td>MD</td>
<td>ED</td>
<td>ED</td>
</tr>
</tbody>
</table>

E. Notes: (1) MD: Mechanical Divisions 21, 22, 23. (2) ED: Electrical Division 26. (3) Fire alarm-related and power wiring provided under Division 26; Control-related wiring and relays provided under Division 212223. (4) If furnished as part of factory equipment under Division 21, 22, 23, wiring and connections only by Electrical Division 26. (5) If any control devices carry the Full Load Current to any motor, they shall be furnished under Division 21, 22, 23, but shall be set in place and connected under Division 26. (6) Except where indicated as part of a motor control center on the Electrical Drawings. (7) Division 26 shall provide the logic contact closure and the wiring to the local DDC temperature control panel. Division 26 shall also provide interface with the fire alarm system, proof of flow devices (duct/fan air flow switches), connecting wiring, smoke control logic, panel, relays, damper monitoring, and associated devices for a complete smoke control system.

1.11 ACCESSIBILITY

A. Contractor is responsible for verifying that equipment and devices will fit within the space shown on the drawings. Contractor shall locate all equipment which must be serviced, operated or maintained, in fully accessible positions. Such equipment shall include, but not be limited to, valves, traps, clean outs, drain points, motors, controllers, motor control centers, service panels, fuel fill and drain points, etc. Provide sufficient access space for: all equipment (e.g., CAV / VAV boxes control and damper devices, reheat coil and fan powered units, AHU cooling and heating coils, fire damper access doors and ability to change the linkage, all low point drain valves, heating and cooling coil vents, pre-filter and final filter removal, etc.).

B. Equipment requiring periodic maintenance shall be installed to permit removal without damage to other work. If required for better accessibility, provide access doors for this purpose. Provide access door to the upstream side of turning vanes and all other equipment
and devices requiring maintenance and replacement. All equipment requiring lubrication shall have accessible external grease fitting for maintenance purposes.

C . Minor deviations from the drawings may be made to allow for better accessibility, but changes of magnitude or which involve extra cost shall not be made without approval from the Architect/Engineer.

1.12 QUALITY ASSURANCE

A . Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

B . Installer Qualifications: Company specializing in performing the work of this section with a minimum of 5 years documented experience. Company personnel shall be approved by manufacturer for all product installations and required training.

C . Conform to all applicable standards, codes and regulation and industry best practice requirements.

D . All materials and equipment shall be new, shall bear manufacturer's name, and shall conform to the grade, quality and standards specified herein. Type, capacity and application shall be suitable and capable of satisfactory operation for the purpose intended. All equipment and components shall include UL label and/or marking on equipment body/device including manufacturer's name, pressure rating(s), electrical classification(s), limits and ratings as applicable to individual components for the purpose specified and intended.

E . Equipment Selection: All items of a given type shall be the product of the same manufacturer. Equipment of greater or larger power, dimensions, capacities, and ratings may be considered provided such proposed equipment is approved in writing by Architect/Engineer and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. See Deviations & Substitutions for requirements. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

F . Listing and Labeling:

1. Provide motors that are listed and labeled. Terms "listed and labeled": As defined by UL, NEC, Article 100 or other applicable recognized agency as specified in the Contract Documents.


3. All Base materials: Comply with standard of ASTM and ANSI.

4. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped.

5. Steel piping, supports and welding

6. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

7. Steel supports - Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
8. Steel pipe welding - Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."


10. All Electrical Devices and Wiring: Conform to standards of NEC. All devices: UL listed and identified.

G. Cutting and Patching: Unless otherwise required by the Contract Documents, Contractor shall be responsible for all cutting, fitting and patching required to complete the Work, or to make portions of the Work and existing conditions fit together properly, and all such areas shall be restored to the conditions existing prior to the cutting, fitting and patching unless otherwise provided in the Contract Documents.

H. Contractor shall promptly correct any portion of the Work that is defective or not in accordance with the Contract Documents or rejected by Architect/Engineer or Owner. Contractor shall be responsible for, and pay for all costs arising out of, any additional testing and inspections, demolition, uncovering and replacement and additional design and consulting services required to properly correct any portion of the Work.

I. Contractor shall comply with the Contract Documents and all Laws, standards and handling criteria regarding hazardous substances, wastes and materials, including asbestos-containing materials, lead-based paints, petroleum (or any constituent thereof), mold, radon, and polychlorinated biphenyl (PCB), ("Hazardous Materials") in performing the Work. Unless required by the Contract Documents, no Hazardous Materials shall be brought onto the Project.

J. Lead Free Requirements

1. Contractor shall endeavor to use lead free products and where required by law, ordinance, regulation or standard all materials products and practices shall comply with limitations and requirements as to the allowable limits and/or percentages of lead. Lead free products must be certified by an independent 3rd party.

2. This provision shall apply to any and all similarly regulated materials, products and practices that may be considered hazardous or are otherwise regulated by applicable law, ordinance regulation or standard in the project local.

1.13 COMMISSIONING

A. Owner has engaged the services of an independent Commissioning Agent to document the completion of the Fire Suppression, Plumbing, Laboratory Gas, Mechanical HVAC, Controls, Electrical, Communications, and Electronic Safety and Security systems for the project. Comply with the requirements of Commissioning Specification for assisting and cooperating with the Commissioning Agent.

1.14 DELIVERY, STORAGE & HANDLING

A. All materials and equipment shall be adequately covered and protected against dirt, water, chemical or mechanical damage, and theft. At completion, all work, equipment and materials shall be cleaned, and damage repaired by Contractor. Damaged equipment will be replaced by the contractor if Owner does not accept repairs done to the equipment. Such replacement shall be scheduled to minimize building system interruption if occupied or scheduled for occupancy.
B. Material delivered at the site shall not be left exposed to the weather or left unattended. Deliver pipes, tubes and conduit with factory-applied end-caps. Contractor shall be responsible to maintain end-caps or provide temporary end caps on all open ended piping, tubes and conduit through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

C. Protect stored material from moisture and dirt. Protect plastic pipes and materials from sunlight and support to prevent sagging and bending.

D. Elevate stored materials above grade. When stored inside, do not exceed structural capacity of the floor.

E. Provide protective coatings to materials to prevent damage and/or infiltration of moisture and dirt on all materials and equipment including but not limited to cast iron and steel valves.

F. Contractor shall check the openings in the building and the size of the doors, passages, and openings through which equipment is to be admitted. Wherever necessary, he shall provide the equipment in sections or knocked down in order to admit the equipment through these openings.

G. Contractor shall provide all rigging, erection and hoisting equipment as required to handle or place equipment and piping in position. This rigging and hoisting equipment shall only be attached and placed on the structure in locations as approved by Architect/Engineer at the site.

1.15 PERMITS, FEES AND UTILITIES

A. Obtain and pay for all necessary permits, fees and utilities and inspections required to perform the Work.

B. Coordinate work with local regulatory entities, utility companies and others as required to fully comply with the requirements of this Section and the Contract Documents, including those for both temporary and permanent services.

C. Permits, fees and utility expenses to be paid by Owner, if any, shall be only as specifically required by the contract documents, and then only to the extent so specified.

1.16 DOCUMENT OWNERSHIP

A. The Drawings and Specifications, combined with the calculations, field data, notes, and reports, are the intellectual and real property of the Architect and/or Engineer. This covers all forms of written and recorded or electronic media. The reuse of these documents without specific permission of the Engineer is prohibited. The Drawings may be employed by the Owner and Contractor for the express use of constructing, commissioning, and operating the facility only upon proper execution of the Agreement for Use of Electronic Files & Data.

1.17 GUARANTEE AND WARRANTY

A. Contractor warrants to Owner that materials and equipment provided under the Contract will be of notify Contractor of such defect or deficiency in writing. This period of correction relates only to the specific obligation to correct defects and deficiencies and in no way otherwise limits the Contractor’s responsibility for Work that is not in accordance with the Contract Documents. If Contractor fails to timely correct defects or deficiencies in the Work, Owner may, at its sole option, correct them and charge contractor for all cost therefore.
B. See Division 01 including but not limited to Section 017800 - Closeout Submittals, for additional warranty requirements.

C. Specific exclusions, if any, from this one (1) year warrantee and guarantee period are listed in the individual specification sections.

1.18 LIMITATIONS OF LIABILITY

A. To the extent any of the following provisions are not more stringently included in the Contract Document the following Limitations of Liability shall apply:

B. Architect/Engineer is not responsible for Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and is not be responsible for Contractor's failure to perform or furnish the work in accordance with the Contract Documents.

C. In the event that Architect/Engineer's employees or sub-consultants make comments or issue warnings about safety issues, such comments and warnings shall be considered to have been offered by a Good Samaritan and shall not impose any obligation or responsibility.

D. Engineer will not be responsible for the acts or omissions of Owner, Contractor, any subcontractor, any supplier, or of any other person or organization performing or furnishing any of the portions of the work.

E. Contractor understands and acknowledges that Engineer is not authorized to order extra work or issue Change Orders to or stop the work, however in the event and to the degree that Engineer may offer advice, suggestions, and opinions Contractor shall not rely on such advice, suggestions, and opinions unless directed in writing by Owner or its designated representative, and shall, in no event, make any claim against the Engineer for any such advice, suggestions, and opinions.

F. To the fullest extent permitted by law, Contractor shall indemnify and hold harmless Architect, Engineer, and their joint ventures', officers, directors, partners, employees and agents from and against any and all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused in whole or in part by the negligent acts or omissions of Contractor; Contractor's officers, directors, partners, employees, agents; or Contractor's subcontractors or material men in the performance of Work. Contractor shall direct its insurer to list Architect, Engineer, and their joint ventures', as Additional Insureds on general liability insurance policies covering this project. Prior to commencing work, Contractor shall submit copies of its certificate of insurance to both Architect and Engineer.

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.
      1) 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.
   e. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
   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.
   g. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
   h. Solvent Cements for Joining Plastic Piping:
      1) ABS Piping: ASTM D 2235.

2.4 ACCESS PANELS

A. Furnish access panels required for mechanical work to General Contractor for installation, together with exact direction for proper location. Furnish panels of approved adequate size for valves and equipment requiring service and installed above ceilings, behind walls or in furring, complete with correct frame for type of building construction involved. Exact size, number and location of access panels is not necessarily shown on Drawings. Use no panel smaller than 12 inches by 12 inches for simple manual access or smaller than 16 inches by 20 inches where personnel must pass through. Micor Style AP, AT, ATR, DW, K or M panels or equivalent Elmdor, Nystrom, or Karp as required by construction. Panels installed in fire-rated construction shall be UL labeled for a 1-1/2 hour fire protective rating.

B. Construction of equipment shall be as follows:
   1. All prefabricated equipment shall be designed and constructed in such a manner that all parts of said equipment and the equipment as a whole, including attachments, will resist the forces (including seismic where applicable) to which they may be subjected.
2. Unless otherwise specified or required, design criteria shall be no less than 1.5g for lateral forces and 0.6g for vertical forces.

3. Provisions for support and anchorage of equipment shall be an integral part of each item and shall include the fastening means and all necessary internal and external bracing, brackets and connections.

C. Specifications for many items are or may be described on the drawings, including but not limited to wiring devices, lighting fixtures, control devices, etc. are or may be described on the drawings. Contractor shall promptly advise Architect/Engineer of any conflicts or discrepancies.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Refer to Division 01 Sections for general demolition requirements and procedures.

B. Disconnect, demolish, and remove systems, equipment, and components indicated to be removed.
   1. Plumbing fixtures and equipment to Be Removed: Remove fixture and associated supports and piping and cap at last point of continued service. Dead legs may be no longer than 3 times the pipe diameter of the capped branch piping. Cap remaining piping with same or compatible material.

3.2 CONNECTION TO EXISTING SYSTEMS

A. Connections to existing systems shall be performed during normal operating conditions. All tap connections shall be 'live' or 'wet'. Under the expressed written consent of the Owner, existing systems may be shut down for new connections. Upon approval of shut-down or when 'live' tap connections are to be performed, the Contractor shall schedule with the Owner and provide a minimum of five (5) working days' advanced notice.

3.3 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 Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
   g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
   h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
   i. 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) Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
   c) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   d) Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   e) Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
   f) Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
   g) Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes except for wet areas.
N.  Permanent sleeves are not required for holes formed by removable PE sleeves.

O.  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 except where building separations or seismic joints require additional. 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 7 Section 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.

5.  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.
   a.  Install steel pipe for sleeves smaller than 6 inches in diameter.
   b.  Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   c.  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.

6.  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.
   a.  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.

7.  Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations details on the drawings. Refer to Division 07 Section for materials.

P.  Verify final equipment locations for roughing-in.
Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 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.


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.
      a. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
      b. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
      c. Plastic 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) ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.

3.5 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.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are 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 mechanical 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.

3.7 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 9 Sections.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 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 and form equipment anchorages as detailed in the structural drawings.

2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

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 concrete and reinforcement as specified in Division 3 Sections and the Structural Drawings.

3.9 CUTTING AND PATCHING (EXISTING BUILDING ONLY)

A. Do or arrange and pay for cutting and patching of existing building and yard surfaces required for completion of work. Limitations: No cutting or channeling of underpinning or structural members permitted without written permission of Architect/Engineer. No weakening of structural parts permitted, and any work impaired will be corrected by others
and cost charged to you. Patch openings in and through concrete and masonry with dry pack. Patch and refinish any surfaces you have damaged; match adjacent surfaces.

3.10 SAFETY

A. The Drawings and the Specifications do not include design or construction details or instructions relating to your safety precautions or to means, methods, techniques, sequences or procedures required for you to perform your work.

B. Provide necessary shoring, railing, barricades, protective devices, safety instructions and procedures to perform the work safely and to comply with the Safety Requirements of the governing authorities.

3.11 COOPERATION WITH OTHER TRades

A. Cooperate with other trades in furnishing material and location requirements of sleeves, bucks, chases, mountings, backings, foundations and wiring required for installation of mechanical items. Set sleeves, inserts, anchor bolts, cast-in-place iron work, etc. Upon failure to properly direct, locate and size such work at the correct times, provide additional required cutting and patching as directed and approved.

3.12 EXCAVATION AND BACKFILL

A. Do necessary trenching and excavating for installation of underground piping and equipment. Use necessary precautions not to affect the bearing value of soil under and near footings. Excavate pipe trenches with proper pitch six inches deeper than required by line grade and prefill to line grade with pea gravel. Where trenching occurs through existing paving, walks, curbs, etc., patch and repair to original conditions. Compact backfill with vibratory or roller compaction equipment in nine inch layers to 90 percent density. Dispose of excess excavated material as directed. Backfill under floor slabs and under hard surfaced yard areas (i.e. walks, drives, parking areas) to be crushed rock unless otherwise indicated, compacted in nine inch layers. Backfill material and compaction to comply with Site Work Section of these Specifications.

B. Provide and maintain ample means and devices with which to promptly remove and dispose of water entering the excavation during the time it is being prepared for the pipe or equipment laying, during the laying of pipe or equipment and until the backfill has been completed.

3.13 CLEANING

A. General

1. Clean all dirt and construction dust and debris from all plumbing systems, facilities and equipment and leave in a new condition. Touch up paint where necessary.

2. Where existing systems are expanded and/or remodeled, clean the new installation prior to making final connection to the existing systems.

   a. Domestic Water System: Flush with clean water to eliminate grease, cuttings and foreign matter; run water until clear and free of oil. Chlorinate domestic water by filling the system with a solution containing 50 parts per million of available chlorine for a period of 24 hours. During this time open and close all valves at least twice. Flush system with water until residual chlorine content is not more than one part per million. Chlorinate or as required by AHJ.
b. Final disinfection of domestic water systems includes but is not limited to all domestic water outlets, flush valves faucets, emergency equipment, storage tanks.

c. Clean all faucet outlet flow controls and mixing valve inlet strainers prior to turning project over to owner.

d. Drainage and Vent System: Remove debris from cleanouts, drains, strainers, baskets, traps, etc., and leave same accessible and operable.

e. Fixtures and Equipment: remove construction protection tags and labels, thoroughly clean all plumbing equipment, scour all fixtures and trim just prior to building acceptance.

3.14 FINAL OPERATION AND INSTRUCTION

A. Upon completion of the installation of the equipment prior to final acceptance, operate the plant for a period of 5 eight-hour days; instruct the Owner in all details of operation and maintenance.

1. This requirement is in addition to “Operation Test” specified above.

   a. Any required instructions from manufacturer’s representatives shall be given during this period. The 5 days specified under “Operation Test” do not substitute for these 7 days of final operation and instruction.

   b. All arrangements for operation periods shall be made through Architect/Engineer and Owner’s Representative.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated, with plain ends and integral welded waterstop collar.

C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.


E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
2.2 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

B. Plastic or rubber waterstop collar with center opening to match piping OD.

2.3 GROUT

A. Description: Nonshrink, 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.

2.4 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

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 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.
D. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Division 07.

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-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. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Interior Partitions:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves or PVC pipe sleeves coordinated with piping material.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Escutcheons.
      2. Floor plates.

1.3 DEFINITIONS
   A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS
   A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
   B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
   C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
   D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
   E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
   F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.2 FLOOR PLATES
   A. Split Floor Plates: Cast brass with concealed hinge.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of 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.
   b. Chrome-Plated Piping: One-piece cast brass or split-casting brass with polished, chrome-plated finish.
   c. Coordinate one of the following options with project architect:
      1) Insulated Piping: One-piece steel with polished, chrome-plated finish.
      2) Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
      3) Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
      4) Insulated Piping: One-piece stamped steel [or split-plate, stamped steel with concealed hinge] [or split-plate, stamped steel with exposed-rivet hinge] with polished, chrome-plated finish.
   d. Coordinate one of the following options with project architect:
      1) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
      2) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
      3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
      4) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel [or split-plate, stamped steel with concealed hinge] [or split-plate, stamped steel with exposed-rivet hinge] with polished, chrome-plated finish.
   e. Coordinate one of the following options with project architect:
      1) Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
      2) Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
      3) Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
      4) Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel [or split-plate, stamped steel with concealed hinge] [or split-plate, stamped steel with exposed-rivet hinge] with polished, chrome-plated finish.
   f. Coordinate one of the following options with project architect
1) Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.

2) Bare Piping in Unfinished Service Spaces: One-piece cast brass with [polished, chrome-plated] [rough-brass] finish.

3) Bare Piping in Unfinished Service Spaces: One-piece stamped steel [or split-plate, stamped steel with concealed hinge] [or split-plate, stamped steel with exposed-rivet hinge] with polished, chrome-plated finish.

g. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.

h. Bare Piping in Equipment Rooms: One-piece cast brass with [polished, chrome-plated] [rough-brass] finish.

i. Bare Piping in Equipment Rooms: One-piece stamped steel [or split-plate, stamped steel with concealed hinge] [or split-plate, stamped steel with exposed-rivet hinge] with polished, chrome-plated finish.

2. Escutcheons for Existing Piping to Remain:

a. Chrome-Plated Piping: Split-casting, stamped steel with [concealed] [or] [exposed-rivet] hinge with polished, chrome-plated finish.

b. Insulated Piping: Split-plate, stamped steel with [concealed] [or] [exposed-rivet] hinge with polished, chrome-plated finish.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with [concealed] [or] [exposed-rivet] hinge with polished, chrome-plated finish.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with [concealed] [or] [exposed-rivet] hinge with polished, chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with [concealed] [or] [exposed-rivet] hinge with polished, chrome-plated finish.

f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with [concealed] [or] [exposed-rivet] hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping [and] [Relocated Existing Piping]: One-piece, floor plate.

2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bimetallic-actuated thermometers.
   2. Filled-system thermometers.
   4. Light-activated thermometers.
   5. Thermowells.
   6. Dial-type pressure gages.
   7. Gage attachments.
   8. Test plugs.
   10. Sight flow indicators.

B. Related Requirements:
    1. Section 221119 "Domestic Water Piping Specialties" for water meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Metal-Case, Dial-Type Pressure Gages:
   2. Case: Liquid-filled; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Window: Glass or plastic.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Plastic-Case, Dial-Type Pressure Gages:
   2. Case: Sealed plastic, 4-1/2-inch nominal diameter.
   3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   5. Movement: Mechanical, with link to pressure element and connection to pointer.
   9. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.2 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.
   1. <Insert location>.

K. Install pressure gages in the following locations:
   1. Inlet and outlet of each pressure-reducing valve.
   2. Suction and discharge of each domestic water pump.
   3. <Insert location>.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 PRESSURE-GAGE SCHEDULE

A. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
   1. Metal case, dial type.
   2. Plastic case, dial type.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi
B. Scale Range for Domestic Water Piping: 0 to 100 psi

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes general duty valves for plumbing piping.

1.2 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.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING
   A. Prepare valves for shipping as follows:
      1. Protect internal parts against rust and corrosion.
      2. Protect threads, flange faces, grooves, and weld ends.
      3. Set gate 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. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   6. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.


E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. RS Valves in Insulated Piping: With 2-inch stem extensions.

I. Valve Bypass and Drain Connections: MSS SP-45.

J. Valve Actuator Types:
   1. Handwheel: For valves other than quarter-turn types.
   2. Handlever: For quarter-turn valves smaller than NPS 4; for butterfly valves NPS 6 and smaller.

K. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Gate Valves: With rising stem.
   2. Ball Valves: Include 2-inch stem extensions.
      a. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
      b. Memory stops that are fully adjustable after insulation is applied.
2.2 BRASS BALL VALVES

A. Brass Ball Valves, One-Piece:

1. Description:
   b. CWP Rating: 400 psig.
   c. Body Design: One piece.
   d. Body Material: Forged brass or bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass or stainless steel.
   h. Ball: Chrome-plated brass or stainless steel.
   i. Port: Reduced.

B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Description:
   a. Standard: MSS SP-110 or MSS SP-145.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

C. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Press Ends:

1. Description:
   a. Standard: MSS SP-110 or MSS SP-145.
   b. CWP Rating: Minimum 200 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Press.
   g. Seats: PTFE or RPTFE.
   h. Stem: Brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.
k. O-Ring Seal: Buna-N or EPDM.

D. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:

1. Description:
   a. Standard: MSS SP-110 or MSS SP-145.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.

E. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Press Ends:

1. Description:
   a. Standard: MSS SP-110 or MSS SP-145.
   b. CWP Rating: Minimum 200 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Press.
   g. Seats: PTFE or RPTFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.
   k. O-Ring Seal: Buna-N or EPDM.

F. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:

1. Description:
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

G. Brass Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:

1. Description:
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Brass or bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Regular.

H. Brass Ball Valves, Three-Piece with Full Port and Brass Trim:

1. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

I. Brass Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:

1. Description:
   b. CWP Rating: 600 psig.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.
2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, One-Piece with Bronze Trim:
   1. Description:
      b. CWP Rating: 400 psig.
      c. Body Design: One piece.
      d. Body Material: Bronze.
      e. Ends: Threaded.
      f. Seats: PTFE.
      g. Stem: Bronze.
      h. Ball: Chrome-plated brass.
      i. Port: Reduced.

B. Bronze Ball Valves, One-Piece with Stainless-Steel Trim:
   1. Description:
      b. CWP Rating: 600 psig.
      c. Body Design: One piece.
      d. Body Material: Bronze.
      e. Ends: Threaded.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Reduced.

C. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:
   1. Description:
      a. Standard: MSS SP-110 or MSS-145.
      b. CWP Rating: 600 psig.
      c. Body Design: Two piece.
      d. Body Material: Bronze.
      e. Ends: Threaded and soldered.
      f. Seats: PTFE.
      g. Stem: Bronze or brass.
      h. Ball: Chrome-plated brass.
      i. Port: Full.
D. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Description:
   a. Standard: MSS SP-110 or MSS-145.
   b. CWP Rating: Minimum 200 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Press.
   g. Seats: PTFE or RTPFE.
   h. Stem: Bronze or brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.
   k. O-Ring Seal: EPDM or Buna-N.

E. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:

1. Description:
   a. Standard: MSS SP-110 or MSS-145.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Threaded or soldered.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel, vented.
   i. Port: Full.

F. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:

1. Description:
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE.
   g. Stem: Bronze or brass.
   h. Ball: Chrome-plated brass.
   i. Port: Regular.
G. Bronze Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:
   1. Description:
      b. CWP Rating: 600 psig.
      c. Body Design: Two piece.
      d. Body Material: Bronze.
      e. Ends: Threaded.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Regular.

H. Bronze Ball Valves, Three-Piece with Full Port and Bronze or Brass Trim:
   1. Description:
      b. CWP Rating: 600 psig.
      d. Body Material: Bronze.
      e. Ends: Threaded.
      f. Seats: PTFE.
      g. Stem: Bronze or brass.
      h. Ball: Chrome-plated brass.
      i. Port: Full.

I. Bronze Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:
   1. Description:
      b. CWP Rating: 600 psig.
      d. Body Material: Bronze.
      e. Ends: Threaded.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Full.

J. Bronze Ball Valves, Three-Piece with Regular Port and Bronze Trim:
   1. Description:
K. Bronze Ball Valves, Three-Piece with Regular Port and Stainless-Steel Trim:
   1. Description:
      b. CWP Rating: 600 psig.
      d. Body Material: Bronze.
      e. Ends:Threaded or soldered.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Regular.

L. Bronze Ball Valves, Two-Piece, Safety-Exhaust:
   1. Description:
      b. CWP Rating: 600 psig.
      c. Body Design: Two piece.
      e. Ends: Threaded.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
      i. Port: Full.

2.4 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:
   1. Description:
a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Bronze Lift Check Valves with Nonmetallic Disc, Class 125:

1. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 200 psig.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: NBR, PTFE.

2.5 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Description:
   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: PTFE.

C. Bronze Swing Check Valves with Bronze Disc, Class 150:

1. Description:
   a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

D. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:
   1. Description:
      a. Standard: MSS SP-80, Type 4.
      b. CWP Rating: 300 psig.
      c. Body Design: Horizontal flow.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: PTFE.

E. Bronze Swing Check Valves, Press Ends:
   1. Description:
      a. Standard: MSS SP-80 and MSS SP-139.
      b. CWP Rating: Minimum 200 psig.
      c. Body Design: Horizontal flow.
      e. Ends: Press.
      g. Disc: Brass or bronze.

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. Check Valves: Install check valves for proper direction of flow.
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

G. 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 valves.
   2. Throttling Service: Ball valves.

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 or press-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Brass ball valves, two-piece with full port and brass or stainless steel trim.
   2. Bronze ball valves, two-piece with full port and bronze, brass, or stainless steel trim.
   3. Bronze swing check valves with bronze disc, Class 125, with soldered or threaded end connections.
B. CPVC Pipe: Union-ball valve.

C. PVC Pipe: Union-ball valve.

D. CPVC Pipe: CPVC ball check valve.

E. PVC Pipe: PVC ball check valve.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All support systems, including seismic support, designed and submitted by either the mechanical contractor or separate support contractor are to meet the criteria of performance requirements and manufacturers listed herein.

1.2 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Fiberglass pipe hangers.
   4. Metal framing systems.
   5. Fiberglass strut systems.
   6. Thermal hanger-shield inserts.
   7. Fastener systems.
   8. Pipe stands.
   9. Pipe-positioning systems.
  10. Equipment supports.

1.3 ACTION SUBMITTALS

A. 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.
   2. Metal framing systems.
   3. Fiberglass strut systems.
   4. Pipe stands.
   5. Equipment supports.

B. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
   2. Include design calculations for designing trapeze hangers.
1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing 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.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 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, hot-dip galvanized, or electro-galvanized.
   3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

C. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, 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.

2.4 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:
   1. Description: Similar to MSS SP-58, Type 1 steel pipe hanger, except hanger is made of fiberglass or fiberglass-reinforced resin.
   2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass or polypropylene.

B. Strap-Type, Fiberglass Pipe Hangers:
   1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger, except hanger is made of fiberglass-reinforced resin.
   2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts.

2.5 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B-line, an Eaton business.
      b. Mason Industries.
      c. Tolco Tolstrut.
      d. Unistrut; Part of Atkore International.
   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 carbon-steel channel with inturned lips.
   5. Channel Width: Selected for applicable load criteria.
   6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   8. Paint Coating: Epoxy, acrylic, or urethane.

2.6 FIBERGLASS STRUT SYSTEMS

A. Description: Structural-grade, factory-formed, glass-fiber-resin channels and angles for supporting multiple parallel pipes.

2. Channels: Continuous slotted fiberglass-reinforced plastic channel with inturned lips.
3. Channel Width: Selected for applicable load criteria.
4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
5. Fitting and Accessory Materials: Same as those for channels and angles.
6. Rated Strength: Selected to suit applicable load criteria.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.7 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CADDY; a brand of nVent.
2. Carpenter & Paterson, Inc.
5. Pipe Shields Inc.
6. Piping Technology & Products, Inc.
7. Rilco Manufacturing Co., Inc.
8. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II calcium silicate with vapor barrier or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-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.
2.8 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: Subject to compliance with requirements, provide products by one of the following:
   a. B-Line.
   b. Hilti, Inc.
   c. MKT Fastening.
   d. MKT Fastening, LLC.
   e. Simpson Strong-Tie Co., Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, 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: Subject to compliance with requirements, provide products by one of the following:
   a. B-line, an Eaton business.
   b. Empire Tool and Manufacturing Co., Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   e. MKT Fastening, LLC.

2. Indoor Applications: Zinc-coated or stainless steel.

2.9 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.10 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.11 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.
E. Grout: ASTM C1107/C1107M, 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 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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 A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. 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. Pipe Stand Installation:
1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


K. 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.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. 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.

N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. 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.

P. 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.
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 or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/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.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 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 finishes.

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 stainless-steel pipe hangers or fiberglass pipe hangers and corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. 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.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

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 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 occurs.

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 occurs.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.

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 occurs and vertical adjustment is unnecessary.

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, in addition to expansion and contraction, is required.

K. 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.

L. 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 of 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.

M. 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.

N. 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.

O. 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.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Elastomeric isolation pads.
   2. Elastomeric isolation mounts.
   3. Housed-spring isolators.
   4. Restrained-spring isolators.
   5. Pipe-riser resilient supports.
   6. Resilient pipe guides.
   7. Elastomeric hangers.
   8. Spring hangers.
  10. Restraint channel bracings.
  13. Steel and inertia, vibration isolation equipment bases.

B. Provide vibration and seismic restraint for plumbing equipment to prevent the transmission of vibration and mechanically transmitted sound to the building structure and meet applicable codes as indicated on the drawings.

C. Include adjustments of each mounting system, and the measurement of isolator system performance. Specific mounting arrangements for each item of equipment shall be as described herein, and as specified in other Division 22 sections.

1.3 DEFINITIONS

A. $A_v$: Effective peak velocity related acceleration coefficient

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
   1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
   3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
   4. Seismic-Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
      b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
      c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
      d. Preapproval and Evaluation Documentation: By
      e. an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "OPA" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a Structural Engineer licensed in California. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.

1.6 DESIGN CRITERIA

A. Refer to Structural Drawings and specifications for seismic performance criteria.

B. Plumbing equipment shall be vibration isolated as specified in this section unless otherwise noted in project-specific acoustical design criteria.

C. Equipment vibration limits:

1. All equipment shall be statically and dynamically balanced to meet the following vibration limits under all design operating conditions and under support conditions comparable to the conditions specified in the equipment vibration isolation schedule, at the end of this section.

2. These vibration limits apply to the three orthogonal axes on the isolated equipment - either on the bearings or the equipment support structure, whichever applicable - and for frequencies between 2 and 200 Hz, using an FFT frequency resolution of 1Hz.

3. For equipment on inertia bases or with large inertia mass these vibration limits shall be reduced by the ratio equipment weight to total weight of equipment plus inertia mass. Inertia mass refers to non-rotating mass rigidly attached to rotating equipment.

D. All external vibration isolation and seismic restraint devices specified in this section shall be provided by a single supplier.

E. All seismic restraint devices specified in this section shall be provided by a single supplier.

F. When an OSP certification is required by OSHPD, deviations from these specifications will be allowed in strict compliance with the OSP.

G. All vibration isolation and seismic hardware shall be anchored at all times to the building structure.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Refer to structural drawings and specifications for site-specific, seismic anchoring criteria.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.

3. Size: Factory or field cut to match requirements of supported equipment.

4. Pad Material: Oil and water resistant with elastomeric properties.

5. Infused nonwoven cotton or synthetic fibers.


7. Sandwich-Core Material: Resilient and elastomeric.
   a. Surface Pattern: Waffle pattern.
   b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Isolation.

2. Mounting Plates:
   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. California Dynamics Corporation.
   b. Mason Industries, Inc.
   c. Vibration Isolation.

2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   a. Housing: Cast-ductile iron or welded steel.
   b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.
   d. Novia; A Division of C&P.
   e. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.


7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.
   d. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Top housing with attachment and leveling bolt or threaded mounting holes and internal leveling device.

2.7 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.
   d. Vibration Mountings & Controls, Inc.
   e. Vibration Isolation.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Top plate with threaded mounting holes.
   c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

5. Minimum Additional Travel: 50 percent of the required deflection at rated load.

7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-REstrained-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.
   d. Vibration Mountings & Controls, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.

2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.
2.11 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.
   d. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.
2.13 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Kinetics Noise Control, Inc.
   2. Mason Industries, Inc.
   3. Vibration Mountings & Controls, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.14 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-line, an Eaton business.
   2. Hilti, Inc.
   3. Mason Industries, Inc.
   4. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.15 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Kinetics Noise Control, Inc.
   2. Mason Industries, Inc.
   3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A603 galvanized or ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.16 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. B-line, an Eaton business.
2. CADDY; a brand of nVent.
4. Mason Industries, Inc.
5. Novia; A Division of C&P.
6. TOLCO.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.17 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. B-line, an Eaton business.
   2. Hilti, Inc.
   4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.18 ADHESIVE ANCHOR BOLTS

A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
   C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS
   A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
   B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners as required by applicable code or where indicated or scheduled on Drawings as required to prevent buckling of hanger rods due to seismic forces.
   C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION
   A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."
   B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
   C. Comply with requirements in Section 07 72 00 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
   D. Equipment Restraints:
      1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
      2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
      3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
   E. Piping Restraints:
      1. Comply with requirements in MSS SP-127.
   F. Install cables so they do not bend across edges of adjacent equipment or building structure.
G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer’s recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in individual plumbing system specialties specifications for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days’ advance notice.


4. Test to 90 percent of rated proof load of device.

5. Measure isolator restraint clearance.

6. Measure isolator deflection.

7. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pipe labels.
   2. Valve tags.

1.3 ACTION 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.

PART 2 - PRODUCTS

2.1 PIPE LABELS


2. Colors: Comply with ASME A13.1, unless otherwise indicated.

3. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

4. Full-band pipe markers extending 360 degrees around pipe at each location.

5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

2.2 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 beaded chain or S-hook.
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 GENERAL INSTALLATION REQUIREMENTS

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.

3.3 PIPE LABEL INSTALLATION

A. Pipe Label Locations: 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.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including
pipes where flow is allowed in both directions.

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:

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Domestic recirculating hot-water piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. 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, flanges, valves, and specialties for each type of insulation.

1.4 INFORMATIONAL SUBMITTALS

A. 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.

B. 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 in accordance with ASTM E84 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.
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 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.

1.8 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

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Aeroflex USA.

   b. Armacell LLC.

   c. K-Flex USA.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. Knauf Insulation.
      c. Owens Corning.
   2. Preformed Pipe Insulation: Type I, Grade A, with factory-applied ASJ-SSL.
   3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.

2.2 INSULATING CEMENTS

2.3 ADHESIVES
   A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
   B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive, black.
   C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS AND COATINGS
   A. Materials shall be compatible with insulation materials, jackets, and substrates.
   B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
      1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
      2. Service Temperature Range: 0 to plus 180 deg F.
      3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.

2.5 LAGGING ADHESIVES
   A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
      1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
      2. Service Temperature Range: 0 to plus 180 deg F.

2.6 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 58 to plus 176 deg F.
   3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.8 FIELD-APPLIED JACKETS

A. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.

   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, and end caps.
2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

2.10 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A240/A240M.

B. Wire: 0.062-inch soft-annealed, stainless steel.

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. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. 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 of 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 storage, application, and finishing. Replace insulation materials that get wet.

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 attached to structure with vapor-barrier mastic.
   3. Install insert materials and 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 4 inches o.c.
For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with 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 25 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 in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
   Install insulation continuously through walls and partitions.

B. 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 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. 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 07 84 13 "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, Mechanical Couplings, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of 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 of same material and thickness as that 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 of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.

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 and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties, and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 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 that of 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 that of 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. 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.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

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. Underground piping.
   2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
   1. NPS 1-1/4 and Smaller: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
      b. Vapor Retarder Required.
   2. NPS 1-1/2 and Larger: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      b. Vapor Retarder Required.

B. Domestic Hot and Recirculated Hot Water:
   1. NPS 1-1/4 and Smaller: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   2. NPS 1-1/2 and Larger: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. The purpose of this section is to specify the Division 22 responsibilities and participation in the commissioning process. See Division 1, Section 019100, “Commissioning,” for Contractor-related commissioning requirements.

1. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from the Division 22 Contractor for:
   a. Testing and start-up of the mechanical equipment.
   b. Completion and endorsement of pre-functional test checklists provided by the Commissioning Authority to assure that Division 22 equipment and systems are fully operational and ready for functional testing.
   c. Providing qualified personnel to assist the Commissioning Authority with functional testing to verify equipment/system performance.
   d. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
   e. Providing training for the systems specified in Division 22 with coordination of Owner by the Commissioning Authority.

B. Division 22 Contractor shall cooperate with the Commissioning Authority in the following manner:
   1. Allow sufficient time before final completion dates so that test and balance, controls point-to-point checkout, and functional testing can be accomplished.
   2. Provide labor and material to make corrections when required without undue delay.
   3. Put all plumbing systems and equipment into full operation and continue the operation of the same during each working day of commissioning.

C. Related Sections
   1. Section 019100 – Commissioning
   2. Division 22 - Plumbing
   3. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC)
   4. Division 26 – Electrical

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Standard certified test equipment for commissioning will be provided by the Commissioning Authority.

B. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.
PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

A. Specific pre-commissioning responsibilities of Division 22 are as follows:
   1. Normal start-up services required to bring each system into a fully operational state. This includes motor rotational check, cleaning, filling, purging, control sequences of operation, leak testing, full-load and part-load performance, etc.
   2. Normal testing, adjusting and balancing services required to verify each system is operating at design capacities.
   3. Complete pre-functional test checklists for all equipment and systems to be commissioned.
   4. Demonstrate system readings as requested by the Commissioning Authority and adjust units to achieve specified operation.
   5. Factory start-up services for key equipment and systems specified in Division 22. The Division 22 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

3.2 PARTICIPATION IN COMMISSIONING

A. The Division 22 Contractor shall provide skilled technicians to start-up and debug all systems within the Division 22 work (particularly with controls equipment). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

C. Provide skilled technicians to manipulate the following equipment and systems to be commissioned for functional testing:
   1. Domestic water heating systems
   2. Domestic water system
   3. Lab vacuum system
   4. Lab compressed air system
   5. Lab gas system
   6. Deionized water system

3.3 WORK TO RESOLVE DEFICIENCIES
A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet Acceptable Performance. Correction of work will be completed under the direction of the Architect, with input from the Contractor, Equipment Supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer-of-Record will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

3.4 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

A. Seasonal commissioning pertains to testing under full-load conditions during peak loading, as well as part-load conditions. Initial commissioning will be done as soon as contract work is completed regardless of season. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes with a fully occupied building. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required demonstrating performance.

B. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.5 TRAINING

A. The Division 22 Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each mechanical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.
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. Copper tube and fittings.
   2. CPVC piping.
   3. PVC pipe and fittings.
   4. Piping joining materials.
   5. Transition fittings.
   6. Dielectric fittings.

B. Related Requirements:

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 Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Owner'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 61 and NSF 372.
2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.


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.

G. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Viega LLC.
   2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end.
      Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
   3. Minimum 200-psig working-pressure rating at 250 deg F.

H. Appurtenances for Grooved-End Copper Tubing:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Victaulic Company.
   2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75/B 75M copper tube or
      ASTM B 584 bronze castings.
   3. Mechanical Couplings for Grooved-End Copper Tubing:
      a. Copper-tube dimensions and design similar to AWWA C606.
      b. Ferrous housing sections.
      c. EPDM-rubber gaskets suitable for hot and cold water.
      d. Bolts and nuts.
      e. Minimum Pressure Rating: 300 psig.

2.3 CPVC PIPING

A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40.
   2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
2.4 PVC PIPE AND FITTINGS


2.5 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.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6 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.

D. Plastic-to-Metal Transition Fittings:
   1. Description:
      a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
      b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:
   1. Description:
      a. CPVC or PVC four-part union.
b. Brass or stainless-steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.7 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 Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. WATTS.
   c. Wilkins.
   d. Zurn Industries, LLC.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Victaulic Company.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.

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. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level and plumb.

E. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. 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.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. 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.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install thermostats in hot-water circulation piping.

O. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

S. Do not use flanges or valves underground.

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. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

I. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Piping: Join according to ASTM D 2855.

J. 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 Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

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.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "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.

C. Install hangers for copper piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install vinyl-coated hangers for CPVC, PVC and PP piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of copper piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of CPVC PVC and PP piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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. Extend domestic water piping 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.
   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 Section 22 05 53 "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.
      a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
      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:
Flush piping system with clean, potable water until dirty water does not appear at outlets.

Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
   1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

D. Aboveground domestic water piping, NPS 2-1/2 and smaller, in all areas outside of the Trace Metals Lab shall be:
   1. Hard copper tube, ASTM B 88, Type L; cast or wrought-copper, solder-joint fittings; and soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

E. Aboveground domestic water piping, NPS 2-1/2 and smaller, in all areas inside of the Trace Metals Lab shall be:
   1. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.

### 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 or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 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
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. Drain valves.
      3. Water-hammer arresters.
      4. Air vents.
      5. Flexible connectors.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For domestic water piping specialties.
      1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES
   A. Potable-water piping and components shall comply with NSF 61.
   B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS
   A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.
2.3 BALANCING VALVES

A. Circuit Balancing Valves: Adjustable, with 2 readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong Pumps, Inc.
   b. ITT Fluid Technology Corp.; ITT Bell & Gossett Div.
   c. Taco, Inc.
   d. Tour & Anderson, Inc.; Valve Div.
   e. Watts Industries; Water Products Div.

2. 2-Inch NPS and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.

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:
   b. Josam Company.
   c. MIFAB, Inc.
   d. Precision Plumbing Products.
   e. Sioux Chief Manufacturing Company, Inc.
   f. WATTS.
   g. Zurn Industries, LLC.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

### 2.6 AIR VENTS

A. Bolted-Construction Automatic Air Vents:
   1. Body: Bronze.
   2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
   3. Float: Replaceable, corrosion-resistant metal.
   5. Size: NPS 1/2 minimum inlet.

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### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.

B. Air Vents: Install vents at high points of water piping.

#### 3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

C. Comply with requirements for grounding equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

#### 3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each pressure vacuum breaker according to authorities having jurisdiction and the device’s reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

#### 3.4 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.
B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components.

1.2 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities. Accessible fixtures comply with federal “Standards for Accessible Design,” in compliance with the Americans with Disabilities Act.

B. ADA: Americans with Disabilities Act. A reference to ADA means that a fixture is an Accessible Fixture.

C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.


1.3 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, flow rates, capacities and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

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 plumbing fixtures to include in emergency, operation, and maintenance manuals.

1.4 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:
   2. Vitreous-China Fixtures: ASME A112.19.2M.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Faucets: ASME A112.18.1.

I. Comply with the following applicable standards and other requirements specified for shower faucets:
   1. Faucets: ASME A112.18.1.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   2. Brass and Copper Supplies: ASME A112.18.1.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
3. Off-Floor Fixture Supports: ASME A112.6.1M.

PART 2 - PRODUCTS

2.1 FITTINGS

A. Fittings for Equipment Specified in Other Sections: Fittings include the following:
1. Supply Inlets: Brass pipe or copper tube, size required for final connection.
2. Supply Stops: Chrome-plated brass, angle or straight; compression, loose-key type; same size as supply inlet and with outlet matching supply riser.
4. Traps: 0.045-inch thick tubular brass, slip-joint inlet, cleanout, wall flange, escutcheons, and size to match equipment. Use chrome-plated tube for exposed applications.

B. Fitting insulation kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Guy Gray, IPS Corporation or approved equal.
2. Lavatory and sink pipe enclosures, white rigid high-impact, stain-resistant, rigid PVC for ADA compliance. Include manufacturer’s standard fasteners, straps, and adhesives.

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 floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. 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 valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

J. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

K. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

L. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

M. 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.

N. Install toilet seats on water closets.

O. 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.

P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
Q. Install shower flow-control fittings with specified maximum flow rates in shower arms.

R. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

S. 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 "Escutcheons for Plumbing Piping."

T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

U. Include fitting insulation kits for accessible fixtures according to the following:
   1. Lavatories: Cover hot, cold-water, and tempered water supplies, stops, and handles, drain, trap, and waste to wall.
   2. Sinks: Cover hot, cold-water, and tempered water supplies, stops, and handles, drain, trap, and waste to wall.
   3. Fixtures with Offset Drain: Cover hot, cold-water, and tempered water supplies, stops, and handles, drain, trap, and waste to wall.
   4. Other Fixtures: Cover exposed fittings below fixture

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. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

D. Connect cold water and electrical power to electric heating water-tempering equipment.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. 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. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

D. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements.
   1. Test and adjust controls and safeties.

E. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

F. 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. Adjust or replace fixture flow regulators for proper flow and stream height.

D. Adjust equipment temperature settings.

E. Replace washers and seals of leaking and dripping faucets and stops.

F. 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

A. Provide all options and accessories as indicated.
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 SUBMITTALS
   A. General: See Section 220100 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

   B. Product Data: Provide submittals of the following:
      1. Pipes, tubes, fittings, valves, and manifolds.
   C. Reports and Certificates: Provide submittals of the following:
      1. Field Quality Control Test and Inspection Report.

1.3 QUALITY ASSURANCE
   A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

   B. ASME Compliance:
      1. Comply with ASME B31.9, "Building Services Piping," for laboratory compressed-air piping operating at 150 psig or less.
      2. Comply with ASME B31.9, "Building Services Piping," for vacuum piping in laboratory facilities.

1.4 COORDINATION
   A. Coordinate medical compressed-air service connections with other service connections.

PART 2 - PRODUCTS

2.1 LABORATORY GAS AND VACUUM PIPES, TUBES, AND FITTINGS
   A. For all laboratory gases, all positive-pressure laboratory gas piping, tubing, and fittings shall have been manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1.
      1. Each length of tubing shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.
      2. Fittings and other components shall be delivered manufacturer sealed and labeled, and kept sealed until prepared for installation.
B. Copper Laboratory Gas Tube: ASTM B 819, Type L, seamless, drawn temper, that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and in blue for Type L tube.

C. Wrought-Copper Fittings: MSS SP-73, with dimensions for brazed joints.

D. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.

E. Shape-Memory-Metal Couplings: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy.

2.2 PIPING FOR HIGH PURITY LABORATORY GASES:

A. Piping: ASTM SA312 Type 316L seamless stainless steel tubing with Swagelok fittings and joints. With the approval of Owner, flared metal gasket face seal fittings may be used. Order pipe, tubing, and fittings from manufacturer as pre-cleaned and factory sealed for oxygen use.

B. Valves:
   1. 1/2" point of use valves: Nupro series stainless steel UW bellows valve with tube extensions for butt-welding.
   2. 1/2" and 3/4" line valves: Stainless steel diaphragm valve with tube extension and purge ports for butt-welding.

2.3 LIQUID NITROGEN AND LIQUID ARGON PIPING SYSTEM:

A. MVE or CVI vacuum jacketed cryogenic pipe with bayonet type fittings. Inner pipe to be constructed out of Invar or 304SS. Jacket shall be 304 stainless steel. Vacuum jacket shall be 304 stainless steel. Vacuum jacket must have provisions for re-evaluation and shall be included as an integral part of the system. Rigid and flexible sections of the system shall be designed for easy adaptation for the dislocation and stresses caused by temperature differentials. Piping shall be designed to withstand a maximum working pressure of 150 PSIG.

2.4 DEIONIZED WATER PIPING:

A. Pipe valves and fittings shall be polypropylene, virgin Schedule 80, Type 1.

B. Pipe, fittings, and valves shall be manufactured from a compound which meets the requirements of ASTM D-2146.

C. Compound from which pipe is produced shall have minimum design stress rating of 1000 psi at 73 deg. F.

D. Materials for pipes, fittings, and valves shall have been tested and approved for conveying potable water by the National Sanitation Foundation and shall bear the NSF hallmark.

E. Installation practices, including support spacing and joint threading, shall comply with manufacturer's printed recommendations.

F. System piping components shall be the products of one manufacturer.
2.5 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6 VALVES

A. General Requirements for Laboratory Gas and Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

B. Laboratory Gas Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      c. Amico Corporation.
      d. BeaconMedaes.
      e. Conbraco Industries, Inc.
      f. NIBCO INC.
      g. Squire-Cogswell/Aeros Instruments, Inc.
      h. Tri-Tech Medical.
   2. Pressure Rating: 300 psig minimum.
   4. Seats: PTFE or TFE.
   5. Handle: Lever type with locking device.
   6. Stem: Blowout proof with PTFE or TFE seal.

C. Laboratory Gas Check Valves: In-line pattern, bronze.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Amico Corporation.
      c. BeaconMedaes.
      d. Conbraco Industries, Inc.
      e. Squire-Cogswell/Aeros Instruments, Inc.
      f. Tri-Tech Medical.
   2. Pressure Rating: 300 psig minimum.
D. Gas Safety Valves:
   1. Bronze body.
   2. ASME-construction, poppet, pressure-relief type.
   3. Settings to match system requirements.
   4. Positive-pressure gas valves, for all gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

E. Pressure Regulators:
   1. Bronze or stainless steel body and trim.
   2. Spring-loaded, diaphragm-operated, relieving type.
   4. Rated for 250-psig minimum inlet pressure.
   5. Capable of controlling delivered gas pressure within 0.5 psig for each 10-psig inlet pressure.
   6. Positive-pressure gas valves, for all gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

2.7 GAS-SERVICE CONNECTIONS

A. General Requirements for Laboratory Service Connections:
   1. All positive-pressure gas-service connections, for all gas types, shall be manufacturer cleaned, purged, and sealed as for oxygen service in accordance with CGA G-4.1.
   2. Suitable for specific gas pressure and suction service listed.
   3. Include roughing-in assemblies, finishing assemblies, and cover plates.
   4. Recessed-type units made for concealed piping unless otherwise indicated.

B. Roughing-in Assembly:
   1. Steel outlet box for recessed mounting and concealed piping.
   2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
   3. Double seals that will prevent gas leakage.
   4. ASTM B819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

C. Finishing Assembly:
   1. Brass housing with primary check valve.
   2. Double seals that will prevent gas leakage.
   3. Cover plate with gas-service label.

D. Quick-Coupler Pressure Service Connections: Outlets with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed
connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.

E. Cover Plates: One piece, [aluminum] [or] [stainless steel] and permanent, color-coded, identifying label matching corresponding service.

2.8 GAS MANIFOLDS

A. Manufacturer cleaned, purged, and sealed, for all medical gas type, for oxygen service in accordance with CGA G-4.1.

B. Manifold and Headers:
   1. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks.
   2. Designed for 2000-psig minimum inlet pressure, except nitrous oxide manifolds may be designed for 800 psig, and carbon dioxide manifolds may be designed for 1500 psig.
   3. Cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1.
   4. Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gauge.

C. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.

2.9 LIQUID NITROGEN VALVE:

A. Provide cryogenic shutoff valve for nitrogen. Valve shall be suitable for low temperature service down to -250 deg. F at 300 psig and shall provide tight shutoff.

2.10 DEIONIZED WATER VALVES

A. Provide full port, 100 percent shutoff, twin union, 150 psi non-shock cold water at 75 deg. F. Valves shall be fabricated of CPVC with threaded double union pipe connections. Valves to have Viton O-ring seals and twin Teflon seats and be complete with handle. Provide valves manufactured by Chemtrol, Hayward, and Sloan will be acceptable.

2.11 SERVICE COCKS FOR COMPRESSED AIR, VACUUM, AND LABORATORY GAS

A. Wall-Mounted Service Cocks: Chicago Faucet No. 987-F-WH (one 987 flange plus two (2) 937-WH outlets) for wall-mounted cocks.

B. Deck-Mounted Service Cocks: Chicago Faucet No. 982-WH (one 982 turret plus two (2) 937-WH outlets) and one 957-3K shank per turret.

C. Pipe-Mounted Service Cocks: Chicago Faucet 937 WH valves with male fitting.

2.12 FLEXIBLE PIPE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Hyspan Precision Products, Inc.
5. Metraflex, Inc.
6. Proco Products, Inc.
7. Unaflex.
8. Universal Metal Hose; a Hyspan Co.

B. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   2. End Connections: Threaded copper pipe or plain-end copper tube.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Laboratory Compressed Air Piping: Type L, copper gas tube; wrought-copper fittings; and brazed joints.

B. Laboratory Vacuum Piping: Type L, copper gas tube; wrought-copper fittings; and brazed joints.

C. Specialty Gas Piping: Type L, copper tube; wrought-copper fittings; and brazed joints.

D. Laboratory Gas Piping except Nitrogen Piping: Type L, copper tube; wrought-copper fittings; and brazed joints.

E. Laboratory Nitrogen Piping: Type K, copper tube; wrought-copper fittings; and brazed joints.

F. Drain Piping: Use the following piping materials:
   1. Copper water tube, wrought-copper fittings, and soldered joints.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Comply with NFPA 55 for installation of laboratory gas piping.

C. Comply with ASSE Standard #6010 for installation of compressed-air piping.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

G. Install piping adjacent to equipment and specialties to allow service and maintenance.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.

I. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 23 Section "Meters and Gages for Mechanical Piping."

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Division 23 Section "Vibration and Seismic Controls for Mechanical Piping and Equipment."

P. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

Q. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.

R. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.

B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install pressure regulators on compressed-air piping where reduced pressure is required.

F. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain so contents spill over or into it.

G. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

3.4 JOINT CONSTRUCTION

A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

B. Threaded Joints: Apply appropriate tape to external pipe threads.

C. Brazed Joints: Join copper tube and fittings according to CDA’s “Copper Tube Handbook,” “Brazed Joints” Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 23 Section “Vibration and Seismic Controls for Mechanical Piping and Equipment” for seismic-restraint devices.

B. Comply with requirements in Division 23 Section “Hangers and Supports for Mechanical Piping and Equipment” for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:
   1. 100-Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
   2. Longer Than 100-Feet: MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100-Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 23 Section “Hangers and Supports for Mechanical Piping and Equipment” for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12-inches of each fitting and coupling.

H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1/4: 60-inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72-inches with 3/8-inch rod.
4. NPS 1: 96-inches with 3/8-inch rod.
6. NPS 1-1/2: 10-feet with 3/8-inch rod.
7. NPS 2: 11-feet with 3/8-inch rod.
8. NPS 2-1/2: 13-feet with 1/2-inch rod.
9. NPS 3: 14-feet with 1/2-inch rod.
10. NPS 4: 16-feet with 1/2-inch rod.

J. Install supports for vertical copper tubing every 10-feet.

3.6 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for laboratory compressed-air piping, valves, and specialties. Comply with requirements in Division 23 Section "Identification for Mechanical Piping and Equipment."

3.7 FIELD QUALITY CONTROL FOR PIPING IN LABORATORY FACILITIES

A. Testing Agency: Engage qualified testing agency to perform field tests and inspections of compressed-air piping in nonmedical laboratory facilities and prepare test reports.

B. Perform tests and inspections of compressed-air piping in nonmedical laboratory facilities and prepare test reports.

C. Tests and Inspections:
   1. Piping Leak Tests for Laboratory Gas Piping: Test new and modified parts of existing piping. Cap and fill laboratory gas piping with oil-free dry nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
   2. Repair leaks and retest until no leaks exist.
   3. Inspect filters and pressure regulators for proper operation.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:

1.3 PERFORMANCE REQUIREMENTS
A. Single-Wall Piping Pressure Rating: 10-feet head of water.

1.4 SUBMITTALS
A. General: See Section 230100 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.
B. Product Data: Provided submittals of the following:
   1. Piping and fittings.
C. Reports and Certificates: Provide submittals of the following:
   1. Qualification Data: For qualified Installer.
   2. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
B. Do not store plastic pipe or fittings in direct sunlight.
C. Protect pipe, fittings, and seals from dirt and damage.

1.6 EXTRA MATERIALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 SINGLE-WALL PIPE AND FITTINGS
A. PP Drainage Pipe and Fittings: ASTM F1412 pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions and with fire-retardant additive complying with ASTM D4101; with fusion-joint ends.
1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.

2. Georg Fischer Fuseal® PP Corrosive Waste

2.2 PIPING SPECIALTIES

1. Corrosion-Resistant Traps:
   a. Type: P-trap or drum trap.
   b. Size: NPS 1-1/2 or NPS 2, as required to match connected piping.
   c. PP: ASTM D4101, with mechanical-joint pipe connections.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Chemical-Waste Piping:

1. Install PP piping in accordance with manufacturer’s instructions and all applicable code requirements.

2. Install piping next to equipment, accessories, and specialties to allow service and maintenance.

3. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.

4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

5. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

7. Install piping at indicated slopes.

8. Install piping free of sags and bends.

9. Install fittings for changes in direction and branch connections.

10. Install escutcheons for penetrations of walls, ceilings, and floors as required in Division 23, “Common Mechanical Materials and Methods.”

3.3 JOINT CONSTRUCTION

A. Chemical-Waste Piping:


2. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.
3.4 HANGER AND SUPPORT INSTALLATION

A. Pipe sizes in this article refer to aboveground, single-wall piping.

B. Comply with requirements in Division 23 Section "Vibration and Seismic Controls for Mechanical Piping and Equipment" for seismic-restraint devices.

C. Comply with requirements in Division 23 Section "Hangers and Supports for Mechanical Piping and Equipment" for pipe hanger and support devices. Install the following:
   1. Vertical Piping: MSS Type 8 or MSS Type 42, riser 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.

D. Comply with requirements in Division 23 Section "Hangers and Supports for Mechanical Piping and Equipment" for installation of supports.

E. Support horizontal piping and tubing within 12-inches of each fitting and coupling.

F. Support vertical piping and tubing at base and at each floor.

G. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8-inch.

H. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
   2. NPS 2-1/2 and NPS 3: 42-inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48-inches with 5/8-inch rod.

I. Install supports for vertical PP piping every 72-inches.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make connections to existing piping so finished Work complies as nearly as practical with requirements specified for new Work.

C. Install piping adjacent to equipment to allow service and maintenance.

3.6 LABELING AND IDENTIFICATION

A. Comply with requirements in Division 23 Section "Identification for Mechanical Piping and Equipment" for labeling of equipment and piping.
1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.7 FIELD QUALITY CONTROL

A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24-inches of backfill is in place and again at completion of Project.

1. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Hydrostatic Tests for Drainage Piping:
      1) Allowable leakage is a maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
      2) Close openings in system and fill with water.
      3) Disconnect water supply.
      4) Test and inspect joints for leaks.

2. Leaks and loss in test pressure constitute defects that must be repaired.

3. Submit separate reports for each test.

B. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.

3.8 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.

B. Single-Wall, Chemical-Waste Sewerage Piping: Use the following piping materials for each size range:

1. NPS 1-1/2 to NPS 4: PP drainage pipe and fittings and fusion joints.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork and associated piping materials and installation instructions common to most HVAC systems and components including but not limited to ductwork, dielectric fittings, mechanical sleeve seals, sleeves, escutcheons, grout, mechanical demolition, equipment installation requirements common to equipment sections, painting and finishing, concrete bases, supports and anchorages, general coordination, mechanical/electrical wiring and device coordination.

1.2 DEFINITIONS

A. Following is a list of abbreviations generally used in Division 23.
   1. AABC - Associated Air Balance Council
   2. AHJ - Authority Having Jurisdiction
   3. ADC - Air Diffusion Council
   4. AGA - American Gas Standard.
   5. AHJ - Authority Having Jurisdiction
   6. AMCA - Air Moving and Conditioning Association
   7. ANSI - American National Standards Institute
   8. ARI - Air Conditioning and Refrigeration Institute
   9. ASC - Adhesive and Sealant Council
   10. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
   11. ASME - American Society of Mechanical Engineers
   12. ASSE - American Society of Sanitary Engineering
   13. ASTM - American Society for Testing and Materials
   14. AWWA - American Water Works Association
   15. AWS - American Welding Society
   16. NBS - National Bureau of Standards
   17. NEBB - National Environmental Balancing Bureau
   18. NEC - National Electric Code
   19. NEMA - National Electrical Manufacturers’ Association
   20. NFPA - National Fire Protection Association
   21. OSHA - Occupational Safety & Health Administration
   22. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
   23. UL - Underwriters Laboratories

B. Terms used on the drawings or in the specifications shall have the following meanings:
1. Approved Equal: An Item suggested by the Contractor that is allowed by the Engineer to replace an item listed in the Specifications or Drawings. The burden of proof of equality is the responsibility of the Contractor.

2. Furnish: Supply and deliver, ready for installation, assembly or intended use, all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular work referred to.

3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at the project site as required to complete all items of work as required for the intended use/operation including all testing, certification, and other requirements for final turnover to the Owner.

4. Provide: “Furnish” and “Install.”

5. Owner Furnished, Contractor Installed: The Owner will furnish at his cost and the Contractor shall receive, protect, store and install in the performance of the Work.

6. Finished Spaces: Spaces other than electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

7. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

8. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include installations above ceilings, in shafts, trenches, partitions, or other enclosures.

9. 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 embedded in or below masonry or concrete construction, earthwork/trenches, within unheated shelters, crawl spaces, or enclosures.

10. Wiring: All wires, raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connectors, splices, and all other items necessary and/or required in connection with such work.

11. Raceway: All raceways, conduit, fittings, hangers, supports, sleeves, etc.
1.3 GENERAL REQUIREMENTS

A. Examine the Drawings, Specifications, and other Contract Documents relating to the Work and the work of all trades and become fully informed as to the extent and character of work required. Coordinate all work with that of others to ensure proper and complete installation of all materials, equipment and supports. It is the intent of the drawings, specifications and related Contract Documents to provide a complete working installation of all systems and equipment called for, in proper operating condition, finished, tested and ready for its intended use (hereinafter "Design Intent"). Provide all items not specifically shown on the drawings, called for in the specifications or related Contract Documents, but required to conform to the Design Intent without additional cost or schedule impact. The scope of work shall include all labor, material and equipment to achieve the Design Intent and all necessary and required temporary and incidental equipment, connections, services, supports, hoisting and scaffolding, access provisions, tools, appliances, consumables, fees, permits and licenses, debris removal/disposal, supervision and labor, including required start-up, checkout and training to provide complete and fully operable systems in full compliance with the Contract Documents.

B. The drawings, specifications and related Contract Documents are intended to be complementary and interrelated; what is required by one is as if required by another. Similarly, information and/or requirements may be included in one and not another. Contractor is responsible to conduct a full and thorough review of all Contract Documents to ascertain requirements of the Work before proceeding, including but not limited to all drawings and specifications. Where there is a conflict in or between the drawings, specifications or other related Contract Documents as to performance, the more stringent requirement shall apply, or as to quality, the highest quality provision shall apply and be included, each without cost or schedule impact.

C. Before submitting a bid and prior to the start of work, Contractor shall examine all conditions relating to the Work, including that associated with the work of other trades upon which Contractor's work may rely or otherwise depend, to achieve the Design Intent, in accordance with the best trade practices, workmanship and highest quality product installation, taking into account the sequence of the work, delivery, storage and hoisting requirements, requirements for access, testing and temporary services and all other site limitations and project complexities. Report to the Architect/Engineer any conditions which might prevent installation of materials and/or equipment in the manner intended by the Contract Documents or contrary to applicable codes, standards or regulations.

D. No consideration or allowance will be granted for any alleged misunderstanding of materials, equipment or components to be furnished or work to be done; it being agreed that tender of proposal carries with it agreement to items, terms and conditions required by the Contract Documents.

E. Site Visit: Visit the site and verify the exact conditions relating to the work and obtain such information as may be necessary to present a complete and comprehensive bid. No allowance will be made for any extra expense due to Contractor's failure to make such a visit and reasonably verify all actual/existing conditions. In the event of a conflict between existing conditions and the requirements of the Contract Documents, perform the necessary work to conform to Design Intent. The Owner or his representative will be the sole individual to interpret the intent of the Drawings in the event of a conflict between (1) existing conditions and those shown on the drawings, or (2) quality of existing material and quality of material indicated on the drawings or in the specifications. Wherever a conflict such as this occurs, the higher standard shall prevail.
1.4 SPECIAL REQUIREMENTS

A. When applicable, Contractor acknowledges the ongoing operations of the Owner at or in close proximity to the Project and agrees to coordinate the timing of the Work with the Owner’s ongoing operations; perform the Work in a manner that minimizes or eliminates and adverse impact upon the Owner’s ongoing operations; confine operations at the site to areas approved by Owner, permitted by law, permits and the Contract Documents; comply with the Owner’s standard security, health and safety policies and procedures; not unreasonably encumber the site with any materials or equipment; and not place signs or advertising on or about the site without prior approval of Owner.

B. Where applicable, all seismic construction, restraints, bracing, mounts and hanging systems shall be in full compliance with the requirements of all Authorities Having Jurisdiction (AHJ’s), pre-approval, certification and engineering (including certified engineering calculations and stamps). Contractor shall be solely responsible for obtaining and complying with all requirements of the AHJ.

1.5 SUBMITTALS

A. Reference Division 01 for submittal requirements.

B. Submittal Schedule: Provide a detailed submittal schedule including all requirements of this Division and its subdivisions to the Architect and Engineer within thirty (30) days of contract award.

1. Contractor shall submit for the Engineer’s approval a Submittal Schedule for the performance of the work that is consistent with the requirements of the project schedule. The Submittal Schedule shall allow reasonable time for the Architect and other consultants review as specified in Division 01 Submittal Procedures. If the time for Architects/Engineer review is not otherwise specified, the review period (from date of receipt) shall be fifteen (15) business days. Once approved by the Architect/Engineer, submittal dates and time limits established by the Submittal Schedule shall not, except for reasonable cause, be changed or exceeded by the Contractor.

2. For each submittal required by the Contract Documents the schedule shall include: specification section number, subsection/paragraph identification number, item description (as stated in the applicable specification section, subsection or other Contract Document) and the scheduled delivery date to the Architect/Engineer.

3. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project schedule resulting from any deviation to the approved Submittal Schedule, including but not limited to; payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer as may be required to perform out of sequence, stacked, critical, delayed, unscheduled or multiple reviews of required submittals necessitated by rejection of a prior submittal, (cumulatively and hereinafter, “Additional Review Costs”)

C. General:

1. Review is for general conformance with the Contract Documents and is not intended to otherwise approve or verify dimensions, quantities, or to coordinate the Work shown on shop drawings on or between Contractor and the work of other trades or Sections. Contractor is solely responsible for quantities, dimensions, means and methods. Dimensions shall be confirmed and correlated by Contractor at the jobsite prior to the start of the Work (procurement, fabrication, construction or other commencement activities). Contractor’s failure to fully verify conditions at the jobsite prior to
2. Submittal review shall be performed to show compliance with the design intent. Contractor shall specifically note any deviations from the Contract Documents and explain the reason and nature of the deviation. Such deviations will be reviewed or rejected on the submittal. Deviations not so identified shall not relieve the Contractor from the requirements of the Contract Documents.

3. Resubmittals will be reviewed for compliance with comment(s) made on the original submittal only. Architect/Engineer shall not be responsible for changes made upon resubmittal that are not clearly identified (highlighted) and respond directly to the initial rejection. Resubmittals should not be packaged with non-related first time submittals; all resubmittals must be marked with the resubmittal number and date and must otherwise comply with all submittal requirements.

4. Submit shop drawings, penetration locations, supplemental data, etc., as may be required by the Contract Documents for all materials, equipment and other components of the work included in all Sections of this Division and other provisions of the Contract Documents in accordance with the requirements of this Division and Division 01.

5. All submittals must be reviewed by Contractor, and bear Contractors review stamp and signoff for Conformity to the Contract Documents, prior to the submission of any required submittal to Architect/Engineer. Submittals that fail to meet this requirement will be considered incomplete, will not be reviewed by Architect/Engineer and will be returned to Contractor, without review and/or rejected and resubmittal will be required. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

6. Forward all submittals to Architect/Engineer in a coherent, organized fashion, complete and packaged as required herein, Architect/Engineer may reject submittals that fail to comply with this or any other provision of the Contract Documents and Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

7. Subject to other provisions of the Contract Documents and in the absence of a more stringent requirement, Architect/Engineer will review a submittal not more than two (2) times. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

8. Identify each submittal item by reference to Specification Section paragraph in which item is specified, or drawing/detail number, as applicable. In addition, for equipment submittals, include identification numbers appearing on the equipment schedule.

9. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words “as specified” are not sufficient identification.

10. Organize submittals in same sequence as they appear in specification sections, articles or paragraphs.

11. All materials and equipment submittals shall have a summary sheet at the front complete with catalog numbers. Where materials or equipment pertain to more than one building, submittals shall clearly indicate at which locations the materials or equipment is to be installed.

12. Submittals shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping and/or conduit entrance, access requirements
for installation and maintenance, physical size and dimension, electrical characteristics and requirements, foundation/curbs and all permanent and temporary support details as well as all information relating to weight, including but not limited to live and dead weights.

D. Catalog Cuts and Submittal Literature: Catalog cuts, submittal literature and published material may be included to supplement scale drawings.

1. Prepare submittals electronically in accordance with the following and Division 01.
2. Submittal literature, drawings and diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item.
3. Substitutions: Comply with Division 01 Product Substitution Procedures.

E. Shop Drawings:

1. Shop drawings shall include all significant Division systems, equipment and components, including but not limited to all terminal devices, connections and elevations. Include all related specialty rooms (i.e., electrical, data/technology). Drawings shall be at a minimum scale of 1/4 inch per 1 ft.-0 inch and shall be fully coordinated with the work of other trades and/or Sections.
2. Identify congested areas and clearly indicate solutions to space problems, developed in conjunction with the work of other trades and/or Sections. Identification of space problems without proposed solutions is not acceptable and is grounds for rejection. For such areas indicate, superimposed, the work of all trades and/or Sections involved and:
   a. Clearly identify each area of congestion and deviations from the Contract Documents, and:
   b. Proposed solution(s), clearly documented and signed-off by all other trades and/or Sections involved.

F. Shop Fabrication Drawings: Drawings are for the Contractor’s use and shall be its responsibility. Do not submit shop fabrication documents unless specifically requested.

G. Testing and Balancing: Coordinate Shop Drawings to include any additional components for proper system testing and balancing.

H. Certificates: Submit final inspection certificates signed by governing authorities.

I. Operating and Maintenance Instructions and Manuals.

1. Instructions on major items, including but not limited to: fans, air handlers, AC units and temperature controls, shall be by representative of manufacturer of respective equipment.
2. Submit as identified below and as directed in Division 01.
   a. Names, addresses and phone numbers of contractors and subcontractors. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
   b. Complete operating and maintenance instructions and parts lists of all equipment and component parts. Data sheets to show complete internal wiring, and electrical ratings and characteristics, catalog data on component parts whether furnished by
equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or failure, and description of operating, test, adjustment, and maintenance procedures.

1) Where data sheets included in manual cover equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.

c. Operating Instructions should include, but not be limited to:

1) Normal starting, operational and shutdown procedures, including emergency procedures for each type of equipment/system.

2) Summer, winter, day/night, unattended and other environmental and special systems requirements/procedures.

3) Equipment wiring diagrams.

4) Balancing or other applicable system, equipment reports

5) All other items as may be specified/required by this Section and the Contract Documents.

d. Maintenance Instructions:

1) All items as may be specified/required by this Section and the Contract Documents.

2) Lubricants and lubrication instructions, including a lubrication chart listing each item of equipment, all points of lubrication, lubricant type, dates and lubrication schedule

3) All other items as may be specified/required by this Section and the Contract Documents

e. Manufacturers Data (each piece of equipment)

1) Installation instructions

2) Drawings and specifications

3) Parts List, including recommended stock and long lead parts/components.

4) Wiring and riser diagrams.

5) Warranties and guarantees for all equipment, materials and components, including repair, replacement and labor from both Contractor and manufacturer as required by the Contract Documents.

6) Certificates of Installation - manufacturer’s certification of supervision during equipment installation and start-up procedures.

7) Instruction certificates - certificates of compliance with Sections specific training and instruction programs.

8) All other items as may be specified/required by this Section and the Contract Documents.

J. Record Documents:

1. Maintain one (1) complete set of blueline prints and specifications at the job site exclusively for recording deviations from the drawings which are necessary because of job conditions, request for information and/or approved change orders. Record
locations and depths of buried and concealed conduits or other systems components from fixed, easily identifiable objects, such as building walls or other fixed physical objects. Where conduits are concealed in walls or other fixed physical objects, indicate distances from building corners or other building features not likely to be disturbed by fixture alterations. Drawings, specifications (as-builts) and approved submittals.

2. Where the project uses a BIM model the Contractor shall keep the model updated in a similar fashion, maintaining the current project record as described in (a), above and submit, an addition to all other requirements of this Section and other provisions of the Contract Documents a complete and accurate BIM model for the project.

3. Prior to Substantial Completion, obtain from the Architect a complete set of electronic CADD drawings. Record all revisions to these drawings to indicate as-built conditions. Indicate all changes, including RFI’s, on this set of documents. Submit one set of blueprints of these revised drawings for review. Make necessary changes and deliver to Architect one set of reproducibles and one electronic copy, including and BIM model, upon Final Completion and Acceptance. Refer to Division 01 for additional requirements.

4. Drawings shall be accurately scaled to 1/8 inch - 1 foot or larger using the same version of AutoCAD or other electronic media as used by Architect/Engineer. Drawings shall include all addenda and Change Order items.

5. Furnish valve charts for HVAC systems. Tag all valves with brass disc and chain. Use no duplicate numbers. Valve charts to indicate valve number, size, location, function and normal position. Mount glazed frames containing one set of valve charts in the building as directed. Bind remaining valve charts with Operating and Maintenance Manuals.

6. All test reports, certifications, and inspection reports.

7. AHJ/Specialty AHJ Approvals

8. Substantial and Final inspection certificate signed by governing authorities.

9. All other items as may be specified/required by this Section and/or other provisions of the Contract Documents.

1.6 EQUIPMENT DEVIATIONS AND SUBSTITUTIONS

A. See Division 01 for requirements and procedures related to Deviations and Substitutions. Unless specified elsewhere in the Contract Documents, a minimum of two (2) weeks shall be allowed for evaluation. The burden of all systems re-engineering/design, testing, suitability and constructability is solely placed upon the Contractor for all deviations from the basis of design as reflected in the Contract Documents.

B. No substitutions will be allowed and/or considered unless the description of a product includes the phrase “approved equal” and then only upon a determination as to equivalency and impact upon the project budget, schedule and the work of others, including any redesign of the project or its system components by the Architect, Engineer or other trades. The final determination as to sufficiency or acceptance of any such substitution and/or deviation properly requested and submitted by Contractor will lie solely with the Architect/Engineer. Contractor may not implement substitutions that have not been approved by Architect/Engineer.

C. Where the Contractor proposes to use and item of equipment other than that specified or detailed on the drawings which requires any redesign of any portion of the project, including but not limited to the mechanical, electrical, plumbing, structure, or architectural design or
any of their respective subcomponents. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project budget and/or schedule resulting from any required investigation, analysis or redesign, including but not limited to; payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer, Owner or AHJ as may be required to perform the investigation, analysis or redesign (cumulatively and hereinafter, “Deviation Review Costs”).

D. If approved by Architect/Engineer, all such redesign, including all new drawings and detailing required, will be prepared by the Architect/Engineer and their sub-consultants for Change Order documentation for approval by Owner and the Authority Having Jurisdiction will be paid by the Contractor as part of the Deviation Review Costs.

E. Where such approved deviation requires a different quantity and arrangement of equipment, wiring, conduit, supports, foundations, pads, curbs, or equipment from that specified or indicated on the drawings or other Contract Documents, Contractor shall be responsible for all such costs, including the work of other trades and shall be solely responsible to furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system at no additional cost or schedule impact to the project (cumulatively and hereinafter “Deviation Construction Costs”).

1.7 COORDINATION

A. Drawings and corresponding electronic media are diagrammatic and indicate the general arrangement of systems and work included in the Work. Consult the drawings, details and other electronic media for locations of fixtures and equipment; where same are not definitely located, obtain this information from the Architect/Engineer.

B. The drawings and related electronic media have been made to scale with the best knowledge of conditions, dimensions and space requirements available at the time of design and shall be followed as closely as possible during performance of the Work and coordination with the work of others. The foregoing however shall not relieve Contractor from its responsibility to verify all conditions. Dimensions and space requirements prior to commencement of the Work and to immediately report any errors or discrepancies to the Architect/Engineer.

C. Check drawings and related electronic media of other trades to verify spaces and conditions in which work will be performed prior to commencement of the work.

D. If directed by the Architect/Engineer or required for proper installation, execution and coordination of the work, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed.

E. Take all dimensions from Architectural and Structural Drawings, certified equipment drawings and from the actual field measurements before fabricating work. All conflicts shall immediately be reported to the Architect/Engineer. Contractor is solely responsible for conflicts known or which reasonably should have been know but not reported or resolved before commencement of the work.

F. Equipment furnished shall fit in allocated space with due provision for manufacturer’s recommended access and proper maintenance requirements. Verify and coordinate space requirements with all trades and equipment which comprise the Work.
G. Prior to construction, coordinate the Work with that of other trades and building components. Prepare coordination drawings (or other specified electronic media) for all major trades, utilities and other primary systems routing in conjunction with the contract documents to maximize the pre-installation planning and coordination of trades, utilities and systems and minimize the requirement to manage field coordination through the RFI’s, ASI’s or other similar processes.

H. Before starting work, carefully examine the site and all Contract Documents. Become thoroughly familiar with new and existing conditions governing work on this project. Verify indicated elevations, building measurements, rough-in dimensions and equipment locations before proceeding with any of the work.

I. Contractor shall be solely responsible for coordination and shall bear the cost of its failure to coordinate installation or of failure to advise Architect/Engineer of installation conflicts.

J. Sequence, coordinate, and integrate installations of systems materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to building enclosure.

1.8 ELECTRICAL WIRING AND COORDINATION

A. In general, power wiring will be provided under Division 26 - Electrical, and control wiring will be provided under Division 23 - Heating Ventilating and Air Conditioning, unless otherwise specified.

B. Electric wiring provided under Division 23 shall be in accordance with the requirements of Division 26.

C. Except where noted otherwise, control wiring under Division 23 shall include all connections to control devices, interlock wiring, control relays, sensing devices, etc. incidental to the building automation system and the proper operation of equipment provided under Division 23.

D. The following schedule summarizes the Division or work and material responsibilities.

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<th>ITEM</th>
<th>FURNISHED UNDER</th>
<th>SET IN PLACE OR MOUNTED UNDER</th>
<th>WIRED AND CONNECTED UNDER</th>
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<td>MD 1</td>
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<td>Resistance heaters</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
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<td>Fire protection controls, including remote switches, flow switches</td>
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<td>Motor controls where specified as an integral package</td>
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<td>Motor controllers</td>
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<td>ITEM</td>
<td>FURNISHED UNDER</td>
<td>SET IN PLACE OR MOUNTED UNDER</td>
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<tr>
<td>Duct smoke detectors</td>
<td>ED</td>
<td>MD</td>
<td>ED 3</td>
</tr>
<tr>
<td>Smoke and fire/smoke dampers (with and without end switches)</td>
<td>MD</td>
<td>MD</td>
<td>ED 3</td>
</tr>
<tr>
<td>Control power source for temperature and equipment control panels</td>
<td>ED</td>
<td>ED</td>
<td>ED</td>
</tr>
<tr>
<td>Electric temperature control relays and miscellaneous devices</td>
<td>MD</td>
<td>MD 5</td>
<td>MD 5</td>
</tr>
<tr>
<td>Level and float switches</td>
<td>MD</td>
<td>MD 5</td>
<td>MD 5</td>
</tr>
<tr>
<td>Pipe mounted control devices such as flow switches, flow sensors, valves, and wells</td>
<td>MD</td>
<td>MD 5</td>
<td>MD 5</td>
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<tr>
<td>Thermostats and space sensors</td>
<td>MD</td>
<td>MD 5</td>
<td>MD 5</td>
</tr>
<tr>
<td>Duct mounted control devices such as temperature, humidity, flow and pressure sensors</td>
<td>MD</td>
<td>MD 5</td>
<td>MD 5</td>
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<tr>
<td>Damper actuators</td>
<td>MD</td>
<td>MD 5</td>
<td>MD 5</td>
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<tr>
<td>Control dampers</td>
<td>MD</td>
<td>MD</td>
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<tr>
<td>Variable frequency drives (VFD) specified to be mounted on or in the mechanical equipment</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
</tr>
<tr>
<td>VFD specified to be mounted separately from the mechanical equipment</td>
<td>MD</td>
<td>ED</td>
<td>ED</td>
</tr>
</tbody>
</table>

E. Notes: (1) MD: Mechanical Divisions 21, 22, 23. (2) ED: Electrical Division 26. (3) Fire Alarm related and power wiring provided under Division 26; Control-related wiring and relays provided under Divisions 21, 22, 23. (4) If furnished as part of factory equipment under Divisions 21, 22, 23, wiring and connections only by Electrical Division 26. (5) If any control devices carry the Full Load Current to any motor, they shall be furnished under Divisions 21, 22, 23, but shall be set in place and connected under Division 26. (6) Except where indicated
as part of a motor control center on the Electrical Drawings. (7) Division 26 shall provide the logic contact closure and the wiring to the local DDC temperature control panel. Division 26 shall also provide interface with the fire alarm system, proof of flow devices (duct/fan air flow switches), connecting wiring, smoke control logic, panel, relays, damper monitoring, and associated devices for a complete smoke control system.

1.9 ACCESSIBILITY

A. Contractor is responsible for verifying that equipment and devices will fit within the space shown on the drawings. Contractor shall locate all equipment which must be serviced, operated or maintained, if fully accessible positions.

B. Equipment requiring periodic maintenance shall be installed to permit removal without damage to other work. If required for better accessibility, provide access doors for this purpose. Provide access door to the upstream side of turning vanes and all other equipment and devices requiring maintenance and replacement. All equipment requiring lubrication shall have accessible external grease fitting for maintenance purposes.

C. Minor deviations from the drawings may be made to allow for better accessibility, but changes of magnitude or which involve extra cost shall not be made without approval from the Architect/Engineer.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with a minimum of 5 years documented experience. Company personnel shall be approved by manufacturer for all product installations and required training.

C. Conform to all applicable standards, codes and regulation and industry best practice requirements.

D. All materials and equipment shall be new, shall bear manufacturer’s name, and shall conform to the grade, quality and standards specified herein. Type, capacity and application shall be suitable and capable of satisfactory operation for the purpose intended. All equipment and components shall include UL label and/or marking on equipment body/device including manufacturer’s name, pressure rating(s), electrical classification(s), limits and ratings as applicable to individual components for the purpose specified and intended.

E. Equipment Selection: All items of a given type shall be the product of the same manufacturer. Equipment of greater or larger power, dimensions, capacities, and ratings may be considered provided such proposed equipment is approved in writing by Architect/Engineer and connecting electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. See Deviations and Substitutions for requirements. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings of efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

F. Listing and labeling: Provide motors that are listed and labeled. Terms “listed and labeled”: as defined by UL, NEC, Article 100 or other applicable recognized agency as specified in the Contract Documents.
G. Cutting and Patching: Unless otherwise required by the Contract Documents, Contractor shall be responsible for all cutting, fitting and patching required to complete the Work, or to make portions of the Work and existing conditions fit together properly, and all such areas shall be restored to the conditions existing prior to the cutting, fitting and patching unless otherwise provided in the Contract Documents.

H. Promptly correct any portion of Work that is defective or not in accordance with the Contract Documents or rejected by the Architect/Engineer or Owner. Contractor shall be responsible for, and pay for all costs arising out of, any additional testing and inspections, demolition, uncovering and replacement and additional design and consulting services required to properly correct any portion of the Work.

I. Comply with the Contract Documents and all Laws, standards and handling criteria regarding hazardous substances, wastes and materials, including asbestos-containing materials, lead-based paints, petroleum (or any constituent thereof), mold, radon, and polychlorinated biphenyl (PCB), (“Hazardous Materials”) in performing the Work. Unless required by the Contract Documents, no Hazardous Materials shall be brought onto the Project.

J. Lead Free Requirements: Use lead free products, and where required by law, ordinance, regulation or standard, all materials products and practices shall comply with limitations and requirements as to the allowable limits and/or percentages of lead. Lead free products must be certified by and independent 3rd party.

1. This provision shall apply to any and all similarly regulated materials, products and practices that may be considered hazardous or are otherwise regulated by applicable law, ordinance regulation or standard in the project local.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Cover and protect all materials and equipment against dirt, water, chemical or mechanical damage, and theft. At completion, all work, equipment and materials shall be cleaned, and damage repaired by Contractor. Damaged equipment will be replaced by the Contractor if Owner does not accept repairs done to the equipment. Such replacement shall be scheduled to minimize building system interruption of occupied or scheduled for occupancy.

B. Material delivered at the site shall not be left exposed to the weather or left unattended. Deliver pipes, tubes and conduit with factory-applied end-caps. Contractor shall be responsible to maintain end-caps or provide temporary end caps on all open-ended piping, tubes and conduit through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

C. Protect stored material from moisture and dirt. Protect plastic pipes and materials from sunlight and support to prevent sagging and bending.

D. Elevate stored materials above grade. When stored inside, to not exceed structural capacity of the floor.

E. Provide protective coatings to materials to prevent damage and/or infiltration of moisture and dirt on all materials and equipment including but not limited to cast iron and steel valves.

F. Check the openings in the building and the size of the doors, passages, and openings through which equipment is to be admitted. Wherever necessary, provide the equipment in sections or knocked down in order to admit the equipment through these openings.
G. Provide all rigging, erection and hoisting equipment as required to handle or place equipment and piping in position. This rigging and hoisting equipment shall only be attached and placed on the structure in locations as approved by Architect/Engineer at the site.

1.12 PERMITS, FEES AND UTILITIES

A. Obtain and pay for all necessary permits, fees and utilities and inspections required to perform the Work.

B. Coordinate work with local regulatory entities, utility companies and others as required to fully comply with the requirements of this section and the Contract Documents, including those for both temporary and permanent services.

C. Permits, fees and utility expenses to be paid by Owner, if any, shall only where specifically required by the Contract Documents, and then only to the extent so specified.

1.13 DOCUMENT OWNERSHIP

A. The Drawings and Specifications, combined with the calculations, field data, notes, and reports, are the intellectual and real property of the Architect and/or Engineer. This covers all forms of written and recorded or electronic media. The reuse of these documents without specific permission of the Engineer is prohibited. The Drawings may be employed by the Owner and Contractor for the express use of constructing, commissioning, and operating the facility only upon proper execution of the Agreement for Use of Electronic Files and Data.

1.14 GUARANTEE AND WARRANTY

A. Contractor warrants to Owner that the materials and equipment provided under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects. Work, materials and equipment not conforming to these requirements, including substitutions not properly approved by Change Order, shall be considered defective. This warranty excludes remedy for damage caused by improper or insufficient maintenance, improper operation or normal wear, tear and usage. Contractor shall assign to Owner, or otherwise assure the Owner has the full benefit of, all warranties and guarantees of manufacturer, subcontractors, sub-subcontractors and suppliers, and Contractor shall perform the Work in a manner that does not adversely affect or invalidate any available warranties or guarantees.

B. Contractor shall warrant and guarantee all work against faulty material or workmanship for a period of one (1) year from the date of final completion and written acceptance by the Owner, unless specified more stringently elsewhere in the Contract Documents.

C. If the project is occupied or the systems placed in operation in several phases at the request of the Owner, the guarantee of each system or piece of equipment used shall begin on the date each system or piece of equipment was placed in satisfactory operation, tested, commissioned, and accepted, in writing, by the Owner. The use of building equipment for temporary service and testing or phases of work completed prior to the projects final completion and acceptance by the Owner does not constitute the commencement of the warranty period.

D. If a defect or deficiency in the Work is discovered within the one (1) year Warranty and Guarantee period or within such longer period as may be prescribed by the Laws or by any specific guarantee, and Owner elects to have Contractor correct such defect or deficiency,
Owner shall notify Contractor of such defect or deficiency in writing. This period of correction relates only to the specific obligation to correct defects and deficiencies and in no way otherwise limits the Contractor’s responsibility for Work that is not in accordance with the Contract Documents. If Contractor fails to timely correct defects or deficiencies in the Work, Owner may, at its sole option, correct them and charge Contractor for all cost therefore.

E. See Division 01 - Closeout Submittals for additional warranty requirements.

F. Specific exclusions, if any, from this one (1) year warrantee and guarantee period are listed in the individual specification sections.

1.15 LIMITATIONS OF LIABILITY

A. To the extent any of the following provisions are not more stringently included in the Contract Document, the following Limitations of Liability shall apply:

1. Architect/Engineer is not responsible for Contractor’s means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and is not responsible for Contractor’s failure to perform or furnish the work in accordance with the Contract Documents.

2. In the event that Architect/Engineer’s employees or sub-consultants make comments or issue warnings about safety issues, such comments and warnings shall be considered to have been offered by a Good Samaritan and shall not impose any obligation or responsibility.

3. Engineer will not be responsible for the acts or omissions of Owner, Contractor, any subcontractor, any supplier, or of any other person or organization performing or furnishing any of the portions of the work.

4. Contractor understands and acknowledges that Engineer is not authorized to order extra work or issue Change Orders to the work, however in the event and to the degree that Engineer may offer advice, suggestions, and opinions Contractor shall not rely on such advice, suggestions, and opinions unless directed in writing by Owner or its designated representative, and shall, in no event, make any claim against the Engineer for any such advice, suggestions, and opinions.

5. To the fullest extent permitted by law, Contractor shall indemnify and hold harmless Architect, Engineer, and their joint ventures, officers, directors, partners, employees and agents from and against any and all claims, costs, loses and damages (including but not limited to all fees and charge of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused in whole or in part by the negligent acts or omissions of Contractor, Contractor’s officers, directors, partners, employees, agents; or Contractor’s subcontractors or material men in the performance of Work. Contractor shall direct its insurer to list Architect, Engineer, and their joint ventures, as Additional Insureds on general liability insurance policies covering this project. Prior to commencing work, Contractor shall submit copies of its certificate of insurance to both Architect and Engineer.

1.16 COMMISSIONING

A. Owner has engaged the services of an independent Commissioning Agent to document the completion of the Fire Suppression, Plumbing, Laboratory Gas, Mechanical HVAC, Controls, Electrical, Communications, and Electronic Safety and Security systems for the project. Comply with the requirements of Commissioning Specification for assisting and cooperating with the Commissioning Agent.
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. Manufacturer: Unless otherwise specified, company specializing in manufacturing specified products for at least 3 years.

2.2 MATERIALS AND EQUIPMENT

A. The device numbers noted in this specification are generally those of a specific manufacturer and represent the minimum quality required as the basis of design for this project. Subject to the Substitutions and other provisions of the Contract Documents, Contractor may submit equivalent devices from the other manufacturers listed in the section.

B. Materials and equipment used in carrying out these specifications shall be new and have UL listing, or listing by other recognized testing laboratory when such listings are available.

C. All material shall bear manufacturer’s name, model number, electrical characteristics and other identification and shall be the standard product of manufacturer regularly engaged in production of similar material.

D. Construction of equipment shall be as follows:

1. All prefabricated equipment shall be designed and constructed in such a manner that all parts of said equipment and the equipment as a whole, including attachments, will resist the forces (including seismic where applicable) to which they may be subjected.

2. Unless otherwise specified or required, design criteria shall be no less than 1.5g for lateral forces and 0.6g for vertical forces.

3. Provisions for support and anchorage of equipment shall be an integral part of each item and shall include the fastening means and all necessary internal and external bracing, brackets and connections.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Refer to Division 01 Sections “Cutting and Patching” and “Selective Demolition” and Section 260501 “Minor Demolition” for general demolition requirements and procedures.

B. Disconnect, demolish, and remove 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. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
   a. 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 CONTINUITY OF SERVICES AND CONNECTION TO EXISTING WORK

A. Contractor, in the performance of the Work shall plan for and incorporate into the work the continuity of services. Where the continuity of service(s) is required to be interrupted, Contractor shall plan and schedule the work to minimize interruptions to the facility and its normal operations, prearrange and coordinate all outages/interruptions with Owner’s representative, utilities and the work of others. Requests for system interruptions/outrages must be submitted at least 5 days prior to intended shutdown time and then subject to Owner’s adjustment and/or approval.

B. For connections that require a significant down-time or interruption to facility operations (as determined by the Owner), Contractor shall provide for Owner’s written approval a detailed plan, schedule and description of the work for each system interruption. The plan shall include a description and schedule of each work item to be completed, designation of site supervisor and contact information, designated work crew as well as facility access and egress points for materials, manpower and equipment, contingency plan for parts, materials and equipment as well as a program to restore systems in the event of unplanned disruption or inability to complete the work in the timeframe scheduled and approved by Owner. Contractor shall confirm scheduled dates with the Owner and provide a minimum of 5 days advance notice for each operation.

C. Where possible and subject to Owners sole discretion, connections to existing systems shall be performed during normal operating conditions. Unless required otherwise (specifications, code, practice, etc.) all tap connections shall be "live," "wet" or "hot," with the proper safety programs and procedures for isolating system components to ensure the safety of the workforce, occupants and the facility.

D. Where service(s) interruption is scheduled to impact the facility and/or operations in any of the following ways, the work shall be performed between the hours of 1 and 5 AM during the work-week if the work can be completed during that timeframe and without significant impact upon the facility and/or operations, or on the weekend and at hours specified by Owner. The work required by this provision shall be completed at no additional cost provided the work involves:
   1. Service interruption to more than 10% of the facility
   2. Service interruption to public areas lasting more than 5 minutes (i.e., public lobby, meeting rooms, etc.)
3. Service interruption to critical services where Owner is not able to make accommodations (i.e., OR Rooms).

4. Service interruption to critical facility operations lasting more than 5 minutes and where Owner is not able to make accommodations (i.e., fire alarm systems).

5. Service interruption to any system that may increase or pose a risk to property or any person in or about the facility.

E. Include all costs for overtime labor, expedited materials, equipment and contingency planning as necessary to maintain continuity of services, schedule and complete necessary connections. Also include provisions for maintaining any and all supplemental systems that may be required to remain in service for the safety, protection and critical operations of the facility and its occupants including but not limited to; Fire Alarm, Security, Phone/Data, BAS, Emergency Power and similarly related critical or emergency systems. Such provisions shall include but not be limited to temporary power, lighting, materials, equipment and/or installations (including removal and cleanup thereof) required to maintain such systems and as required to safely and properly complete the work.

F. Contractor shall be liable for any and all damages resulting from unscheduled outages/interruptions or for those not confined to the pre-approved timeframes to complete the work.

3.3 UTILITY SERVICE(S)

A. Verify and coordinate the work with local utility companies providing service to the facility and/or site and coordination with the work of others. This shall include, but not be limited to:

1. Confirmation of schedule and service routing and sequence of the work to be performed by each utility, Contractor, subcontractor or others to ensure that the work can be performed without impact to the project schedule and with minimum interruption to services.

2. Verification of utility services point of entry to the facility, including applicable invert elevations, proper placement of sleeves and/or penetrations and sealant thereof.

3. Establishing utility point of contact, documenting the local utility company representatives:
   a. Company:
   b. Contact Person:
   c. Contact Telephone Number:
   d. Provide required connections for each incoming utility service.

3.4 PIPING SYSTEMS

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 cast-brass type with polished chrome-plated finish.
   g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
   h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
   i. 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. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.

f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.

g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes except for wet areas.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. 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 except where building separations or seismic joints require additional. 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 for flashing.

   d. 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.

5. 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.

   a. Install steel pipe for sleeves smaller than 6 inches in diameter.

   b. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

   c. 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.

6. 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.

a. 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.

7. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations details on the drawings. Refer to Division 07 Section for materials.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.5 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.

I. Plastic 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.6 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.

3.7 EQUIPMENT INSTALLATION

A. Follow manufacturer's instructions.

B. Where the product has no manufacturer's instructions, follow these specifications. Where neither the manufacturer nor these specifications contain such instructions, install in accordance with the standards listed above. No allowance of any kind will be made for negligence on part of Contractor to foresee means of bringing in or installing equipment into position.
   1. Verify all dimensions by field measurements.
   2. Install systems, materials, and equipment to provide the maximum headroom possible.
   3. Install systems, materials, and equipment to comply with approved submittal data, including coordination drawings
4. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

5. Fit surface panels, devices and outlets with neat, appropriate trims, plates or covers, without over-hanging edges, protruding corners or raw edges, to leave a finished appearance.

6. Extend maintenance and access components (i.e., grease fittings, service panels, and similar items) to accessible locations.

7. Install equipment to allow right of way for piping installed at required slope.

C. Locations:

1. Verify all locations with actual field conditions, architectural, structural, electrical, plumbing, heating and ventilating plans to avert possible installation conflicts.

2. Architect/Engineer reserves the right to make minor changes prior to installation without cost to Owner.

3. Coordinate work with that of other trades to assure symmetrical placing of fixtures, sprinkler heads and other exposed components with respect to ceiling tile, grilles, etc. See Architectural reflected ceiling plan for exact location of light fixtures and other equipment.

4. Any work which is incorrectly installed without prior verification without required coordination will be ordered removed and relocated and any changes or damage resulting to other work shall be repaired and/or replaced at no cost to the Owner.

5. In general, locate all finished devices or other exposed finished devices as indicated on or by symbols on drawings. Where devices or other exposed finished components occur in face, decks or base millwork, walls, ceilings or other finished surfaces carefully coordinate with details and arrangements of same.

6. All mounting heights shown on drawings are from finish floor to centerline unless otherwise indicated or required by code. Mounting heights at non-typical locations shown with (+) sign and height required noted adjacent to such device. Devices located in concrete block, brick or tile walls are to be adjusted in height to coordinate with modular joints of the materials. Verify requirements with Architect prior to installation.

D. Equipment Connections:

1. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference to other installations. Rearrangement or relocation of work that blocks access to mechanical duct inspection or servicing panels, valves, fire damper actuators and similar apparatus shall be done at no cost to the Owner.

2. Coordinate the work with that of other trades to ensure all required connections are provided to ensure proper installation and operation.

3. Provide complete electrical connections for all items of equipment requiring such connections, including incidental wiring, materials, devices and labor necessary for a finished working installation.

4. Verify the location and method for connecting to each item of equipment prior to roughing-in. Check voltage and phase of each item of equipment before connection.

5. Verify motor connections for the proper direction of rotation.
3.8 NOISE CONTROL
A. Provide insulation, isolators and other sound attenuation requirements as specified by Contract Documents.

3.9 FIRE WALL PENETRATIONS
A. Perform necessary fire rated wall sealing for the work in accordance with Division 07.
B. Provide necessary wall material to maintain fire wall rating where flush mounted equipment or components installed.
C. Where systems or components penetrate floors, ceilings, ducts, chases and fire walls, provide fire stopping to maintain integrity of the fire assembly. Fire stopping method shall be approved by the authority having jurisdiction.

3.10 EQUIPMENT SUPPORT
A. General:
1. Provide a system of supporting devices and hangers for support and bracing of piping, conduit and equipment as required by code or as provided under this Division as indicated on plans and as described herein.
2. Do not install supporting devices so as to obstruct access to equipment.
3. Floor-mounted equipment shall not be held in place solely by its own dead weight. Include floor anchor fastening in all cases.
4. Do not support ductwork, piping, conduits, conductors, or equipment from other piping, conduits, ceiling grids, equipment, ductwork, or ceiling supports. In all cases, provide independent supports for such components and equipment.
B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to code (including seismic codes where applicable).
1. Construct concrete bases and form equipment anchorages as detailed in the structural drawings.
2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
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 concrete and reinforcement as specified in Division 03 Sections and the Structural Drawings.
C. Metal Supports and Anchorages:
1. Refer to local codes, practices and standards for installation and material requirements and limitations relating to the use of metal supports and anchorages (including applicable seismic requirements).

2. Refer to Division 05 Section "Metal Fabrications" for structural steel.

3. Field Welding: Comply with AWS D1.1.

D. Wood Supports and Anchorages:

1. Refer to local codes, practices and standards for installation and material requirements and limitations relating to the use of wood supports and anchorages (i.e., fire retardant materials).

2. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor materials and equipment.

3. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

4. Attach to substrates as required to support applied loads.

E. Grouting:

1. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

2. Clean surfaces that will come into contact with grout.

3. Provide forms as required for placement of grout.

4. Avoid air entrapment during placement of grout.

5. Place grout, completely filling equipment bases.

6. Place grout on concrete bases and provide smooth bearing surface for equipment.

7. Place grout around anchors.

8. Cure placed grout.

3.11 PAINTING

A. Painting of systems, equipment, and components is specified in Division 09. Unless and to the extent that painting is not specified elsewhere in the Contract Documents, all exposed materials in finished areas and on exterior walls shall be painted to match surrounding surfaces.

B. Contractor shall be responsible for and shall coordinate the timing of painting with the work of other trades and to minimize the requirements for damage and touchup to the work.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.12 CUTTING, PATCHING, AND CORE DRILLING

A. General:
1. Refer to Divisions 01, 03 and other related provision of the Contract Documents, including Structural Drawings and Specifications for requirements relating to cutting, patching and core drilling of walls, floors and other surfaces.

2. Do not cut or break any steel or wood framing, concrete, masonry, or partitions, etc., without permission from the Architect or as shown on the Drawings.

3. Subject to the provisions of this Section and other portions of the Contract Documents cut, channel, chase and drill floors, walls, partitions and ceilings as necessary for the proper installation, support and anchorage of piping, ductwork, raceway, boxes, and other equipment.

4. Repair any damage to the building, piping, equipment, or finish.

5. Perform repairs with materials matching the original and install in accordance with appropriate sections of the Contract Documents.

6. Where trenching is done through existing paving, walks, curbs, etc. Contractor is responsible for patching and repairs to original condition.

7. In new work, patch and refinish all finished surfaces damaged by this Contractor to match adjacent surface.

8. Where new work is installed in the existing building, patch and refinish surfaces damaged to match existing. Refinishing to be as directed by the Architect.

9. All related refinishing to be as directed by the Architect.

B. All cutting, patching and/or core drilling of structural systems that are do not appear on or that deviate in any way from the Structural Drawings must be preapproved by the Structural Engineer and Contractor shall provide all data, calculations and/or other requirements as maybe required by the Structural Engineer, prior to commencement of the work, including but not limited to:

1. X-Ray of structural systems to show the actual location of reinforcement.

2. Size and dimensions of penetrating ductwork, piping or conduit including placement within desired opening and required clearances, means of fastening and/or support including all anchoring systems and fasteners.

3. As a general rule, subject to adjustment by Structural Engineer, penetrating ductwork, piping or conduit shall pass through the center of all structural openings, avoiding structural members by minimums specified on the Structural Drawings.

C. Core Drilling Layouts: Unless otherwise specified in the Contract Documents Contractor shall provide to the Structural Engineer a complete floor by floor core drilling layout for all required floor core penetrations in advance of the work for Structural Engineer’s review and approval. Core drilling layouts shall include size, dimension and specific locations of core drilling for all trades. Contractor shall not be permitted to conduct independent coring without providing such layout to Structural Engineer.

3.13 EXCAVATION, BACKFILL AND WATERPROOFING

A. Refer to Divisions 01, 02, and other related provisions of the Contract Documents, including but not limited to Sitework and Structural Drawings and related specifications for requirements relating to excavation, backfill and waterproofing for each trade.

B. Do necessary trenching and excavating for installation of underground piping, raceways and equipment. Use necessary precautions not to affect the bearing value of soil under and near
footings. Excavate trenches with proper pitch six inches deeper than required by line grade and prefll to line grade with pea gravel. Where trenching occurs through existing paving, walks, curbs, etc., patch and repair to original conditions. Compact backfill with vibratory or roller compaction equipment in 9-inch layers to 90 percent density. Dispose of excess excavated material as directed. Backfill under floor slabs and under hard surfaced yard areas (i.e., walks, drives, parking areas) to be crushed rock unless otherwise indicated, compacted in 9-inch layers. Backfill material and compaction to comply with Site Work Section of these Specifications.

C. Provide and maintain ample means and devices with which to promptly remove and dispose of water entering the excavation during the time it is being prepared for the piping, raceways or equipment laying, during the laying of materials or equipment and until the backfill has been completed.

D. Avoid, if possible, penetrations of waterproof membranes. Where such penetration is required, perform it prior to waterproofing and in accordance with Architectural details. Where penetrations are not detailed or must be conducted through waterproof membranes, provide a detail of the penetrations for approval of the Architect.

3.14 SAFETY AND PROTECTION

A. The Contract Documents do not include nor is Architect/Engineer responsible for the design of construction details or instructions relating to Contractor’ safety or protective measures or precautions or as it pertains to its means, methods, techniques, sequences or procedures required for to perform the work.

B. Provide necessary shoring, railing, barricades, protective devices, temporary systems/supports, safety instructions and procedures to perform the work safely and to comply with the Safety Requirements of the governing authorities.

C. Unless otherwise specifically detailed and included, the Contract Documents represent the finished state of all systems and components related to the work and it is Contractor’s sole responsibility to provide the necessary means, methods, equipment and protection of the work and those performing the work during construction. Neither Architect/Engineer nor any of their respective subconsultants shall be responsible or liable for Contractors failure to adequately protect the work or those performing the work during construction.

3.15 CLEANING

A. General:
   1. At all times keep the premises free from accumulation of waste materials or rubbish caused by the employees or the work. At the completion of the work, remove all superfluous materials, equipment and debris related to or resulting from the work.

   2. All systems, equipment and component including but not limited to all panels, compartments, points of access, surface areas, panels, whether concealed or not shall be free from debris, filings, clippings, dirt, dust and debris and in a new condition. Touch up paint where necessary.

   3. Where existing systems are expanded and/or remodeled, clean the new installation prior to making final connection to the existing systems.
      a. Natural Gas, Compressed Air, and Vacuum Piping: Blow clear of debris with oil free nitrogen or compressed air. Drain and clean all low points, strainers and pockets.
b. Heating Water, Chilled Water, and Condensing Water Systems: Use one pound of trisodium-phosphate or sodium hydroxide (lye) for each 50 gallons in the system, or one pound of sodium carbonate for each 30 gallons in the system. Fill, vent and circulate the system with this solution at design operating temperature. After circulating for four hours, drain and fill with fresh water. Test for pH and add sufficient amount of the cleaning chemical to obtain a pH between seven and eight. Clean all strainers and remove start-up strainers (from suction diffusers) after the system has operated for one week.

c. Steam and Condensate Piping: Utilize full steam pressure to satisfactorily clean all steam supply and return piping. During initial stages of operation, elements shall be removed from all traps and condensate waste. When all traces of grease, rust, scale and dirt are removed, trap elements shall be replaced and strainers cleaned. System shall then be operated for 5-day period. Upon completion of test period, traps and strainers shall again be cleaned.

d. Refrigeration Piping: Take special care to keep all refrigeration tubing clean and dry. If the use of non-sealed tubing is approved, clean the non-sealed tubing as follows:
   1) Wipe each tube internally with a dry, lintless cloth followed with a clean lintless cloth saturated with Freon-113. Repeat until the saturated cloth no longer becomes discolored by dirt.
   2) Wipe with a clean cloth saturated with compressor oil and squeezed dry.
   3) Wipe with a dry, lintless cloth.

3.16 ASBESTOS OR OTHER HAZARDOUS BEARING MATERIAL

A . If during the course of work, the Contractor observes the existence of asbestos, asbestos bearing material or other hazardous material, the Contractor shall immediately terminate further work and notify the Owner of the condition. The Owner will, after consultation with the Architect, determine a further course of action.

3.17 COOPERATION WITH OTHER TRADES

A . Contractor shall cooperate with and coordinate the work with that of all other trades in the performance of the work, including but not limited to: delivery of equipment and materials, furnishing material and location requirements of sleeves, bucks, chases, supports, mountings, backings, inserts, anchor bolts, cast-in-place box-out or steel embeds, routings, sequencing, locations, finished devices, etc., for proper installation of its work. Contractor shall be responsible for any and all removal, replacement or repairs to its work or the work of others for its failure to fully comply with this provision.

3.18 OPERATION AND INSTRUCTION

A . Upon completion of the work and prior to final acceptance, Contractor shall operate the equipment for a period as required to fully instruct the Owner and its authorized representatives in all details of operation, adjustment and maintenance. Absent more stringent requirements found elsewhere in the Contract Documents, Contractor shall, at a minimum:
   1. Schedule with Owner and its designated representatives a single time and location for a 1-day instruction class and submit three copies of certificate, signed by Owner's representatives, attesting to the Owner's authorized representatives having been so
instructed. All arrangements shall be made through Architect and Owner’s Representative.

2. Thoroughly review and instruct Owner and its designated representatives on all aspects of systems and facilities operations and maintenance utilizing the Instructions and Manuals submitted under the provisions of this Section. Any required instructions from manufacturer’s representatives shall be given during this period.

3. This requirement is in addition to any “Operation Test” specified in the Contract Documents.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

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 alternating-current power systems up to 480 V and installed at equipment manufacturer’s factory or shipped separately by equipment manufacturer for field installation.

1.3 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

1.4 REFERENCES

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers.

C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.


1.5 SUBMITTALS

A. See Section 013000 “Administrative Requirements”, for submittal procedures.

B. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

C. Manufacturer Seismic Qualification Certification: Submit certification that motors, accessories, and components will withstand seismic forces defined in Division 23 Section “Vibration and Seismic Control for HVAC Piping and Equipment. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in PART 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:
   a. Magnetic controllers.
   b. Multispeed controllers.
   c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers and suitable for use throughout speed range without overheating.

3. Matched to torque and horsepower requirements of the load.

4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

C. 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 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.
2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of and altitude of 3300-ft. above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.


F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading. Furnish lubrication instructions with the motors.

G. Temperature Rise: Class B

H. Insulation: Class F

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Motor Enclosures: Provide motor enclosures suitable for operating conditions encountered. Provide open dripproof frames for indoor and protected applications and in locations free of dust and moisture. Provide totally enclosed or encapsulated motors outdoors and in locations of adverse, non-explosive atmospheres. Provide explosionproof motors for installations in hazardous locations. Motors shall be designed for hazard encountered and bear UL labels listing class of service for which motors are protected. Provide terminal boxes of adequate size to accommodate required conduit, wire, and terminations. Terminal box shall have lugs sized in accordance with NFPA 70 and shall be threaded for conduit.

K. Lifting Lugs: Provide lifting lugs for motors larger than 25 HP.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Variable Frequency Controllers:
   1. Coordinate ratings, characteristics, and features with controller manufacturer.
   2. 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.
3. Provide maintenance free shaft grounding ring kits to protect motors and attached equipment from damaging shaft electrical currents at all motor speeds. Kits shall be furnished, and factory installed by the equipment supplier.

4. Premium-Efficient Motors: Class B temperature rise; Class F insulation.

5. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

6. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD-INSTALLED MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.

B. Install motors on concrete bases complying with Division 03.

C. Comply with mounting and anchoring requirements specified in Division 23 Section "Vibration and Seismic Control for HVAC".
3.3 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

A. Prepare for acceptance tests.
   1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer’s written instructions.
   2. Verify bearing lubrication.
   3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
   4. Test interlocks and control and safety features for proper operation.
   5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

B. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

D. Perform the following field tests and inspections and prepare test reports:
   1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on factory installed motors. 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.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pipe hangers and supports.
   2. Pipe stands.
   3. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

A. Product Data: For each type of product.
B. Welding certificates.
C. Shop Drawings: Submit signed and sealed drawings by a qualified professional engineer for approval by OSHPD. Provide scale drawings showing location and type of anchorage or support used keyed to the design details and mounting attachments to the structure. Show fabrication and installation details, calculations, and product data for the following:
   1. Trapeze pipe hangers.
   2. Metal framing systems.
   3. Pipe stands.
   4. Equipment supports.

1.5 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, Section IX.
PART 2 - PRODUCTS

2.1 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.

3. Design seismic-restraint hangers and supports for piping and equipment. Supports, restraints and hangers are required to be pre-approved by OSHPD. Copies of the pre-approval details with "OPA" designation numbers must be on the jobsite prior to installation.

2.2 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: Pre-galvanized, hot-dip galvanized, or electro-galvanized.


4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.


B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.


C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel or stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, 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.
2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
   2. Manufacturers:
      a. Unistrut Corp.
      b. Tyco International, Ltd.
      c. Tolco
      d. Cooper B-Line, Inc.
   4. Channels: Continuous slotted carbon-steel or stainless-steel channel with inturned lips.
   5. Channel Width: Selected for applicable load criteria.
   6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   8. Coating: Manufacturer’s standard finish.

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: ASTM C552, Type II calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C552, Type II calcium silicate.

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. Mechanical-Expansion Anchors: Insert-wedge-type anchors 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. Cooper B-Line, Inc.
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. MKT Fastening, LLC.
      e. Powers Fasteners.
   2. Indoor Applications: Zinc-coated or stainless steel.

2.7 PIPE STANDS

A. General Requirements: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Manufacturers:
   1. ERICO International Corporation
   2. MIRO Industries
   3. RPS

C. Compact Pipe Stand:
   1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Hardware: Galvanized steel or polycarbonate.

D. Low-Profile, Single Base, Single-Pipe Stand:
   1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Vertical Members: Two or more cadmium plated steel or stainless steel, continuous-thread rods.
   4. Horizontal Member: Adjustable horizontal, cadmium plated steel or stainless steel, pipe support channels.
   5. Pipe Supports: Roller.
   6. Hardware: Cadmium plated steel or stainless steel.
8. Height: 12-inches above roof.

E. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 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 or stainless-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for outdoor applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
6. 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.

7. 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.

8. 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.

9. 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.

10. 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.

11. 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 unnecessary.

12. 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.

K. 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.

L. 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. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. 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. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

4. C-Clamps (MSS Type 23): For structural shapes.
5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
10. 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:
    - Light (MSS Type 31): 750 lb.
    - Medium (MSS Type 32): 1500 lb.
    - Heavy (MSS Type 33): 3000 lb.
11. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

N. 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.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, provide spring hangers as specified in Section 230548.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. All pipe supports shall be OPA approved or submitted for OSHPD approval with calculations and drawings with a stamp or a licensed structural engineer in the state of California. Unless otherwise noted and except as specified in piping system sections, install pipes per details shown on drawings or as submitted or approved as OPA drawings from the manufacturer. Where OPA details do not exist, provide details for review by OSHPD which are based guidelines (MSS) referenced and compliance with Section 230548.

B. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
   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 A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation: Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


J. 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. 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.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. 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.

O. 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.

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 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.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/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.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2-inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0-mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

C. Relevant codes and trade standards include the following:
   1. ISO 23872 and BS 4675 - Mechanical Vibration for Rotating Machinery
   2. ANSI S2.19 - Mechanical Vibration - Balance Quality Requirements of Rigid Rotors
   3. ANSI S3.29 - Evaluation of Human Exposure to Vibration
   4. ANSI/AMCA Standard 204-96, - Balance Quality and Vibration Levels for Fans
   5. NEBB - Sound and Vibration in Environmental Systems
   6. NEBB - Procedural Standards for Measuring Sound and Vibration
   8. ARI Guideline G - Mechanical Balance of Fans and Blowers
   9. Local and National Building Codes, as applicable including Seismic/Wind, Site-specific, Restraint/Anchoring design parameters as stated in project structural drawings.

1.2 SUMMARY

A. Provide vibration control and seismic restraints for Division 23 work. Work in this section includes labor, material, tools, appliances and equipment necessary for a complete vibration isolation and seismic restraint installation as indicated on drawings and in compliance with the specifications of this section.

B. Furnish submittals including details, design calculations, schedules, shop drawings, certifications and sealed cover letter for vibration isolation and seismic restraint.

C. Isolate vibration-generating equipment from building structure by means of vibration isolators. Do not rigidly connect system components, such as piping and conduit, to vibration generating equipment unless these components are isolated through flexible connectors or vibration eliminating hangers.

D. Provide vibration isolators to isolate main piping and ducts within mechanical equipment rooms from building structure. Isolate additional length of pipes and ducts as specified herein and as noted on drawings.

E. Coordinate work to avoid rigid contact to components installed by other trades. Provide corrective work necessitated by conflicts due to incorrect installation.

F. Correct variance or non-compliance with the specifications at no additional cost.

G. Related Requirements:
1.3 DEFINITIONS


C. NRTL: Nationally Recognized Testing Laboratory

D. OSHPD: Office of Statewide Health Planning and Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
   1. Cover letter from Qualified Professional Engineer: Cover letter shall state that the Qualified Professional Engineer has reviewed seismic calculations, details, and shop drawings for compliance with the project seismic performance requirements and seismic design criteria.
   2. Seismic restraint calculations, details, and shop drawings, complying with Performance Requirements and project requirements, signed and sealed by a Qualified Professional Engineer.
   4. Product Data: Provide catalog cuts or data sheets on vibration isolators and specific restraints details in compliance with the specifications.
      a. Indicate application, style, material, strength, anchorage, and finish for each type and size device.
      b. Include load rating, deflection rating, and overload capacity for each device.
      c. For Interlocking Snubbers, include ratings for horizontal, vertical, and combined loads.
      d. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of an evaluation service member of ICC-ES, OSHPD, or an agency acceptable to Authorities Having Jurisdiction.
e. Seismic restraint devices shall be tested for horizontal and vertical loading and shall bear anchorage pre-approval OPA number from OSHPD, pre-approval by ICC-ES, or pre-approval by another agency acceptable to Authorities Having Jurisdiction, showing maximum seismic restraint ratings.

5. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic and wind forces required to select vibration isolators and seismic and wind restraints. Include calculations of combined tensile and shear loads. Coordinate with the drawings to determine the total height of the structure and the height of the equipment or system to be restrained within the structure. Coordinate design calculations with wind load calculations required for equipment mounted outdoors.

6. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to building structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

7. Seismic and Wind Restraint Details:
   a. Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

   b. Submit materials used for sway bracing. Indicate attachment of the sway bracing to the structure and to the braced component.

   c. Submit specific information relating to the type and size of anchorage (anchor bolts, etc.). Provide manufacturer’s certification that anchorage is suitable for dynamic seismic forces.

   d. Coordinate seismic restraint and vibration isolation details with wind restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

   e. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or OSHPD, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

8. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

9. Floor plan shop drawings: Indicate locations and types of all required vibration isolators, seismic anchorage, and seismic sway bracing, including locations of transverse and longitudinal sway bracing and rod stiffeners. For each location, reference specific details that indicate method of attachment to the building structure.

10. Welding certificates.

1.5 CONTRACTOR'S DELEGATED DESIGN RESPONSIBILITIES

   A. Obtain the services of a Qualified Professional Engineer to perform vibration and seismic design complying with the specified performance requirements.
B. Determine vibration isolation and seismic restraint sizes, quantity, type and locations. Coordinate design based on final equipment selection, and ductwork, piping and controls layout.

C. Prepare and submit shop drawings as specified in SHOP DRAWINGS AND SUBMITTAL REQUIREMENTS article above.

D. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic and wind forces required to select vibration isolators and seismic and wind restraints.

E. Details: Provide design details and analysis to support selection and arrangement of seismic and wind restraints. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors.

F. Determine anchor bolts or other type fasteners and their embedment into building structure or concrete housekeeping pad.

G. Coordinate with the Structural Engineer of Record attachments and anchorage to the building structure.

H. Furnish certification that the Qualified Professional Engineer has reviewed seismic calculations, details, and shop drawings for compliance with the project seismic performance requirements and seismic design criteria.

I. In addition to the components identified on the drawings and in the specifications to be seismically braced, provide seismic bracing in accordance with International Building Code Referenced Standard ASCE 7-05 13.2.3 Consequential Damage.

J. Inspect the installation of vibration and seismic control as specified in Part 3 of this specification section.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Authorities Having Jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Any device that provides seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, showing maximum seismic-restraint ratings. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. The Contractor shall be responsible for rebalancing, realigning, other remedial required actions, including replacement of any systems, that are found to produce noise and vibration exceeding manufacturer's and project's requirements.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Refer to structural drawings and specifications for site-specific, seismic and wind restraint and anchoring criteria. See Vibration Isolation Schedule on drawings.

B. Wind-Restraint Loading:
   1. Basic Wind Speed: 110 mph.
   2. Building Classification Category: II.
   3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

C. Seismic-Restraint Loading:
   1. Height: Determine the total height of the structure and the height of the equipment or system to be restrained within the structure by coordination with the Architectural Plans and the General Contractor.
   2. Site Classification as Defined in the IBC: D.
   3. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
   4. Component Importance Factor: 1.5
   5. Design Spectral Response Acceleration ($S_s$) at Short Periods (0.2 Second): 1.289
   6. Design Spectral Response Acceleration ($S_1$) at 1.0-Second Period: 0.498
   7. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

D. Vibration Limits: All equipment shall be statically and dynamically balanced to meet the following vibration limits under all design operating conditions and under support conditions comparable to the conditions specified in the equipment vibration isolation schedule.

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Vibration Limit Inches/Sec, RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fans – direct drive</td>
<td>0.025</td>
</tr>
<tr>
<td>All other rotating equipment</td>
<td>0.1</td>
</tr>
</tbody>
</table>

1. These vibration limits apply to the three orthogonal axes on the isolated equipment and for frequencies between 2 and 200 Hz, using an FFT frequency resolution of 1 Hz.

2.2 GENERAL REQUIREMENTS

A. Equipment shall bear manufacturer’s name, trademark, ASME, UL, and other labels where a standard has been established.

B. Equipment shall be latest approved design of standard cataloged items with factory-certified ratings.
C. Steel springs shall be of stable type, having horizontal stiffness at least equal to vertical stiffness. Shear stress at solid shall be sufficiently low that spring does not exceed its elastic limit and shall be certified by manufacturer for infinite cycle life classification.

D. Floor-mounted spring isolators shall be of housed or semi-housed type for seismic restraint or of unhoused type utilized with separate seismic snubbers. Limit stops shall be provided to limit excessive vertical motion of the supported equipment when the load is reduced or when subjected to torquing or external forces. Floor mounts may be of single or multi-spring type so designed to concentrate supported load at center of support. Floor-mounted isolators shall be equipped with ribbed neoprene pad bonded to underside of baseplate. Floor mounts shall be selected so that no more than 1 inch of adjustment is required to level equipment.

E. Hangers shall be of box type. Metal-to-metal contact between hanger rods and hanger box components shall be prevented through design of spring diameters and hanger box hole size, to permit hanger rod to swing through a 30 degree arc before contacting metal and short-circuiting spring. Box hangers shall be designed to withstand temporary loading equal to 400 percent of rated design load without visible deformation or failure.

F. Where isolator mounts for floor-mounted equipment are required to be attached to equipment, frames or bases, the mounts shall be attached in a manner to maintain operating clearance of 3/4 to 1-1/2 inch under equipment base or frame.

G. Spring isolators supporting a given piece of equipment shall be selected on basis of equal spring deflection. Therefore, spring isolators should compensate for unequal loading at various isolator locations. Equipment shall be level after operating load is applied.

H. Isolators for equipment to be installed outdoors shall be designed to provide adequate restraint to withstand wind loading of 30 psf applied in any direction without failure of isolator.

I. Support equipment, piping, and ductwork with vibration isolation to prevent transmission of vibration and mechanically transmitted sound. Select vibration isolators in accordance with the weight distribution of final equipment selection to produce uniform deflections.

J. Seismic/wind restraint devices shall be coordinated with vibration isolators and shall not inhibit the vibration performance and transmit undue noise and vibration into the building structure.

K. Provide vibration isolation and wind/seismic restraint devices by a single supplier.

2.3 ELASTOMERIC ISOLATION PADS – SPEC TYPE SW

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Mountings & Controls, Inc.
   d. Vibrex/M.W. Sausse.
   e. Vibro Acoustics.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area. Provide shims where necessary.

3. Size: Factory or field cut to match requirements of supported equipment.

4. Pad Material: Oil and water resistant with elastomeric properties.

5. Surface Pattern: Ribbed or Waffle pattern.

6. Infused nonwoven cotton or synthetic fibers.

7. Load-bearing metal plates adhered to pads with shims provided where required.

8. Sandwich-Core Material: Elastomeric infused nonwoven cotton or synthetic fibers.

9. If through bolts are used, provide shoulder washers to prevent short-circuiting.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS – SPEC TYPE BR

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Mountings & Controls, Inc.
   d. Vibrex/M.W. Sausse.
   e. Vibro Acoustics.

2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   a. Housing: Cast-ductile iron or welded steel.
   b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS – SPEC TYPE SLF

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Mountings & Controls, Inc.
   d. Vibrex/M.W. Sausse.
   e. Vibro Acoustics.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.


7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 RESTRAINED-SPRING ISOLATORS – SPEC TYPE SLR

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Mountings & Controls, Inc.
   d. Vibrex/M.W. Sausse.
   e. Vibro Acoustics.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Top plate with threaded mounting holes.
   c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

5. Minimum Additional Travel: 50 percent of the required deflection at rated load.


7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS – SPEC TYPE SSLFH

A. Freestanding, Housed Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Mountings & Controls, Inc.
   d. Vibrex/M.W. Sausse.
      e. Vibro Acoustics.

2. Housing: Ductile iron or steel providing all directional seismic snubbing.

3. Snubber: Adjustable vertically to allow maximum 1/4-inch travel in all directions before contacting the resilient snubber collars.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

5. Minimum Additional Travel: 50 percent of the required deflection at rated load.


7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 SPRING AND NEOPRENE HANGERS – SPEC TYPE RW30N

A. Combination Coil-Spring and Elastomeric-Insert Hanger:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Mountings & Controls, Inc.
   d. Vibrex/M.W. Sausse.
   e. Vibro Acoustics.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" (rebound washer) on lower threaded rod.

9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.9 PRE-COMPRESSED SPRING AND NEOPRENE HANGERS – SPEC TYPE PC30N

A. Combination Coil-Spring and Elastomeric-Insert Hanger:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Mountings & Controls, Inc.
d. Vibrex/M.W. Sausse.
e. Vibro Acoustics.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

8. Adjustable Vertical Stop: Steel pre-compression washer with neoprene washer "up-stop" (rebound washer) on lower threaded rod.

9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

10. Pre-compression: Locked at rated deflection by means of resilient seismic up-stop to keep piping or equipment at a fixed elevation during installation. Provide a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load.

2.10 SNUBBERS – SPEC TYPE Z

A. All directional seismic snubber:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kinetics Noise Control, Inc.
   2. Mason Industries, Inc.
   3. Vibration Mountings & Controls, Inc.
   5. Vibro Acoustics.

C. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.
2.11 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch thick neoprene.
   1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
   2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.12 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch thick neoprene.
   1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.13 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. B-line, an Eaton business.
   2. Hilti, Inc.
   3. Mason Industries, Inc.
   4. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.14 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kinetics Noise Control, Inc.
   2. Mason Industries, Inc.
   3. Vibration Mountings & Controls, Inc.
   5. Vibro Acoustics.

B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.
2.15 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. B-line, an Eaton business.
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.
   4. TOLCO.
   5. Vibration & Seismic Technologies, LLC.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.16 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. B-line, an Eaton business.
   2. Hilti, Inc.
   4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.17 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hilti, Inc.
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.
B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 INSTALLATION OF DUCTWORK VIBRATION ISOLATION

A. Connect ducts to rotating equipment with flexible duct connections.

B. Provide isolation hangers for all ductwork within a distance of 50 ft. from the connected equipment and all ductwork within mechanical equipment rooms. Provide seismic bracing for ductwork and terminal boxes in accordance with SMACNA Guidelines and code requirements.

3.4 INSTALLATION OF PIPING VIBRATION ISOLATORS

A. Connect pipes to vibration generating equipment with flexible pipe connectors.

B. For all piping described herein, provide resilient isolation from building structure. Provide floor-mounted supports with the same type of isolator or media as used for nearest isolated equipment connected to piping. Provide the hanger system with provision for piping to be held in place until connections are made and systems filled with water. Then release isolators to support weight. Provide springs supporting vertical risers with provisions for limit stops. In addition to the above, provide the following isolation:

1. Piping 2 Inch and Larger: Provide isolation hangers for the first 50 ft. of piping from connected equipment and all piping within mechanical equipment rooms. Provide hangers with the same minimum static deflection as specified for the isolation mounts of the connected equipment. Provide resilient neoprene pipe wrap at rigid pipe hangers.
2. Piping Smaller Than 2 Inch: Provide minimum 1/2 inch thick resilient neoprene pipe wrap around piping at each rigid pipe hanger.

3. Provide seismic bracing for piping in accordance with code requirements.

3.5 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 3.

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:
   1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Provided restraints for equipment per applicable code. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift. Restraint of equipment must not inhibit vibration isolation. Comply with requirements in MSS SP-127.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are
encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.6 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.7 INSPECTION OF VIBRATION AND SEISMIC CONTROL

A. Vibration and seismic restraint manufacturer or his representative shall examine the installation of mechanical equipment for the quality of work, missing supports or other defects that will adversely affect the vibration and seismic control systems. Examination shall include but not be limited to the following:

1. Examine the installation of equipment to be supported by vibration isolators, hangers, and any seismic restraints for missing supports and other defects.

2. Examine the installation of ceiling mounted equipment and devices to be supported by hanger wires for missing hanger wires, ceiling clips, supports and other defects.

3. Examine the installation of equipment/components support from building structure for quantity and type(s) of seismic restraints, and anchors and the flexible conduit connection.

4. Examine the installation of floor or pad-mounted equipment for correct quantity and type vibration isolators, seismic restraints, anchors and anchor bolts.

5. Examine the wall-mounted equipment for correct quantity and type seismic restraints and anchors.

6. Measure vibration isolator restraint clearance.

7. Measure vibration isolator deflection.

8. Verify snubber minimum clearances.

9. If a device fails test, modify installations of same type and retest until satisfactory results are achieved.
B. Provide a written report from the vibration and seismic restraint manufacturer or manufacturer’s representative indicating all unsatisfactory conditions to the Engineer.

C. Provide a final inspection by the vibration and seismic restraint manufacturer or manufacturer’s representative and submit written report to the Architect/Engineer certifying a correct installation, performance in compliance with approved submittal data.

D. If Owner or his representative reports objectionable noise or vibration, arrange for field instrumentation testing and measurements by independent acoustical consultant to determine source, cause, and path of disturbance. At no additional cost, correct non-compliance with these specification requirements to the extent that noise or vibration can be attributed to vibration isolators or this portion of the work. Remove and replace malfunctioning devices and retest as specified above.

3.8 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.9 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.
   3. Duct labels.
   4. Valve tags.
   5. Ceiling markers for concealed devices.
   6. Warning signs and labels.
   7. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 QUALITY ASSURANCE


B. Reduction of Lead in Drinking Water Act of 2011. This act redefines "lead free" as "not containing more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent lead when used with respect to wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures". Products required to be "lead free" shall have NSF 61-G or NSF 372 certification. Labels showing compliance shall be readily visible.

C. For renovation work, identification shall match existing scheme in all respects.
1.5 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 location 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 Thickness: stainless steel, 0.025-inch; aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Letter Color: Black
   3. Background Color: White
   4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2- by 3/4-inch.
   5. 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-quarters the size of principal lettering.
   7. 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, 1/16-inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black
   3. Background Color: 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-quarters the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Colors: Comply with ASME A13.1, unless otherwise indicated.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to fully cover circumference of pipe and to attach to pipe without fasteners or adhesive. Use for piping smaller than 6 inch diameter.

D. Strap On Pipe Markers: Preformed semi-rigid plastic formed to partially cover circumference of pipe. Attach to pipe with nylon ties that do not penetrate insulation vapor barrier. Use for piping 6 inch diameter and larger.

E. High Performance Pipe Markers: Pre-coiled semi-rigid PVF over laminated polyester to cover full circumference of pipe and to attach to pipe without adhesive. For piping 6 inch diameter and larger, provide nylon ties that do not penetrate insulation vapor barrier.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include 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: Size letters according to ASME A13.1 for piping.

2.3 DUCT LABELS

A. Duct Markers and Flow Arrows: Durable, self-adhesive vinyl of one consistent color for each system type. Include direction of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

B. Letter style block, 2 inches high minimum.


D. Airborne Infection Isolation Exhaust ductwork shall be labeled “Caution Airborne Infection Isolation Rooms Exhaust.”
2.4 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch; stainless steel, 0.025-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass 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.

2.5 CEILING MARKERS FOR CONCEALED DEVICES

A. Provide self-adhesive ceiling markers on ceiling grid runners in accessible ceilings and at access doors in inaccessible ceilings to indicate locations of concealed equipment, coils, fire dampers, valves, and control devices. Locate labels on the ceiling grid or in the corner of the panel closest to the concealed equipment.

B. Provide 1/2-inch or 3/4-inch diameter, color coded markers matching ANSI/ASME 13.1 standard colors or as otherwise directed by Owner to match facility standards.

C. Provide labeling for all concealed devices unless directed otherwise by the Owner or Architect/Engineer.

2.6 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch thick, and having predrilled holes for attachment hardware.

B. Colors: Conform to ANSI Z35.1.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2- by 3/4-inch.

E. 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-quarters the size of principal lettering.

F. Fasteners: Stainless-steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information plus emergency notification instructions.
2.7 WARNING TAGS

A. Description: 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. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: 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 and on both sides of 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.
   7. On piping above removable acoustical ceilings, omit intermediately spaced labels.
3.5 DUCT LABEL INSTALLATION

A. Install duct labels with permanent adhesive on air ducts in the following color codes:
   1. Blue: For supply ducts.
   2. Yellow: For exhaust and relief air ducts.
   4. Red: For Airborne Infection Isolation Room Exhaust

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.
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. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of air systems
2. Testing, Adjusting, and Balancing of equipment
3. Testing, Adjusting, and Balancing of existing systems and equipment
4. Sound tests
5. Vibration tests
6. Duct leakage tests
7. Indoor air quality measuring
8. Control system verification
9. HVAC equipment quantitative-performance settings
10. Reporting results of activities and procedures specified in this Section

1.3 DEFINITIONS


C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 INFORMATIONAL SUBMITTALS

A. Submit 4 copies, or electronic copy if agreement is reached with architect of record, of Qualification Data, Contract Documents Examination report, and Strategies and Procedures Plan. Submit 2 copies, or electronic copy if agreement is reached with architect of record, of all other submittals required.
B. Qualification Data: Prior to commencing work, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.


E. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

F. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

G. Certified TAB reports.

H. Sample report forms.

I. 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.

J. Warranties specified in this Section

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC or NEBB. TABB Certification is not acceptable.
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
   2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation." Project conditions and requirements, including system effects that can create undesired or unpredictable conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

E. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

F. TAB Report Forms: Use standard forms from AABC’s "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or TAB forms approved by MEOR.

G. Instrumentation Calibration: Calibrate instruments at least every six months or as frequently as required by instrument manufacturer. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

C. Balancing shall not begin until systems have been completed, pressure tested, and are in full working order. The systems shall be in full operation during balancing period. When project phasing results in partial Owner occupancy, perform test and balance procedures for occupied portions of the project as each phase is completed. When subsequent phases of work affect previously balanced portions of the project, re-balance those systems. Coordinate schedule of test and balance work with the Owner.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times. Coordinate schedule of test and balance work with the Owner.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. Provide an extended warranty period of 90 days during which time the Engineer may request a recheck or resetting of any air or water flow rate or pressure regulating valve. Provide assistance of the proper trades to assist Engineer in making any tests or adjustments.
PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 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 installed systems for 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 applicable for intended purpose, are accessible and are installed as required by Contract Documents or as needed to perform specified balancing.

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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. 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 verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine operating safety interlocks and controls on HVAC equipment.
M. 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.

3.2 DEFICIENCIES

A. Report deficiencies in the installation or performance of a system or component discovered before and during performance of Test and Balance procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

B. Retest the deficiencies after all work necessary to correct deficient items has been completed and verified by the affected Contractor.

C. Note all unresolved deficiencies in the final report.

3.3 JOB SITE INSPECTIONS

A. During construction, the Test and Balance Contractor shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other components of the HVAC SYSTEMS to determine if installation can be tested and balanced in compliance with these specifications or if equipment has been installed in a way that access for TAB functions are not possible. Conduct inspections a minimum of 3 times: when 60 percent of the duct work and piping are installed, when 90 percent of the total system is installed, and prior to insulation.

B. Submit a written report of each inspection to the Owner and the contractors responsible for correcting noted deficiencies.

C. Check for necessary balancing hardware (dampers, flow meters, valves, pressure taps, thermometer walls, etc.) to determine if they are installed properly and readily accessible.

D. Identify and evaluate any variations from system-design that will negatively affect system performance.

E. Identify and report possible restrictions in systems (closed fire dampers, long runs of flexible duct and any kinks in flea duct, poorly installed duct fittings, etc.) that could create negative affects to system performance.

3.4 PREPARATION

A. Prepare a TAB plan that includes the following:
   1. Equipment and systems to be tested.
   3. Instrumentation to be used.
   4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
   1. Airside:
a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers’ startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.5 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: 0 to plus 10 percent.
   2. Air Outlets and Inlets: 0 to minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.6 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing", and this Section.

B. Perform testing and balancing of existing systems to the extent that existing systems are affected by renovation work.

C. 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."

D. 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.

E. Take and report testing and balancing measurements in inch-pound (IP) units.
3.7 PRECONSTRUCTION TESTING AND BALANCING OF EXISTING SYSTEMS

A. Perform preconstruction testing of existing systems and equipment that is to remain and be reused.
   1. Measure and record the operating speed, airflow, and static pressure of each fan.
   2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   3. Check the refrigerant charge.
   4. Check the condition of filters.
   5. Check the condition of coils.
   6. Check the operation of the drain pan and condensate drain trap.
   7. Check bearings and other lubricated parts for proper lubrication.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
   1. New filters are installed.
   2. Coils are clean and fins combed.
   3. Drain pans are clean.
   4. Fans are clean.
   5. Bearings and other parts are properly lubricated.
   6. Deficiencies noted in the preconstruction report are corrected.

C. Measure airflow and static pressure at all mains and risers (supply, return, and exhaust) to which any duct system to be modified is connected. The purpose of this work is to establish a baseline for the performance of the existing system prior to any work being done.

D. Measure return flow at inlet to return duct systems for all inlets in areas open to the work area.

E. Verify the control sequence and document performance for each of the terminal units serving the work area. For each terminal unit perform the following steps.
   1. Verify actuators are functional.
   2. Measure and record total flow continuously as unit swings from full heating to full cooling.
   3. With the thermostat set for full heating, measure and document flow and inlet static pressure for each inlet to the units.
   4. With the thermostat set for full cooling, measure and document flow and inlet static pressure for each inlet to the units.
   5. With the thermostat set to space condition (thermostat satisfied), measure and document flow and inlet static pressure for each inlet to the units.
F. Measure and document exhaust device performance. Contractor shall take measurements of the flow and static pressure at each exhaust grille, exhaust hood, vented storage cabinet, and glove box in the work area.

3.8 GENERAL PROCEDURES FOR TESTING AND BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

3.9 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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

   b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses, close to the fan and prior to any outlets, to obtain total airflow.

   c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

   d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

   a. Measure static pressure directly at the fan outlet or through the flexible connection.

   b. Measure static pressure directly at the fan inlet or through the flexible connection.

   c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. 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.

4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

5. 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 occurs. 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.
   1. Measure airflow of submain and branch ducts.
   2. Adjust submain and branch duct volume dampers for specified airflow.
   3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
   1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   2. Measure inlets and outlets airflow.
   3. Adjust each inlet and outlet for specified airflow.
   4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.
   1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
   2. Re-measure and confirm that total airflow is within design.
   3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
   4. Mark all final settings.
   5. Test system in economizer mode. Verify proper operation and adjust if necessary.
   6. Measure and record all operating data.
   7. Record final fan-performance data.

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. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.11 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.12 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 5 locations as designated by the Architect.

B. Instrumentation:
   1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
   2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
   3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
   4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:
   1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
   2. Equipment should be operating at design values.
   3. Calibrate the sound-testing meter prior to taking measurements.
   4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
   5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC)) with the equipment off.
   6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
   7. Take readings no closer than 36-inches from a wall or from the operating equipment and approximately 60-inches from the floor, with the meter held or mounted on a tripod.
   8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.
D. Reporting:
   1. Report shall record the following:
      a. Location.
      b. System tested.
      c. dBA reading.
      d. Sound pressure level in each octave band with equipment on and off.
   2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.13 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 10.

B. Instrumentation:
   1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
   2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
   3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
   4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:
   1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
   2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
   3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
   4. Record CPM or rpm.
   5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:
   1. Report shall record location and the system tested.
   2. Include horizontal-vertical-axial measurements for tests.
   3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.14 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.15 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:
   1. Verify temperature control system is operating within the design limitations.
   2. Confirm that the sequences of operation are in compliance with Contract Documents.
   3. Verify that controllers are calibrated and function as intended.
   4. Verify that controller set points are as indicated.
   5. Verify the operation of lockout or interlock systems.
   6. Verify the operation of valve and damper actuators.
   7. Verify that controlled devices are properly installed and connected to correct controller.
   8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
   9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.16 PROGRESS 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 biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 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.

3. Certify validity and accuracy of field data.

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 specialist.
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. Duct, outlet, and inlet sizes.

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 airflow 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. Outdoor airflow in cfm.
g. Return airflow in cfm.
h. Outdoor-air damper position.
i. Return-air damper position.

F. 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.

G. 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 airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

3.18 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of commissioning authority.

B. Construction Managers 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.

C. 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."

D. 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.

E. If TAB work fails, proceed as follows:
   1. TAB specialists shall 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 specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

F. Prepare test and inspection reports.

3.19 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
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. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. This Section includes duct and plenum insulation, fire-rated insulation systems, adhesives, mastics, sealants, field applied jackets, tape, and securements.

1.3 DEFINITIONS

A. Conditioned Space: A cooled space, heated space, or indirectly conditioned space defined as follows:

1. Cooled Space: an enclosed space within a building that is cooled directly from a cooling system.

2. Heated Space: an enclosed space within a building that is heated directly from a heating system.

3. Indirectly Conditioned Space: An enclosed space within a building that is not a heated space or a cooled space but which is heated or cooled indirectly by being connected to adjacent spaces.

B. Unconditioned Space: An enclosed space within a building that is not a conditioned space. Crawlspace, attics, and parking garages with natural or mechanical ventilation are not considered enclosed spaces.

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. Submit an insulation schedule indicating insulation material, thickness and jacket type for each size range of each service.

C. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

2. Product Data: For coatings, indicating VOC content.

3. Product Data: For sealants, indicating VOC content.

1.5 QUALITY ASSURANCE

A. 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.

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

A. Comply with requirements in the insulation schedules at the end of this section for where insulating materials shall be applied.

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. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Provide 1.0 pcf density insulation with factory-laminated reinforced foil/kraft vapor retarder facing. Jacket permeance shall not exceed 0.02 perm using Procedure A of ASTM E 96. Comply with ASTM C 553, Type II and ASTM C 1290.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Manson Insulation Inc.
e. Owens Corning.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Provide 3.0 pcfdensity, semi-rigid, mineral-fiber board insulation with factory-applied foil reinforced kraft or all-service jacket vapor retarder facing. Jacket permeance shall not exceed 0.02 perm using Procedure A of ASTM E 96. Comply with ASTM C 612, Type IB.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. Knauf Insulation.
   d. Manson Insulation Inc.
   e. Owens Corning.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: Provide high-temperature insulation systems rated for a zero clearance around ductwork to combustible materials. Provide firestop sealants, tape, insulation pins, clips, banding, and other components in accordance with manufacturer’s instructions to maintain product listing and fire rating.

1. Fire-Rated Duct Wrap for Fume Exhaust Ducts: Provide single layer fire resistant wrap consisting of a bio-soluble ceramic fiber blanket encapsulated with a scrim-reinforced foil. Provide system UL listed and tested according to ISO 6944 “Fire Resistance Tests – Ventilation Ducts” for 2-hour fire resistive rating. Provide one of the following products:
   a. Fire Barrier Duct Wrap 615 by 3M
   b. Flameshield VAD Blanket by ETS Schaefer
   c. FireMaster FastWrap XL by Thermal Ceramics
   d. FyreWrap Elite 1.5 Duct Insulation – ADS System by Unifrax

2. Fire-Rated Blanket Duct Access Doors: Provide fire-rated duct access doors rated for use with fire-rated blanket complete with extension kit. Coordinate opening sizes and locations with Sections 233113 “Metal Ducts” and 233300 “Duct Accessories. Installed access assembly shall be rated no less than the fire resistive protection rating to that of fire-rated blanket. Provide extension kit to allow fire-rated blanket layers to mechanically fastened to cover plate for ease or removal and re-installation without the use of a tool. Label “ACCESS PANEL. DO NOT BLOCK” on exterior of access door assembly.

2.3 NOISE CONTROL COVERING

A. Sound Barrier: Provide a sound barrier composed of minimum 0.1 inch thick, mass-loaded, limp vinyl sheet bonded to a thin layer of reinforced aluminum foil on one side. The barrier
shall have a nominal density of 1.0 psf. The barrier shall have a rated service temperature range of -10 deg. F. to 180 deg. F. The barrier material shall have composite fire and smoke hazard ratings as tested by procedure ASTM E-84 not exceeding flame spread index of 25 and smoke developed index of 50.

B. Decoupling Layer: Provide a 1 inch thick, scrim-faced, quilted mineral-fiber batting.

C. Accessories: Provide adhesive tape and bands in accordance with manufacturer's installation instructions.

D. Sound Performance: Provide noise control covering with minimum STC rating of 28 when tested as a free-hanging barrier in accordance with ASTM E90.

E. Manufacturer: Provide Model KNM-100ALQ by Kinetics or Model B-10LAG/QFA-3 by Sound Seal.

2.4 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.


D. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.

2. Service Temperature Range: 0 to plus 180 deg F.


4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
2.7 SEALANTS
A. FSK and Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Sealant shall comply with the testing and product requirements of the California
      Department of Public Health's "Standard Method for the Testing and Evaluation of
      Volatile Organic Chemical Emissions from Indoor Sources Using Environmental
      Chambers."

2.8 FIELD-APPLIED JACKETS
A. Metal Jacket:
   1. Aluminum Jacket with lock seam: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or
      5005, Temper H-14.
   2. Factory cut and rolled to size.
   4. Thickness: Minimum 0.04-inch.
   5. Moisture Barrier for Outdoor Applications: 2.5-mil thick polysurlyn.

2.9 TAPES
A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic
   adhesive; complying with ASTM C 1136.
B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

2.10 SECUREMENTS
A. Bands:
   1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch
      thick, 3/4-inchwide with seal.

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for
      capacitor-discharge welding, length to suit depth of insulation indicated.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully
      annealed for capacitor-discharge welding, length to suit depth of insulation indicated
      with integral galvanized carbon-steel washer.
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to
      projecting spindle that is capable of holding insulation, of thickness indicated, securely
      in position indicated when self-locking washer is in place
   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. 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.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel, aluminum, or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2-inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2-inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.
G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch 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 2-inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4-inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,
install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2-inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2-inches.

4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2-inches.

1. Comply with requirements in Division 07 for penetration firestopping.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2-inches.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 for penetration firestopping.

3.5 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 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, 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 over-compress 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. 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-ft. 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. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6-inches o.c.

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 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 over-compress 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. 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-ft. 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. 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 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07.

D. Install fire-rated insulation system per the manufacturer’s written installation requirements to achieve the UL-Listed fire rating.

3.7 NOISE CONTROL COVERING INSTALLATION

A. Install noise control covering in accordance with manufacturer’s instructions and recommendations.

B. Ensure that the outer surface of the pipe or duct is clean and free of dust, dirt or similar foreign matter.

C. Cut and apply the insulation decoupling layer. Obtain a uniform thickness by butting all seams together; do not overlap joints. At elbows and other fittings, field measure and miter cut the insulation to fit. Temporarily fasten the insulation in place, but ensure that the insulation is not compressed by the fasteners.
D. Wrap the noise barrier around the insulation decoupling layer. Overlap each joint in the barrier with a minimum 2-inch wide strip of barrier material and adhere using adhesive.

E. Provide bands around the barrier on either side of all radial seams and at the midpoint of all barrier sections longer than 24 inches.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12-inches o.c. and at end joints.

3.9 FINISHES

A. Color: See Division 09 for painting requirements.

B. Do not field paint aluminum jackets.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Plenums and Ducts Requiring Insulation:
   1. Outside-air plenums and ducts.

C. Items Not Insulated:
   1. Metal ducts specified to be provided with duct liner.
   2. Factory-insulated flexible ducts.
   3. Factory-insulated plenums and casings.
   4. Flexible connectors.
   5. Vibration-control devices.
   6. Factory-insulated access panels and doors.

3.11 CONDITIONED SPACE DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air duct and plenum insulation shall be the following:
   3. Minimum Installed Insulation R-Value: 3.5.

B. Exposed, rectangular supply-air plenum and duct insulation shall be the following:
   1. Material: Mineral-Fiber Board.
   3. Minimum Installed Insulation R-Value: 3.5.

C. Exposed, round or flat-oval supply-air plenum and duct insulation shall be the following:
3. Minimum Installed Insulation R-Value: 3.5

D. Outside-air duct and plenum insulation shall be the following:
   1. Material: Mineral-Fiber Board.

E. Exhaust air plenum and duct between isolation damper and penetration of building exterior shall be the following:
   1. Material: Mineral-Fiber Board.

F. Laboratory Exhaust Duct between Level 2 floor slab penetration and roof penetration:

3.12 OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Rectangular supply and return-air plenum and duct insulation shall be the following:
   1. Material: Mineral-Fiber Board.
   2. Thickness: 2-inch.

B. Round supply and return-air plenum and duct insulation shall be the following:
   2. Thickness: 3-inch.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Condensate drain piping, indoors and outdoors.
   2. Refrigerant suction and hot-gas piping, indoors and outdoors.

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).

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 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.
1.6 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 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.

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. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Pittsburgh Corning Corporation.
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials. The maximum thermal conductivity shall be 0.25 Btu-in/hr-sq.ft.-deg. F at a mean temperature rating of 75 deg. F. Polyolefin insulation products are not acceptable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. K-Flex USA.

2. Use only factory pre-slit piping insulation with factory applied double seal system using an adhesive seam seal plus an adhesive lap seal across the longitudinal seam. Do not use unslit insulation with field cut longitudinal slit; unslit insulation is acceptable only in short sections where the insulation can be applied over the piping without a longitudinal slit.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Manson Insulation Inc.
   d. Owens Corning.

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, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.
e. Vimasco Corporation.

2. Adhesives shall have a VOC content of 50 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Foster Brand; H. B. Fuller Construction Products.

2. Adhesives shall have a VOC content of 50 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Flexible Elastomeric Adhesive: Comply with MILA-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. K-Flex USA.

2. Adhesives shall have a VOC content of 50 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Mineral-Fiber Adhesive: Comply with MILA-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.
2. Fiberglass adhesive shall have a VOC content of 80 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 Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.

2. Adhesives shall have a VOC content of 50 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

G. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MILA-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. Adhesive shall have a VOC content of 80 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 Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

H. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow Corning Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. P.I.C. Plastics, Inc.
   d. Speedline Corporation.

2. Adhesive shall have a VOC content of 80 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 Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MILPRF-19565C, Type II.
   1. VOC Content: 300 g/L or less.
   2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Knauf Insulation.
      d. Vimasco Corporation.
   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.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Eagle Bridges - Marathon Industries.
      c. Foster Brand; H. B. Fuller Construction Products.
      d. Mon-Eco Industries, Inc.
   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.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2.4 LAGGING ADHESIVES

A. Description: Comply with MILA-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Vimasco Corporation.

2. Adhesives shall have a VOC content of 50 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

5. Service Temperature Range: 0 to plus 180 deg F.


2.5 SEALANTS

A. Cellular-Glass, Phenolic, and Polyisocyanurate Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.
   e. Pittsburgh Corning Corporation.

B. Polystyrene Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.”

C. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.
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. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.”

D. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Childers Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.”
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: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. PVDC Jacket for Indoor Applications: 4-mil thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) ITW Insulation Systems; Illinois Tool Works, Inc.

3. PVDC Jacket for Outdoor Applications: 6-mil thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) ITW Insulation Systems; Illinois Tool Works, Inc.

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) ITW Insulation Systems; Illinois Tool Works, Inc.

5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Childers Brand; H. B. Fuller Construction Products.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Foster Brand; H. B. Fuller Construction Products.
b. Vimasco Corporation.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MILC-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. P.I.C. Plastics, Inc.
   c. Proto Corporation.
   d. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.


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.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. RPR Products, Inc.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper

d. Moisture Barrier for Outdoor Applications: 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.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
   a. Sheet and roll stock ready for shop or field sizing.
   b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      a) Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper
   c. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
   d. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pittsburgh Corning Corporation.
      b. Polyguard Products, Inc.
F. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Polyguard Products, Inc.

G. PVDC Jacket for Indoor Applications: 4-mil thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ITW Insulation Systems; Illinois Tool Works, Inc.

H. PVDC Jacket for Outdoor Applications: 6-mil thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ITW Insulation Systems; Illinois Tool Works, Inc.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ITW Insulation Systems; Illinois Tool Works, Inc.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   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. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   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.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Compac Corporation.
      c. Venture Tape.
   2. Width: 2-inches.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Venture Tape.

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.

**E. PVDC Tape for Indoor Applications:** White vapor-retarder PVDC tape with acrylic adhesive.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ITW Insulation Systems; Illinois Tool Works, Inc.

2. **Width:** 3-inches.

3. **Film Thickness:** 4-mils.

4. **Adhesive Thickness:** 1.5-mils.

5. **Elongation at Break:** 145 percent.

6. **Tensile Strength:** 55 lbf/inch in width.

**F. PVDC Tape for Outdoor Applications:** White vapor-retarder PVDC tape with acrylic adhesive.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ITW Insulation Systems; Illinois Tool Works, Inc.

2. **Width:** 3-inches.

3. **Film Thickness:** 6-mils.

4. **Adhesive Thickness:** 1.5-mils.

5. **Elongation at Break:** 145 percent.

6. **Tensile Strength:** 55 lbf/inch in width.

2.11 **SECUREMENTS**

**A. Bands:**

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. RPR Products, Inc.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015-inch thick, 1/2-inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 1/2-inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

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 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 2-inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2-inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2-inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
F. 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.

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 CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of 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 services, secure laps with outward-clinched staples at 6-inches o.c.

4. For insulation with factory-applied jackets on below-ambient services, 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 cut sections of cellular-glass block insulation of same thickness as pipe 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. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 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.

3.10 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3-inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of 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 services, secure laps with outward-clinched staples at 6-inches o.c.

4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, 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.

C. 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.

D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.11 INSTALLATION OF POLYISOCYANURATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
   2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
   3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of polyisocyanurate insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.12 INSTALLATION OF POLYSTYRENE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.

3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, and make thickness same as adjacent pipe insulation, not to exceed 1-1/2-inch.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed section of polystyrene insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.13 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. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
D. Where metal jackets are indicated, install with 2-inch 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.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2-inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2-inches or less. The 33-1/2-inch circumference limit allows for 2-inch overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.14 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."

i. 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. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.
C. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals

3.16 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.17 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:
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-inch thick.

B. Refrigerant Suction and Hot-Gas Piping:
   1. All Pipe Sizes: Insulation shall be one of the following:
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:
   1. All Pipe Sizes: Flexible Elastomeric: 1-inch thick.

3.18 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:
   1. All Pipe Sizes: Insulation shall be one of the following:
      b. Flexible Elastomeric: 2-inches thick.
      c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2-inches thick.
B. Refrigerant Suction and Hot-Gas Flexible Tubing:
   1. All Pipe Sizes: Flexible Elastomeric: 2-inches thick.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. The purpose of this section is to specify the Division 23 responsibilities and participation in the commissioning process. See Division 1, Section 019100, “Commissioning,” for Contractor-related commissioning requirements.

1. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from the Division 23 contractor for:
   a. Testing and start-up of the mechanical equipment.
   b. Completion and endorsement of pre-functional test checklists provided by the Commissioning Authority to assure that Division 23 equipment and systems are fully operational and ready for functional testing.
   c. Providing qualified personnel to assist the Commissioning Authority with functional testing to verify equipment/system performance.
   d. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
   e. Providing training for the systems specified in Division 23 with coordination of Owner by the Commissioning Authority.

B. Division 23 Contractor shall cooperate with the Commissioning Authority in the following manner:
   1. Allow sufficient time before final completion dates so that test and balance, controls point-to-point checkout, and functional testing can be accomplished.
   2. Provide labor and material to make corrections when required without undue delay.
   3. Put all heating, ventilating, and air conditioning systems and equipment into full operation, and continue the operation of the same during each working day of commissioning.

C. Related Sections
   1. Section 019100 - Commissioning
   2. Division 22 - Plumbing
   3. Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)
   4. Division 26 - Electrical

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Standard certified test equipment for commissioning will be provided by the Commissioning Authority.

B. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment,
demonstrate its use, and assist the Commissioning Authority in the commissioning process.

PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

A. Specific pre-commissioning responsibilities of Division 23 are as follows:
   1. Normal start-up services required to bring each system into a fully operational state. This includes motor rotational check, cleaning, filling, purging, control sequences of operation, leak testing, full-load and part-load performance, etc.
   2. Normal testing, adjusting and balancing services required to verify each system is operating at design capacities.
   3. Complete pre-functional test checklists for all equipment and systems to be commissioned.
   4. Demonstrate system readings as requested by the Commissioning Authority and adjust units to achieve specified operation.
   5. Factory start-up services for key equipment and systems specified in Division 23. The Division 23 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

3.2 PARTICIPATION IN COMMISSIONING

A. The Division 23 Contractor shall provide skilled technicians to start-up and debug all systems within the Division 23 work (particularly with controls equipment). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed upon schedules, and of sufficient duration to complete the necessary tests, adjustments and/or problem resolutions.

B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

C. Provide skilled technicians to manipulate the following equipment and systems to be commissioned for functional testing:
   1. Chilled water system
   2. Heating water system
   3. Air supply, exhaust, relief and ventilation system
   4. Terminal cooling and heating system
   5. Laboratory supply, exhaust and ventilation system
6. Heat recovery system
7. Radiant heating and cooling systems
8. Humidification system
9. Automated control systems

3.3 WORK TO RESOLVE DEFICIENCIES

A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet Acceptable Performance. Correction of work will be completed under the direction of the Architect, with input from the Contractor, Equipment Supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer-of-Record will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

3.4 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes with a fully occupied building. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required demonstrating performance.

B. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.5 TRAINING

A. The Division 23 Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each mechanical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems, including control components, wiring, and piping for equipment not directly controlled by the DDC system. Control system shall be an extension of the existing building automation system. The control systems shall be designed such that each mechanical system shall be capable of operating under stand-alone mode. System Software and firmware shall be updated to the latest version at project completion.

B. Electrical equipment, components and accessories shall be U.L. Listed and Labeled.

C. DDC system and components shall be BACnet Data Communications Protocol compliant. Controllers, devices, and components shall be listed by BACnet Testing Laboratories.

D. Emergency Power: DDC controller and components shall be furnished with emergency power if equipment controlled is circuited to emergency power. All equipment circuited to emergency power shall have integral battery capacity to operate for a minimum of 5 minutes without AC power to allow for transfer switch time delays between normal and alternate sources. Provide either an uninterruptable power supply (UPS) or battery powered equipment.

E. Unless otherwise indicated, the existing DDC system shall remain operational. Temporary services shall be provided as needed to maintain operations in occupied areas. Disruption in service shall be coordinated and approved by the Owner prior to execution of work.

1.2 SUBMITTALS

A. General: For general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

1. Product Data: Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions. Hardware: Include technical data for workstations, controllers, transducers/transmitters, sensors, actuators, and components.

2. Software: Include technical data for operating system software, operator interface, graphics, and other third party applications.

B. Shop Drawings (AutoCAD latest version) from manufacturer detailing equipment assemblies, indicating dimensions, weights, loadings, required clearances, and methods of field assembly, components, and location and size of each field connection. Include the following:

1. Schematic flow diagram for each system type showing fans, pumps, boilers, chillers, coils, dampers, valves, and control devices.

2. Each control device labeled with setting or adjustable range of control.

3. Diagrams for all required electrical wiring. Clearly differentiate between factory-installed and field-installed wiring. Label/tag all field installed wiring.

4. Details of control panel faces, including controls, instruments, and labeling.

5. Detailed written description of control sequence of operation.
6. Communication trunk cable schematic showing system architecture, workstations, DDC controller’s locations and trunk data conductors.

7. Listing of connected data points, including connected control unit and input device.

8. Sample of color system graphics diagrams indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

C. Schedules: Valve schedules identifying valve size, fail-safe position, flow, Cv, actual pressure drop and equipment served. Damper schedules identifying damper size, fail-safe position, pressure drop and equipment served.

D. Field Quality Control and Testing: Test Plans forms which will be used to verify operation of all points and control functions.

E. Certificates: Data Communication Protocol.

1.3 COORDINATION

A. Ensure installation of components is complementary to installation of similar components in other systems.

B. Coordinate installation of DDC system components, control wiring and piping requirements with installation of mechanical systems equipment.

C. Coordinate installation of components (dampers, valves, flow measurement, meters, etc.) provided under this section and to be installed by other sections.

D. Ensure each system is completed calibrated, tested and operational prior to commissioning. Coordinate and provide support for Pre-Functional and Functional Performance Testing.

E. Coordinate and support test/balance contractor for all balancing requirements.

F. Coordinate and provide compatible components with proper communication protocol for interface with equipment being furnished.

G. Where minor adjustments of the work are necessary for purposes of fabrication or installation of items, or resolution of conflicts between items within the intent of the Contract Documents, the Contractor shall make such adjustments with no added compensation. Where such adjustments affect functional or aesthetic design of the work, they shall first be submitted to the Architect/Engineer for review and approval.

1.4 OPERATION AND MAINTENANCE DATA

A. Maintenance data for control systems equipment to include in the operation and maintenance manual include the following:

1. Product data, maintenance instructions and spare parts list (including unit cost) for each type of control device provided by the project.

2. Interconnection wiring diagrams with identified and numbered system components and devices.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

B. Project Record Documents:
1. Accurately record actual location of control components, including panels, controllers, thermostats, and sensors.
2. Shop drawings reflecting actual installation and operating sequences.
3. Include data specified in "Submittals" in final form.
4. System software flow chart reflecting operating sequences.
5. Documented results of Field Quality Control and Testing Plan.
6. Certificate stating that control systems have been tested and adjusted for proper operation.
7. Software License Agreements

1.5 QUALITY ASSURANCE

A. Comply with the current edition of the following codes, regulations and standards or as indicated on drawings:
1. City, county, state and federal regulations and codes including amendments
4. Underwriters Laboratories UL 916 "Energy Management Equipment."
5. ANSI/ASHRAE Standard 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
6. BACnet Testing Laboratories (BTL): Devices and products utilized in the BACnet interface shall be BTL listed and label.

1.6 SERVICE AND GUARANTEE

A. After completion of the system, including software, submit a warranty in accordance with Division 01. Provide all services, materials and equipment necessary for the successful operation of the DDC hardware and controls during the warranty period. Preventive maintenance shall be included. Software and data shall be revised and updated as necessary during warranty period to maintain system performance.

B. During the warranty period provide a 24-hour emergency service number where a qualified automation service technician familiar with the installed system may be reached. This service technician shall have the capability of remotely communicating with the system for troubleshooting and program alterations.

C. Provide inspection for opposite season to test, calibrate, and adjust controls. Submit written report for each inspection.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Store equipment and materials inside and protected from weather.

B. Factory Mounted Controls: Where Factory-Mounted Controls are indicated to be factory mounted on equipment, arrange for shipping, packing and labeling of control devices to the equipment manufacturer. Installation requirements, wiring schematics shall be furnished and coordinated directly with respective unit manufacturer. Unless otherwise indicated, all cost associated with factory-mounted controls and wiring shall be included under this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Approved Manufacturers:
   a. Siemens

2. Technician Qualifications: Direct employee of manufacturer of primary control system with a minimum of 3 years of experience for systems programming, startup, troubleshooting and diagnostics.

3. Installer Qualifications: By the District Office of the manufacturer as a subcontract, or by a firm regularly engaged in the installation of building direct digital HVAC control systems for a period of not less than 5 years. The entire control system shall be installed by qualified electricians and mechanics, all of which are properly trained and qualified for the work they perform, and directly supervised by the local representative of the component manufacturer.

2.2 BASIC DDC SYSTEM

A. General: The Direct Digital Control (DDC) System shall be fully integrated and installed as a complete package of controls and instrumentation. The system shall include, but not limited to, all computer software and hardware, operator input/output devices, sensors and controls required for complete operation. Provide all wiring, installation, supervision and labor, including calibration, adjustments, operator training and checkout necessary for a complete and fully operating system.

B. Integrate this facility with existing Central Operator Workstation(s). Communication network shall be extended connected such that the Operator has access to all facilities via the same log in screen and will utilize the same program commands, control loop software programming languages, and graphics representation as with all other similar systems on the facility wide DDC system. Facility Central Operator Workstation(s) shall be upgraded to the latest software version and any additional software as specified herein will be included. Hardware shall be upgraded or replaced to support software operations. Gateways shall not be used to communicate with existing system without prior approval.

2.3 ADVANCED DDC PANELS

A. General: Advanced DDC panels shall be microprocessor based, multi-tasking, multi-user, real-time digital control processors. Modular in design and consisting of processor board with programmable memory, power supplies, and input/output (I/O) modules with manual
override. Advanced DDC panels shall be provided for each primary air system, primary heating and cooling system to perform independent, stand-alone system operations. Each Advanced DDC panel shall have sufficient memory to support its own operating system and databases including:

1. Control processes.
2. Energy Management Applications.
3. Alarm Management.
4. Historical/Trend Data for all points.
5. Maintenance Support Applications.
7. Operator I/O.
8. Dial-Up Communications.

B. Each Advanced DDC panel shall support the following types of point inputs and outputs (Each Digital and Analog Outputs shall be provided with manual override):

1. Digital Inputs for status/alarm contacts.
2. Digital Outputs for on/off equipment control.
3. Analog Inputs for temperature, pressure, humidity, flow, and position measurements.
4. Analog Outputs for valve and damper position control, and speed capacity control of primary equipment.
5. Pulse Inputs for pulsed contact monitoring.
6. Spare points: Provide a minimum of 3 spare points for each Input/Output point type (not including pulse inputs).

C. Each Advanced DDC panel communication trunk and software shall be configured to support project requirements, including but not limited to, variable volume terminal unit controllers, and other application specific controllers residing on network. Network shall have a minimum of 25-percent extra capacity of the installed system for future additions. Controllers shall consist of any combination of future application specific controllers and variable air volume terminal unit controllers. Advanced DDC panels shall be provided with at least two serial data communication port for operator I/O devices such as industry standard printers, portable operator’s terminals or portable lap-top computers. In lieu of above, one serial data communication port and a local operator access and display panel shall be provided.

D. Each Advanced DDC panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. The DDC panel shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each DDC panel, and shall not require the connection of an operator I/O device.

E. In the event of the loss of normal power, there shall be an orderly shutdown of all advanced DDC panels to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery back-up shall be provided to support the real-time clock and all RAM memory. Upon restoration of
normal power, the DDC panel shall automatically resume full operation without manual intervention. Should DDC panel memory be lost for any reason, the user shall have the capability of reloading the DDC panel via the local area network or via the local HMI port.

F. Provide NEMA enclosure rated for installed conditions. A local disconnect shall be provided at each controller to individually disconnect control power without interruption to any other controller.

2.4 APPLICATION SPECIFIC CONTROLLERS

A. Application Specific Controllers shall be fully programmable or pre-programmed to support, but not be limited to, the control of the following configurations of Unitary equipment to address current requirements as described in the sequence of operation, and for future expansion. Controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally stand-alone fashion. Application programs and parameter data shall be stored in nonvolatile memory:

1. Fan Coils and Air Conditioning Units.

B. The modes of operation supported by the Controllers shall include, but not be limited to, the following:

1. Day/Weekly Schedule.
2. Comfort/Occupancy Mode.
3. Economy Mode (Standby Mode, Unoccupied, etc.).
4. Temporary Override Mode.

C. The operator interface to any Application Specific controller point data or programs shall be through any network-resident PC workstation, any PC or portable operator's terminal connected to any DDC panel in the network, or through terminal jack at room temperature sensor.

D. Provide NEMA enclosure rated for installed location. A local disconnect shall be provided at each Application Specific controller to individually disconnect control power without interruption to any other digital controller.

2.5 APPLICATION SPECIFIC VARIABLE VOLUME TERMINAL UNIT CONTROLLERS (VAV)

A. VAV Terminal Unit Controllers be fully programmable or pre-programmed to support, but not be limited to, the control of the following configurations of terminal units to address current requirements as described in the sequence of operation, point schedule, and for future expansion. Application programs and parameter data shall be stored in nonvolatile memory.

B. VAV Terminal Unit Controllers shall support the following types of input and output points:

1. Proportional Cooling Output.
2. Proportional Heating Output.
3. Fan Control Output (On/Off Logic, or Proportional Series Fan Logic).
5. Velocity Sensor Input.
6. Auxiliary Temperature Input.
7. Override Push-button.

C. The operator interface to any VAV controller point data or programs shall be through any network-resident PC workstation, any PC or portable operator’s terminal connected to any DDC panel in the network, or through terminal jack at room temperature sensor.

D. Provide NEMA enclosure rated for plenum use. A local disconnect shall be provided at each VAV controller to individually disconnect control power without interruption to any other digital controller.

2.6 SURGE PROTECTION

A. Power Line Surge Protection Surge suppressers external to digital controller, shall be installed on all incoming AC power. Surge suppresser shall be rated by UL 1449 (latest edition or as indicated on drawings), and have clamping voltage ratings below the following levels:


2.7 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. UL Listed, Uninterruptible Power Supplies (UPS) for power interruptions and impulses. UPS shall be rated by the current UL 1778 or as indicated on drawings.

B. Rechargeable batteries with 15-30 minutes minimum back-up time. Complete with low battery and AC voltage status alarm indication via RS-232 or dry contact relay module.

2.8 WIRING

A. Wire: Single conductor control wiring above 24 V.

1. Wire size shall be at least No. 14 AWG.
2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be a minimum No. 18 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 600-V, rating and shall be Type TC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be a minimum No. 18 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.
3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 300-V, rating and shall be Type PLTC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.

7. Furnish wire on spools.

2.9 CONTROL COMPONENTS

A. Temperature Sensors:

1. Duct or pipe temperature sensors shall be platinum type 1000 ohm RTD's, factory calibrated within plus or minus 0.2 deg F.
2. Use duct insertion elements with length necessary to achieve tip at midpoint of duct cross section in ducts not affected by temperature stratification. Use averaging elements in duct prone to stratification with length at least the widest dimension of the duct cross section.
3. Insertion temperature elements for liquids shall be stainless steel encased 0.25-inch OD. and tightly matched with the thermowell dimensional tolerance.
4. Temperature thermowells shall be installed with a threaded, NPS 3/4 process and NPS 1/2 Sensor. Minimum insertion length as necessary to reach midpoint of pipe cross section. Furnish with heat-transfer compound to eliminate air gap between wall of sensor and thermowell and to reduce time constant.
5. Provide outside air temperature sensors with watertight inlet fitting, shielded from direct rays of sun. Sensor range selected to accommodate all local weather conditions.
6. Room Temperature Sensors: Analog or thermistor type complete with mounting bracket and cover. Each room temperature sensor shall be provided with an integral terminal jack for laptop or portable operators terminal interface and with the following:
   a. Blank Cover.
   b. LCD Display.
   c. Temperature Setpoint Adjustment.
   d. Override Timer Pushbutton.
7. Room sensors located in areas subjected to damage shall be provided with protective guard.
   a. 50 deg F Span: Room, chilled water, cooling coil discharge air, return air sensors.
   b. 100 deg F Span: Outside air, hot water, heating coil discharge air, mixed air sensors.
c. 200 deg F Span: High temperature hot water, heating hot water, chilled/hot water system sensors.

B. Differential Static Pressure Sensors/Transmitters: Integral pressure transducer and transmitter. Output of pressure instrument shall be 4-20 mA signal proportional to the pressure span. Accuracy shall be 1.0-percent, linearity shall be 0.1-percent. Supply voltage shall be 24 V. Unidirectional with range not exceeding 150-percent of maximum expected input. For Building pressure measurements, provide wall plate (Dwyer A-465 or equal) for indoor building pressure reference and equalizing plate (Dwyer Model A-420A or equal) for atmospheric reference.
1. -0.5 to 0.5 inches of water differential range: Static pressure of specific rooms.
2. 0 to 5 inches of water differential range: Duct static pressure.
3. -0.25 to 0.25 inches of water differential range: Building Static Pressure
4. 0 to 25 psi of water differential range: Heating Water and Chilled Water System differential pressure.

C. Dynamic Pressure Sensors/Transmitters:
1. UL Listed, bidirectional or unidirectional dynamic pressure and airflow measurement assembly. Complete with sensor, transmitter, enclosure, mounting kit and UL plenum rated cabling. Installed accuracy shall be 2-percent airflow (0-3000 cfm FPM), 4-percent dynamic pressure (+0.5 in w.g.) and repeatability shall be +0.25-percent of reading. Sensor assembly shall consist of hermetically sealed thermistors in weather-proof housing. Transmitter output shall be fused, isolated and linear (4-20 mA or 0-10 VDC). 12 bit A/D converter with 0.1-percent output resolution.
   a. Setra, Model 264
   b. Ebtron, Inc., Model STA102 series or approved equal.

D. Differential Pressure Switches:
1. Filter Status: Diaphragm operated which actuate a SPDT snap action switch, unless otherwise indicated. A field adjustable pressure set point with a range suitable for air flow status applications. The switch voltage and current rating shall be double the load requirements and have a three-screw termination configuration for field selectable normally-open or normally-closed operation. Provide threaded, NPS 1/8, high and low process connections for sensing tube connection.
   a. Manufacturer: Dwyer or approved equal.

2. Air System - Limit Differential Pressure Switch: Diaphragm operated which actuate a SPDT snap action switch, unless otherwise indicated. A field adjustable pressure set point with a range suitable for air flow status applications complete with set point latching circuit and external push-button switch for manual reset. The switch voltage and current rating shall be double the load requirements and have a three-screw termination configuration for field selectable normally-open or normally-closed operation. Provide threaded, NPS 1/8, high and low process connections for sensing tube connection.
   a. Manufacturer: Dwyer or approved equal.

3. Water System Differential Pressure Switch: Form-C contacts, automatic reset, screw-adjustable trip point, all components non-corrosive; wetted parts shall consist of a
Buna-N diaphragm with O-ring seal; complete with NEMA rated enclosure suitable for application. Select operating range to match function. Provide instrument gage valve for each input.

E. Binary Water Leak Detectors: When water is present at sensor probes, the relay releases and returns to a non-powered state. During a powered steady state condition, the contacts will change states and signal an alarm condition if:

1. A leak is detected.
2. An internal malfunction occurs.
3. Power is lost to the sensor.
4. Three types of sensors are common and used depending on locations:
   a. Wet floor and secondary pans, remote spot sensor probe typical in overflow pipes or at drains.
   b. Wide area protection such as Data Room ceilings and crawlspaces, water sensing cable.
5. Manufacturers:
   b. Honeywell.
   c. Siemens.
   d. Dorlen Products Inc.
   e. Building Automation Products Inc.
   f. Approved equal.

F. Level Transmitters: Shall be supplied as complete package with electronic unit, sensing element, connecting cable and any installation hardware required. Continuous level transmitter shall produce an output signal that is proportional to level. Measurement shall be free from effects of changes in temperature, density, or acoustic noise in vapor space above level. No moving parts and no routine cleaning and recalibration necessary. Provide factory calibration certificate. Signal output shall be 4 to 20mA range. Response time 0.5 – 30 seconds. Continuous local digital display of level. Transmitter material and accuracy shall be selected based on compatibility with application.

G. Indoor Motion Sensors: Wall or ceiling-mounted, solid-state units with a separate relay unit. Unless otherwise indicated, turn on when covered area is occupied and off when unoccupied; with a time delay for turning off, adjustable over a minimum range of 1 to 15 minutes. Shall have visual indication, to show when motion is being detected during testing and normal operation of the sensor. Sensor technology shall be selected in consideration of application and function and may consist of passive infrared and/or ultrasonic technologies.

H. Actuators: Actuators shall have ISO 9001 quality certification and shall be UL Listed. Provide for all motor-operated dampers, valves, and AHU fan flow control device of sufficient size and type, matched to application, rated for maximum operating (temperature/pressures) conditions.

1. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.
2. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

3. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

4. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

5. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

6. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

7. Provide mounting hardware and linkages for connecting actuator to damper.

8. Select actuators to fail in desired position in the event of a power failure.

9. Internal Positioner to stop automatically at end of travel. Complete with permanently lubricated gear train.

10. All actuators shall be provided with visual position indicator.

11. Substitution for 3-point floating type actuators suitable for pulse width modulation control in lieu of analog type actuators shall be permitted only for terminal units, Unit Heaters, Fan Coil Units, Cabinet Heaters, Finned Tube Radiation and Convectors. Use of non-analog type actuators for any other applications shall not be allowed without prior approval. Provide position feedback for actuators as indicated in "DDC Point List".

I. Control Damper Blade Position Indicator: Switch kit to sense open and closed position of damper blade or integrated actuator end switch/analog position feedback where applicable.

J. Control Valves: Valves shall have stainless steel stems and stuffing boxes with extended necks to clear the piping insulation. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Unless otherwise specified, bodies for valves 1-1/2-inches and smaller shall be brass or bronze, with threaded or union ends; bodies for 2-inch valves shall have threaded ends; and bodies for 2-inches to 3-inches shall be of brass, bronze or iron. Bodies for valves 2-1/2-inches and larger shall be provided with flanged-end connections. Valve Cv shall be within 100 to 125 percent of the calculated Cv. Valves shall provide effective control within pumping system total head pressure with a minimum of 100:1 turndown. Pressure drop not to exceed 5 psig at maximum flow rate for hydronic systems.

1. Two-Way Valves: Two-way modulating valves shall have equal-percentage characteristics. Two-way control valves shall be line size unless otherwise indicated.

2. Three-Way Valves: Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

3. Valves for Chilled-Water and Condenser-Water: Internal valve trim shall be bronze except that valve stems may be Type 316 stainless steel. Valves larger than 4-inches shall be butterfly.

4. Valves for Hot-Water Service Below 250 deg F: Internal trim (including seats, seat rings, modulating plugs, and springs) of valves controlling water hotter than 210 deg F shall be Type 316 stainless steel. Internal trim for valves controlling water 210 deg F or
less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature of 250 deg F or 50 deg F above the system design temperature, whichever is higher.

5. Solenoid Valves: Sized to close against system pressure with manual override capabilities. Body shall be brass or stainless steel.

K. Characterized Control Ball Valves 1/2-Inch to 2-Inches: Valves 1/2-inch through 2-inches shall be nickel plated forged brass body. NPT screw type with stainless steel ball, stem and Reinforced PTFE seats and seals. Flow type for modulating two-way valves shall be equal percentage. Three-way valves shall have equal percentage control port. The stem packing shall consist of two lubricated O-rings designed for on-off or modulating service requiring no maintenance.

L. Pressure Independent Flow Control Valves: Control valve shall be pressure independent modulating type configured to maintain a constant differential pressure across the control surfaces. Cast iron, steel or bronze rated for 150-psig minimum working pressures. Valve internal components shall be stainless steel, steel, Teflon, brass, or bronze. 0 to 100-percent design flow modulation with no more than +5 percent variation. Range-ability shall be 100:1 minimum. Valve flow characteristics shall be able to be changed without removing valve from piping system. Complete with Pressure/temperature ports to measure inlet/outlet/internal pressures and calibrated performance tag.

M. Control Panels: Panels shall be UL listed, NEMA type rated for application and location, surface or flush mounted panel as indicated with key locked door with continuous hinge and standard baked enamel finish.

N. Current Transmitters (split-core): Designed for three phase or single phase installations to convert monitored AC current to a proportional DC voltage of 0-10 Vdc, 4-20 mA output or connected to DDC Network. Transmitter shall be selected based on maximum primary current, voltage and size of conductor. Minimum 2,000 VAC internal isolation and 600 VAC case insulation. Accuracy +/-1-percent of full scale. Complete with LED indicator for normal and fault status. Repeatability plus or minus 2-percent of full scale. Response time 100 milliseconds. Each phase shall be monitored for Equipment Energy consumption (kWh) or demand (kW) metering. Split core only. Veris industries; Hawkeye or equivalent.

O. Current Sensing Relay (split-core): 100-percent solid state, with adjustable range (+/- 1-percent of range) trip set point to monitor AC current. Provide with contact transfer with no calibration drift, complete with LED status indicator. Split core only. Limit off-state leakage to 2 mA or less. Rating (200 ampere minimum) shall exceed equipment being monitored. Veris industries; Hawkeye or equivalent.

P. Control Relays: Relays shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays should be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.

Q. Low Limit Thermostats: DPDT, or SPDT, incremental bulb type; actuates if any 12-inch maximum increment is below its setting; adjustable setting, manual reset. Provide capillary element length of 2.14 equaling 2.14 square feet of coil area per foot capillary element. Upon activation, shall simultaneously shut down equipment and signal the DDC system.
R. Contactors: Single coil electrically operated. Contacts shall be double break silver to silver. Number of contacts and rating shall be selected for the application intended. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.

S. Transformers: Transformers shall conformance to UL 506. Class 2 current limiting type or over-current protection with manual reset. Connected load shall be limited to 75 percent of transformer rated capacity. Shall be installed in appropriate NEMA rated enclosure for application.

T. Nameplates: Laminated plastic 1/16-inch thick with neatly beveled edges and screwed to panel. Color shall be black with 0.375-inch white engraved block lettering unless otherwise specified.

2.10 VARIABLE FREQUENCY DRIVE INTERFACE

A. DDC manufacturer shall coordinate proper communications (BACnet, RS-485, Ethernet, ModBus) interface requirements for compatibility with DDC system. Provide all hardware, software and wiring required for DDC system interface.

2.11 FIRE ALARM SYSTEM INTERFACE

A. Fire Alarm System Interface: Fire alarm system and air handling equipment smoke detectors shall be provided under Division 26. Provide all hardware, software and wiring required for DDC system interface. Coordinate DDC requirements with Fire Alarm System Contractor.

2.12 LIGHTING SYSTEM INTERFACE

A. Lighting Control System Interface: Occupancy sensors shall be provided under Division 26. Provide all hardware, software and wiring required for DDC system interface. Coordinate DDC requirements with Electrical Contractor. Communication protocols for integration with lighting systems shall be compatible with site BAS. Shall be BACnet unless otherwise specified.

2.13 SECURITY SYSTEM INTERFACE

A. Security System Interface: Security system shall be provided under Division 26. Provide all hardware, software and wiring required for DDC system interface. Coordinate DDC requirements with Security System Contractor.

2.14 LABORATORY AIR VALVES/FUME HOOD CONTROL SYSTEM

A. Provide a laboratory control system to control the exhaust airflow out of laboratory rooms and supply up air to the laboratory rooms. Control the exhaust volume of a laboratory fume hood to maintain an average face velocity of 100 ft. per minute into the fume hood. The airflow at the fume hood shall not be varied below the scheduled minimum flow set point. Control the general exhaust volume and supply air volume to maintain the scheduled offset within the laboratory. Maintain the exhaust volume from point exhausts at a constant flow as scheduled.

B. Provide a Room Controller for Lab 194, Lab 2299, and Lab 2299A (3 total).

C. Provide a system complete with laboratory air valves, sash sensors, fume hood monitors, room controllers, and all startup and checkout to result in a fully operational system.
D. Laboratory airflow controls systems shall be fully compatible with the existing Siemens Building Automation System. Laboratory control systems shall interface with the Building Automation System at the laboratory room level. Laboratory control systems shall remain actively functional at the laboratory room level regardless of the Building Automation System status.

E. Air Valves:
   1. The air valves shall be of the Venturi valve control type.
   2. The valves shall be pressure independent over their scheduled range of static pressure drop. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifold system.
   3. Airflow accuracy shall be ±5 percent of signal over an airflow turndown range of no less than 10:1. No minimum entrance or exit duct diameters shall be required to ensure speed of response, accuracy, or pressure independence.
   4. Construction:
      a. General exhaust valve, point exhaust valve, and supply air valve assemblies shall be constructed of 16 gauge aluminum. The assembly’s shaft and shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of aluminum. The pressure independent springs shall be a spring grade stainless steel. All shaft bearing surfaces shall be made of a Teflon, polyester, or polyphenylene sulfide (PPS) composite.
      b. Hood exhaust valve assemblies shall have a baked-on corrosion resistant phenolic coating. The assembly’s shaft shall be 316 stainless steel with a Teflon coating. The pivot arm, shaft support brackets, and internal mounting link shall be made of 316 stainless steel. The pressure independent springs shall be a spring grade stainless steel. All shaft bearing surfaces shall be made of a Teflon, polyester, or polyphenylene sulfide (PPS) composite.
   5. Actuation: For variable-air-volume air valves, provide an electric actuator factory mounted to the valve. The air valves shall modulate based on a 0 to 10 volt electronic signal. The valve shall generate a 0 to 10 volt feedback signal that is linearly proportional to its airflow. Loss of power shall cause exhaust valves to fail open to the maximum scheduled design flow and supply valves to fail to the minimum scheduled design flow. Constant volume valves do not require actuators.
   6. Certification:
      a. Each air valve shall be factory calibrated to its scheduled airflows. Each electronic valve shall be further calibrated and its accuracy verified to ± 5 percent of signal at eight different airflows across the full operating range.
      b. All air valves shall be individually marked with valve specific, factory calibration data. As a minimum, the data should include valve tag number, serial number, model number, eight point valve characterization information, and quality control inspection numbers.

F. Sash Sensors: Provide both vertical sash sensors for all fume hoods. Provide a signal representing overall sash position to the Room Controller.

G. Fume Hood Monitors: Provide one fume hood monitor for each fume hood. The Room Controller shall receive the sash output signal and generate an exhaust airflow control signal
required to maintain constant face velocity. The fume hood monitor shall have both audible alarms and visual alarms and shall include a mute button. The monitor shall have continuous display of normal and alarm conditions by use of green and red LEDs.

H. Monitoring:

1. The laboratory control system shall generate electronic signals linearly proportional to all airflow sources, sash sensors, and flow alarms. The control system shall interface into the Siemens Building Automation System. The following signals (points) shall be available:
   a. Fume hood exhaust air flow
   b. Fume hood face velocity
   c. Fume hood sash position
   d. Fume hood exhaust low flow alarm
   e. Air valve low differential static pressure
   f. General exhaust air flow
   g. Supply air flow

I. Manufacturer: Subject to compliance with requirements, provide products by Siemens or Phoenix Controls Corporation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

B. Notify the Owner Representative in writing of conditions detrimental to the proper and timely completion of the work.

3.2 INSTALLATION (GENERAL)

A. Install in accordance with manufacturer's instructions.

B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to insure a complete operating system in accordance with the sequences of operation and point schedules.

3.3 LOCATION AND INSTALLATION OF COMPONENTS

A. Locate and install components for easy accessibility; in general, mount 60-inches (panels measured from top edge) above floor with minimum 3 ft-0 inch clear access space in front of units.

B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration and high temperature.
C. Identification: Provide permanently mounted tags to all instruments with point address designation, system reference and description. Label all wiring, tubing at each end to match control diagrams.

D. Control Panels:
   1. Provide for controls and instruments at equipment and in mechanical room.
   2. Install temperature gages and pilot lights flush on the cabinet door. Install controllers, switches, timers, transformers, and relays in the interior of the cabinet; mount on a steel or aluminum subpanel or on the back panel of the cabinet. Provide and label control parameters and test points within the panel for total evaluation of system operation. Electrical controls shall be wired to numbered screw type terminal strips.

E. Digital Controllers:
   1. Provide DDC controllers configured to control a single mechanical system such as an air handling unit, terminal unit, chilled water system, heating water system, etc., to operate a system in a complete standalone mode. DDC controllers shall be able to operate and control respective system upon loss of DDC system network communication.
   2. Provide digital control cabinets that protect digital controller electronics from dust, at locations shown on the drawings.
   3. Provide a disconnect power switch and surge protector for each digital controller.
   4. Provide cable management system, such as Panduit, inside control cabinets.

F. Temperature Sensors: Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application.
   1. Room Temperature Sensors: Provide on interior walls to sense average room temperature conditions. Avoid locations which may be covered by office furniture or subjected to sunlight. Room temperature sensors should not be mounted on exterior walls when other locations are available. Unless otherwise indicated, sensors intended for control by occupant, or areas served by displacement systems, center-line mounting height shall be 4 ft above finished floor to allow ADA accessibility. Sensors intended for use by service or maintenance personnel, center-line mounting height shall be at 5 ft above finished floor. Coordination with Architect and Architectural elevations supersedes this guidance.
   2. Duct Temperature Sensors:
      a. Select specific sensor location within duct to accurately sense appropriate air temperatures. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Install gaskets between the sensor housing and duct wall. Seal duct and insulation penetrations.
      b. Install duct averaging sensors, freeze protection sensors, between two rigid supports in a serpentine position to sense average conditions. Capillary element shall be installed with such affixing hardware as to prevent damage to the element and thermally isolate sensing elements from supports. Provide duct access doors to averaging sensors.
   3. Immersion Temperature Sensors: Provide thermowells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense
continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to effect proper flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of the pipe area. Increase piping size as required to avoid restriction. Provide thermowells with thermal transmission material within the well to speed the response of temperature measurement. Provide wells with sealing nuts to contain the thermal transmission material.

4. Outside Air Temperature Sensors: Provide outside air temperature sensor on north side of the building, away from exhaust hoods, air intakes and other areas that may affect temperature readings. Provide sunshields to protect outside air sensor from direct sunlight.

G. Damper Actuators: Actuators shall not be mounted directly in the air stream.

H. Pressure Sensors:

1. General: Install pressure sensing tips in locations to sense appropriate pressure conditions.

2. Duct Static Pressure Sensing: Unless otherwise indicated, locate duct static pressure tip approximately two-thirds of distance from supply fan to end of duct with the greatest pressure drop. Install in accessible and serviceable location.

3. Indoor Building Static Pressure Sensing: Unless otherwise indicated, install differential pressure transducer in accessible and serviceable location. Poly reference tubing to be routed from the differential pressure transducer to an appropriate sensing location for both indoor and outdoor atmospheric references. Selected reference locations to be field coordinated by the controls contractor and mechanical contractor with respect to any applicable equipment manufacturer recommendations, Owner requirements or architectural limitations. Coordinated location shall be indicated on the control shop drawings for review by the Engineer.


5. Steam Pressure Sensing: Install snubbers and isolation valves on steam pressure sensing applications. Install in accessible and serviceable location.

I. Flow Measurement: Install and locate per manufacturer’s instructions.

J. Water Metering: Install and locate per manufacturer’s instructions.

K. Variable Pumping Application: Differential pressure sensor/transmitter shall be hard-wired directly to respective pumping system DDC controller. Utilization of network for data transfer will not be allowed. Unless otherwise indicated, locate hydronic differential pressure sensor/transmitter at the furthest distance from pumping discharge. Install in accessible and serviceable location.

3.4 POWER, CONTROL WIRING, AND CONDUIT

A. All control wiring, all conduit for control wiring, and all miscellaneous accessory equipment for control wiring systems shall be provided by the Control Subcontractor as part of the control system. Conform to Division 26, 27 requirements, NFPA 70, and all local code requirements.
B. All wiring in or through mechanical, electrical rooms, finished spaces, on roofs, in walls, below grade and inside equipment (except within control wiring compartments or control panels) shall be installed in conduit and properly supported. Conduit, raceway, and junction boxes installed or re-used for controls shall be clearly identified by some obvious means as uniquely belonging to the Building Automation System. This identification means can be as simple as the consistent use of a color swath or sticker on conduit ends, or colored conduit.

C. Each I/O cable must be labeled with a modern labeling system at each cable end within 12-inch of termination. Label locations shall be selected to be readily visible without the need to move wires or other objects. Labels shall be made for permanent attachment and readability; Letters and numbers shall not be handwritten.

D. DDC System Power: 120 VAC power provisions for the DDC system shall be provided by Division 26 to the locations indicated. If additional locations for 120 VAC power are required, either extend power from indicated locations, or provide power from nearest electrical panel with available capacity. Provide additional circuit breakers (20 amp maximum) same as installed breakers and label for service. Spare circuit breakers shall not be used unless approved by the Electrical Engineer. Power source shall be same as power source (normal or emergency power) serving equipment being controlled. Power provisions (wiring, installation, and materials) for all components furnished under this section shall be included. Coordinate all work with Electrical Contractor.

E. Plenum Cable: Plenum cable type, installation methods and use shall be subject to City and State Codes and Regulations. Within ceiling space, attach directly to wall or slab on 4-ft centers, or support from ceiling suspension wires on 4-ft centers. Do not attach cables to pipes or ducts, or lay on ceilings. Cables shall be routed as high as possible without interference to equipment, ceiling, lighting access and removal.

F. Instrumentation and communication cable shall not be run together in the same conduit or raceway as power wiring.

G. Provide surge and transient protection consisting of devices installed externally to digital controllers and operator workstations.

H. Communication Cable: Provide all communication wiring between operator workstation and Advanced DDC panels, between Advanced DDC panels and application specific controllers and VAV digital controllers. All communication cable shall be checked for continuity, grounding, and shielding. Local area network communication wiring between operator workstations and Advanced DDC panels shall be in conduit.

I. Network Communications: Coordinate with Owner for Internet, Ethernet availability, connection regulations and restrictions.

J. Grounding: Ground controllers and cabinets to a good earth ground. Grounding of the green AC ground wire, at the breaker panel, alone is not adequate. Run metal conduit from controller panels to adequate building grounds. Ground sensor shields drain wire at controller end. All associated ground loop problems shall be corrected.

K. Provide interface control wiring for equipment with remote sensors, panels, limits, and components, etc., furnished (shipped loose) by the manufacturer and to be field installed. Materials, wiring and termination shall be provided and installed in accordance with manufacturer's instruction, including, but not limited to the following:
1. Indoor/Outdoor Split Unit: Temperature, humidity controllers and Evaporation/condenser sections.

2. AC Unit: Temperature, humidity controllers and control panels.

L. On devices furnished with a local Hand-Off-Auto (H-O-A) switch, wire control circuit so that the H-O-A switch will override the DDC signal unless H-O-A is indexed to the “Auto” position.

3.5 DDC POINT SUMMARY

A. Provide all Database generation.

B. Dynamic Color Display: Provide all dynamic graphic displays at each operator workstation. System graphical displays shall be color-coded. Include outside air temperature indication on each primary air and water systems displays. As a minimum, the following shall be provided:

1. Site Plan: Overall site plan, including all associated buildings.

2. Building Floor Plan: Each floor plan graphic shall contain all graphical displays, equipment with area served, and locations associated with that building floor plan.

3. Detailed Dynamic Color and data system graphics shall be provided for each piece of mechanical equipment including, but not limited to, air and water systems. Provide equipment run status, totalization, alarms, and analog variables for each system.

4. Details, colors, and graphics shall be approved by the Owner prior to generation.

5. All setpoints used for control and tuning shall be displayed and adjustable through the graphical user interface.

C. Runtime Totalization: At a minimum, runtime totalization shall be incorporated, but not limited to, each monitored equipment, fans, and pumps. Warning limits for each point shall be entered with Owner defined messages.

D. Trend Log: Each input/output points shall be trended. Historical archiving of Owner-selected points shall be provided at the operator workstation with the capability of transfer to graphic format representation.

E. Alarm Points: All analog inputs (High/Warning/Low Limits) and selected digital inputs alarm points shall be prioritized, printed, or routed, with alarm message per Owner’s requirements. Loss of communication network shall also initiate an alarm. Provide all software timers necessary to prevent false alarms. Unless indicated otherwise, for non-critical applications, initial alarm setup parameters shall be +/- 5 percent deviation from set point for a time duration exceeding 5 minutes. For critical application such as life safety monitoring or equipment failure, initial alarm setup parameters shall be zero deviation without any time delay.

F. Heavy Equipment Delays and Power Fail Restart Software: Each advanced DDC panel shall be provided with heavy equipment and power fail restart application software. Each advanced DDC panel shall start respective equipment in sequence and shall be time based and not dependent on prior system start-up.

G. Database Save: Provide back-up database for all advanced DDC panels at the operator workstation computer hard disk. Provide additional back-up database for each Advanced DDC panel on Compact Disc (CD).
3.6 FIELD QUALITY CONTROL AND TESTING

A. Demonstrate compliance of the HVAC control system with the contract documents. Calibrate instrumentation and controls and verify the specified accuracy using calibrated test equipment. Adjust controls and equipment to maintain conditions indicated, to perform functions indicated, and to operate in the sequence specified. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that tests are performed by competent employees of the DDC system installer or the DDC system manufacturer regularly employed in the testing and calibration of DDC systems. Calibrate field equipment and verify equipment and system operation before placing the system on-line. Field-testing will be witnessed by the Owner, Owner’s representative or Commissioning Agent and shall include the following:

1. System Inspection: Observe the HVAC system in its shutdown condition. Provide end-to-end wiring checkout. Check dampers and valves for proper normal positions. Document each position for the test report.

2. Calibration Accuracy and Operation of Inputs Test: Check for proper calibration and operation of each input instrument. For each sensor (temperature), record the reading at the sensor, and using traceable test equipment, and record the reading at the digital controller. Document each reading for the test report.

3. Operation of Outputs Test: Check the operation of each output to verify correct operation. Command analog outputs to minimum range, such as 4mA, and maximum range, such as 20mA, measure and record commanded and actual output values. Document each command and result for the test report.

4. Actuator Range Adjustment Test: With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.

5. Digital Controller Start-up and Memory Test: Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a power failure.

6. Surge Protection: Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on communication lines.

7. Application Software Operation Test: Test compliance of the application for:
   a. Ability to communicate with the digital controllers, uploading and downloading of programs
   b. Text editing program: Demonstrate the ability to edit the control program off line
   c. Reporting of alarm conditions: Cause alarm conditions for each alarm, and ensure that workstation receives alarms
   d. Reporting trend and status reports: Demonstrate ability of software to receive and save trend and status reports
   e. Execution of Sequence of Operation: Furnish graphic trends to show the sequence of operation is executed in correct order. Demonstrate the HVAC system operates properly through the complete sequence of operation, for example seasonal, optimal start/warm-up, and occupied/unoccupied modes of operation. Demonstrate proper control system response for abnormal conditions for which there is a specified response by simulating these conditions. Demonstrate hardware
interlocks and safeties work. Demonstrate the control system performs the correct sequence of control after a loss of power.

f. Control Loop Stability and Accuracy: Furnish graphic trends of control loops to demonstrate the control loop is stable and that set point is maintained. Graphical trends of control looses shall demonstrate the following minimum characteristics:

1) Peak Overshoot: Following a setpoint change, loop response shall achieve 10 percent or less overshoot as a ratio of magnitude of the first overshoot above/below setpoint to the magnitude of the setpoint change itself.

2) Decay Ratio: Following a setpoint change or process disturbance, loop response shall produce a “Quarter-Wave Decay” such that each oscillatory peak deviation from setpoint should be only 1/4 of the previous peak deviation on the same side of setpoint.

3) Settling Time: The time following a setpoint change or process disturbance, that it takes for the oscillation to become so small that the deviation does not exceed the specified amount shall not exceed 4 times the amount time necessary for the process variable to achieve setpoint.

g. Opposite Season Test: Testing shall be repeated for opposite season.

B. Document all tests with detailed results. Provide statement that all corrective action taken. Include test report in Operation and Maintenance Manuals.

C. The contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

3.7 TRAINING

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner’s maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.

2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.

3. Minimum Training Requirements:

a. Provide not less than 40 hours of training total.

b. Stagger training over multiple training classes to accommodate Owner’s requirements. All training shall occur before end of warranty period.

C. Training Schedule:

1. Schedule training with Owner 20 business days before expected Substantial Completion.

2. Schedule training to provide Owner with at least 10 business days of notice in advance of training.
3. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:
1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Training Attendee Headcount:
1. Plan in advance of training for five attendees.
2. Make allowance for Owner to add up to two attendee(s) at time of training.
3. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.

F. Training Attendee Prior Knowledge: For guidance in planning required training and instruction, assume attendees have the following:
1. Basic user knowledge of computers and office applications.
2. Intermediate knowledge of HVAC systems.
3. Basic knowledge of DDC system and products installed.

G. Attendee Training Manuals: Provide each attendee with a color hard copy of all training materials and visual presentations.

H. Instructor Requirements:
1. One or multiple qualified instructors, as required, to provide training.
2. Instructors shall have not less than three years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

I. Organization of Training Sessions:
1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:
   a. Daily operators.
   b. Advanced operators.
c. System managers and administrators.

2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

J. Training Outline:
1. Submit training outline for Owner review at least 10 business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

K. On-Site Training:
1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

L. Off-Site Training:
1. Provide conditioned training rooms and workspace with ample tables desks or tables, chairs, power and data connectivity for each attendee.
2. Provide capability to remotely access to Project DDC system for use in training.
3. Provide a workstation for use by each attendee.

M. Training Content for Daily Operators:
1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control
drawings.

11. Understanding physical location and placement of DDC controllers and I/O hardware.

12. Accessing data from DDC controllers.


14. Running each specified report and log.

15. Stepping through graphics penetration tree, displaying all graphics, demonstrating
dynamic updating, and direct access to graphics.

16. Executing digital and analog commands in graphic mode.

17. Demonstrating DDC system performance through trend logs and command tracing.

18. Demonstrating scan, update, and alarm responsiveness.

19. Demonstrating multitasking by showing dynamic curve plot, and graphic construction
operating simultaneously via split screen.

20. Demonstrating the following for HVAC systems and equipment controlled by DDC
system:
   a. Operation of HVAC equipment in normal-off, -on and failed conditions while
      observing individual equipment, dampers and valves for correct position under
      each condition.
   b. For HVAC equipment with factory-installed software, show that integration into
      DDC system is able to communicate with DDC controllers or gateways, as
      applicable.
   c. Hardware interlocks and safeties function properly and DDC system performs
      correct sequence of operation after electrical power interruption and resumption
      after power is restored.
   d. Reporting of alarm conditions for each alarm, and confirm that alarms are received
      at assigned locations, including operator workstations.
   e. Each control loop responds to set point adjustment and stabilizes within time period
      indicated.
   f. Sharing of previously graphed trends of all control loops to demonstrate that each
      control loop is stable and set points are being maintained.

N. Training Content for Advanced Operators:
   1. Making and changing workstation graphics.
   2. Creating, deleting and modifying alarms including annunciation and routing.
   3. Creating, deleting and modifying point trend logs including graphing and printing on an
      ad-hoc basis and operator-defined time intervals.
   4. Creating, deleting and modifying reports.
   5. Creating, deleting and modifying points.
   6. Creating, deleting and modifying programming including ability to edit control programs
      off-line.
   7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.
12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
15. Adjusting, calibrating and replacing DDC system components.

O. Training Content for System Managers and Administrators:
1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

P. Video of Training Sessions:
1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

PART 4 - SEQUENCE OF OPERATION
A. Refer to Sheet M6.01.
B. Controls shall be by the DDC system unless indicated to be by local controls.
C. DDC system shall schedule each system or zone independently per Owner’s operating schedule. Operating schedules shall be confirmed with Owner and adjusted as necessary.
D. Provide all control points necessary to execute the sequence of operations.
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. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. Section Includes:
   1. Refrigerant pipes and fittings.
   2. Refrigerant piping valves and specialties.
   3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
   1. Include pressure drop, based on manufacturer's test data, for the following:
      a. Thermostatic expansion valves.
      b. Solenoid valves.
      c. Hot-gas bypass valves.
      d. Filter dryers.
      e. Strainers.
      f. Pressure-regulating valves.

B. Shop Drawings:
   1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
   2. Show interface and spatial relationships between piping and equipment.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.
1.6 QUALITY ASSURANCE
   A. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
   D. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.7 PRODUCT STORAGE AND HANDLING
   A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

1.8 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. Refrigeration Oil Test Kits: Two > each, containing everything required to conduct one test.
      2. Refrigerant: Two containers each, with 20 lb. of refrigerant.
      3. Filter-Dryer Cartridges: Three of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Line Test Pressure for Refrigerant R-410A:

2.2 COPPER TUBE AND FITTINGS
   A. Copper Tube: ASTM B 88, Type K or L.
   B. Wrought-Copper Fittings: ASME B16.22.
   C. Wrought-Copper Unions: ASME B16.22.
   D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
   E. Brazing Filler Metals: AWS A5.8/A5.8M.
   F. Flexible Connectors:
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch long assembly.
5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines, NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

B. Install isolation valves at each floor, phase or zone of the project to allow for partial system startup of the refrigerant system.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Install a full-size, three-valve bypass around filter dryers.

E. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

F. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

G. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
H. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

I. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.

J. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

K. Install receivers sized to accommodate pump-down charge.

L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
   1. Shot blast the interior of piping.
   2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
   3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
   4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
   5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
   6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

S. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

T. 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."

U. 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."
3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA’s "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel 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 to 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. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.


I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20-ft long.
   2. Roller hangers and spring hangers for individual horizontal runs 20-ft or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20-ft or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C . Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
   1. NPS 1/2: Maximum span, 60-inches; minimum rod, 1/4-inch.
   2. NPS 5/8: Maximum span, 60-inches; minimum rod, 1/4-inch.
   3. NPS 1: Maximum span, 72-inches; minimum rod, 1/4-inch.

D . Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A . Perform the following tests and inspections:
   1. Comply with ASME B31.5, Chapter VI.
   2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
      a. Fill system with nitrogen to the required test pressure.
      b. System shall maintain test pressure at the manifold gage throughout duration of test.
      c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
      d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B . Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A . Charge system using the following procedures:
   1. Install core in filter dryers after leak test but before evacuation.
   2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
   3. Break vacuum with refrigerant gas, allowing pressure to build up to 2-psig.
   4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A . Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B . Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
   1. Open shutoff valves in condenser water circuit.
   2. Verify that compressor oil level is correct.
   3. Open compressor suction and discharge valves.
   4. Open refrigerant valves except bypass valves that are used for other purposes.
   5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION
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 DEFINITIONS

A. CE: Conformite Eropueene (European Compliance).
B. CPT: Control power transformer.
C. DDC: Direct digital control.
D. EMI: Electromagnetic interference.
E. LED: Light-emitting diode.
F. NC: Normally closed.
G. NO: Normally open.
H. OCPD: Overcurrent protective device.
I. PID: Control action, proportional plus integral plus derivative.
J. RFI: Radio-frequency interference.
K. VFD: Variable-frequency motor controller.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFD indicated.
   1. Include dimensions and finishes for VFDs.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Shop Drawings: For each VFD indicated.
   1. Include mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for each VFD, accessories, and components, from manufacturer.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For VFDs to include in operation and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING
A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers.

1.7 WARRANTY
A. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Provide products by ABB, Danfoss, Eaton, or Siemens.

2.2 SYSTEM DESCRIPTION
A. General Requirements for VFDs:
1. VFDs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Provide VFDs specifically designed for controlling HVAC equipment.

2. Comply with NEMA ICS 7.

B. VFD Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

C. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

D. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

E. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFD input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
8. Speed Regulation: Plus or minus 5 percent.

F. Inverter Logic: Microprocessor based, isolated from all power circuits.

G. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.

H. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 0.1 to 999.9 seconds.
   4. Deceleration: 0.1 to 999.9 seconds.
   5. Current Limit: 30 to minimum of 150 percent of maximum rating.

I. Self-Protection and Reliability Features:
   1. Surge Suppression: Factory installed as an integral part of the VFD, complying with UL 1449 SPD, Type 1 or Type 2.
   2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
   4. Inverter overcurrent trips.
   5. VFD and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
   6. Critical frequency rejection, with three selectable, adjustable deadbands.
   7. Instantaneous line-to-line and line-to-ground overcurrent trips.
   10. Short-circuit protection.

J. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
K. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

L. Integral Input Disconnecting Means and OCPD: Provide disconnect with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of VFD input current rating.
2. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.

2.3 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.

B. Panel-Mounted Operator Station: Manufacturer’s standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
   a. Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.

C. Indicating Devices: Digital display, mounted flush in VFD door and connected to display VFD parameters including, but not limited to:
1. Output frequency (Hz).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).
D. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFD settings shall be retained within VFD’s nonvolatile memory.

1. Hardwired Points:
   b. Control: On-off operation.

2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.4 ENCLOSURES

A. VFD Enclosures: NEMA 250, to comply with environmental conditions at installed location.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 72 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Inspect VFD, wiring, components, connections, and equipment installation.
   2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
   3. Test continuity of each circuit.
   4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. VFDs will be considered defective if they do not pass tests and inspections.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round and flat-oval ducts and fittings.
   4. Duct liner.
   5. Sealant and gaskets.
   6. Hangers and supports.
   7. Seismic-restraint devices.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible” and performance requirements and design criteria indicated in “Duct Schedule” Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's “HVAC Duct Construction Standards - Metal and Flexible”, ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
   1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
   2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
   3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.
B. LEED Submittals:
   1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
   2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
   3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
   4. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."

C. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS
   A. Welding certificates.
   B. Field quality-control reports.

1.6 QUALITY ASSURANCE
   A. Welding Qualifications: Qualify procedures and personnel according to the following:
PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL 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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ductmate Industries, Inc.
   b. McGill AirFlow LLC.
   c. SEMCO LLC.
   d. Sheet Metal Connectors, Inc.
   e. Spiral Manufacturing Co., Inc.

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

D. 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.

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 POLYPROPYLENE LAB EXHAUST DUCTWORK

A. For lab exhaust ductwork serving the Trace Metals Lab, provide polypropylene duct system, model AirTech by SimTech or approved equal. Provide molded socket fittings for a watertight seal. Provide manufacturer’s roof penetration kit and wall brackets for exterior routing up to the lab exhaust fan on the roof.

B. Material of construction: Group 1, Class 1, Grade 0 Polypropylene Homopolymer material per ASTM-D4101, Federal Specification L-P-39413 and Military Spec Mil P 461096. PP material to be heat stabilized, UV stabilized and pigmented to RAL 7032.

C. Ducts: Provide seamless ductwork, extruded from the specified material having uniform, consistent wall thickness and roundness. Ducts below 12 inches in diameter shall have minimum 3.0 mm thickness; ducts 12 inches in diameter and larger shall have minimum 5.0 mm thickness.

D. Fittings: All directional fittings shall be molded from the specified material. Mitered and hot air welded fittings are not allowed except for assemblies which are not manufactured as a molded component. Fittings and coupling shall have socket ends which fit snugly around the entire periphery of the pipe. Joints are completed by back welding with hot air and welding rod.

E. Welding Rod: Same material as the duct and fittings.

F. Pressure Rating: Duct and fittings shall be capable of 10 psi positive static pressure and 7 psi negative static pressure.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. For cast-in-place concrete floor assemblies:
      a. Hot-dipped galvanized steel sheet, ASTM A653/A653M FS, with G90/Z275 coating
   2. For all other applications:
      a. Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
3. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Factory- or Shop-Applied Antimicrobial Coating:
   1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
   2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
   4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Owens Corning.
      1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant
coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
   a. 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).

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Aeroflex USA, Inc.
      b. Armacell LLC.
      c. K-Flex USA.
   2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
      a. 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).

C. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Reflectix Inc.
   2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
   3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
   4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
      a. 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. Insulation Pins and Washers:
   1. 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.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2-inches in diameter.
E. Shop Application of Duct Liner: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

7. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 3-inches.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
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.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
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).
11. VOC: Maximum 395 g/L.
12. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
13. Service: Indoor or outdoor.
14. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

**D. Flanged Joint Sealant: Comply with ASTM C 920.**

2. Type: S.
3. Grade: NS.
5. Use: O.
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).

**E. Flange Gaskets:** Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

**F. Round Duct Joint O-Ring Seals:**

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.
2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.8 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-line, an Eaton business.
   2. Ductmate Industries, Inc.
   4. Mason Industries, Inc.
   5. Unistrut; Part of Atkore International.
   6. Vibration & Seismic Technologies, LLC.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by the Office of Statewide Health Planning and Development for the State of California.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval 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 1-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-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 to the following seal classes according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible." Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4-inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4-inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24-inches of each elbow and within 48-inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16-ft.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designated to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA’s "Seismic Restraint Manual: Guidelines for Mechanical Systems." and ASCE/SEI 7.

1. Space lateral supports a maximum of 40-ft o.c., and longitudinal supports a maximum of 80-ft o.c.

2. Brace a change of direction longer than 12-ft.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by the Office of Statewide Health Planning and Development for the State of California.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during
drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. 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.

2. 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.

3. 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.

4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

5. Test for leaks before applying external insulation.

6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

7. Give ten working days' advance notice for testing.

B. Duct system will be considered defective if it does not pass tests and inspections.
3.9 DUCT CLEANING

A. Clean new and existing (when applicable) duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. Supply and Return Ducts:
   1. Ducts Connected to HVAC Equipment:
      a. Pressure Class: Positive or negative, 2-inch wg or less.
      b. Minimum SMACNA Seal Class per ASHRAE/IESNA 90.1, Section 6.4.4.2.1
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Exhaust Ducts:
   1. General Exhaust Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 3-inch wg or less.
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.
   2. Laboratory Exhaust Ducts Connected to Fans Exhausting Fume Hood, Laboratory, and Process (ASHRAE 62.1, Class 3 and Class 4) Air:
      a. Type 304, stainless-steel sheet.
      b. Exposed to View: No. 4 finish.
      c. Concealed: No. 2B or No. 2D finish.
   3. Pressure Class: Positive or negative 3-inch wg.
   5. SMACNA Leakage Class 2.
D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
   1. Ducts Connected to HVAC Equipment:
      a. Pressure Class: Positive or negative 2-inch wg or less.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
   2. Stainless-Steel Ducts:
      a. Exposed to Airstream: Match duct material.
      b. Not Exposed to Airstream: Galvanized.
   3. Aluminum Ducts: Aluminum.

F. Liner:
   1. Supply Air Ducts: Fibrous glass, Type I, 1-inch thick.
   2. Return Air Ducts: Fibrous glass, Type I, 1/2-inch > thick.
   3. Transfer Ducts: Fibrous glass, Type I, 1-inch thick.

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) 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.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. Section Includes:
   1. Backdraft and pressure relief dampers.
   3. Combination fire and smoke dampers.
   4. Flange connectors.
   5. Turning vanes.
   6. Remote damper operators.
   7. Duct-mounted access doors.
   8. Flexible connectors.
   9. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      c. Control-damper installations.
      d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
      e. 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.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

   B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS
   A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
      1. Galvanized Coating Designation: G60.
      2. Exposed-Surface Finish: Mill phosphatized.

   B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish.

   C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

   D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

   E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

   F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.
2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Lloyd Industries, Inc.
   3. Nailor Industries Inc.
   4. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: Hat-shaped, 0.094-inch thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.050-inch thick aluminum sheet with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.

I. Blade Axles:
   1. Material: Nonferrous metal.
   2. Diameter: 0.20-inch.

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball.

M. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Mounting: Front mounted in sleeve.
      a. Sleeve Thickness: 20 gage minimum.
   6. Screen Mounting: Rear mounted.
   7. Screen Material: Aluminum.
   8. Screen Type: Bird.
9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aire Technologies.
   b. American Warming and Ventilating; a Mestek Architectural Group company.
   c. Flexmaster U.S.A., Inc.
   d. Flex-Tek Group.
   e. McGill AirFlow LLC.
   f. Nailor Industries Inc.
   g. Pottorf.
   h. Ruskin Company.
   i. Trox USA Inc.
   j. Vent Products Co., Inc.

2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.

4. Frames:
   a. Frame: Hat-shaped, 0.094-inch thick, galvanized sheet steel.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064-inch thick.


7. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

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. Nailor Industries Inc.
b. Ruskin Company.

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. Hat shaped.
   b. 0.094-inch thick, galvanized sheet steel.
   c. Mitered and welded corners.
   d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized, roll-formed steel, 0.064-inch thick.


8. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.


11. Tie Bars and Brackets: Galvanized steel.

12. Accessories:
   a. Include locking device to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:
   1. Size: 0.5-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.
2.5 COMBINATION FIRE AND SMOKE DAMPERS

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   1. Aire Technologies.
   2. American Warming and Ventilating; a Mestek Architectural Group company.
   3. Cesco Products; a division of MESTEK, Inc.
   5. Nailor Industries Inc.
   6. Pottorf.
   7. Ruskin Company.

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 2000-fpm velocity.**

D. **Fire Rating:** 1-1/2.

E. **Frame:** Hat-shaped, 0.094-inch thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.

F. **Heat-Responsive Device:** Resettable, 165 deg F rated, fusible links.

G. **Smoke Detector:** Integral, factory wired for single-point connection.

H. **Blades:** Roll-formed, horizontal, interlocking, 0.063-inch thick, galvanized sheet steel.

I. **Leakage:** Class I.

J. **Rated pressure and velocity to exceed design airflow conditions.**

K. **Mounting Sleeve:** Factory-installed, 0.039-inch thick, galvanized sheet steel; length to suit wall or floor application.

L. **Master control panel for use in dynamic smoke-management systems.**

M. **Damper Motors:** two-position action.

N. **Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."**
   1. **Motor Sizes:** Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. **Controllers, Electrical Devices, and Wiring:** Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
   3. **Permanent-Split-Capacitor or Shaded-Pole Motors:** With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.

7. Electrical Connection: 115 V, single phase, 60 Hz.

O. Accessories:
1. Auxiliary switches for position indication.
2. Test and reset switches, damper mounted.

2.6 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Hardcast, Inc.
4. Nexus PDQ.
5. Ward Industries; a brand of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aero-Dyne Sound Control Co.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc.
4. Duro Dyne Inc.
5. Elgen Manufacturing.
6. Hardcast, Inc.
7. METALAIRE, Inc.
8. SEMCO LLC.

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.

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, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall for ducts up to 48-inches wide and double wall for larger dimensions.

2.8 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Pottorff.
   2. Ventfabrics, Inc.
   3. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass or Aluminum.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed.

F. Wall-Box Cover-Plate Material: Steel.

2.9 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aire Technologies.
   2. American Warming and Ventilating; a Mestek Architectural Group company.
   3. Cesco Products; a division of MESTEK, Inc.
   4. CL WARD & Family Inc.
   5. Ductmate Industries, Inc.
   7. Flexmaster U.S.A., Inc.
9. McGill AirFlow LLC.
10. Nailor Industries Inc.
11. Pottorff.
12. Ventfabrics, Inc.


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: Two hinges and two sash locks.
   c. Access Doors up to 24- by 48-inches: Continuous and two compression latches.
   d. Access Doors Larger Than 24- by 48-inches: Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
2.10 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. 3M.
   2. Ductmate Industries, Inc.
   3. Flame Gard, Inc.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CL WARD & Family Inc.
   2. Ductmate Industries, Inc.
   3. Duro Dyne Inc.
   4. Elgen Manufacturing.
   5. Hardcast, Inc.
   6. JP Lamborn Co.
   7. Ventfabrics, Inc.
   8. Ward Industries; a brand of Hart & Cooley, 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 fabric strip 3-1/2-inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.
   1. Minimum Weight: 24 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Compliance with ASHRAE/IESNA 90.1 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Connect ducts to duct silencers with flexible duct connectors.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Control devices requiring inspection.
10. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:
   1. One-Hand or Inspection Access: 8- by 5-inches.

L. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with liquid adhesive plus tape, draw bands, or adhesive plus sheet metal screws.

P. Install duct test holes where required for testing and balancing purposes.

Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.

4. Inspect turning vanes for proper and secure installation.

5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Laboratory Fume Exhaust Fan System.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on actual site elevations.
B. Operating Limits: Classify according to AMCA 99.
C. Fan Schedule: The following information is described in an equipment schedule on the
   Drawings.
   1. Fan performance data including capacities, outlet velocities, static pressures, sound
      power characteristics, motor requirements, and electrical characteristics.
   2. Fan arrangement including wheel configuration, inlet and discharge configurations, and
      required accessories.

1.4 SUBMITTALS

A. General: See Section 230100 for general requirements of Product Data, Shop Drawings,
   Reports and Certificates, and Operation and Maintenance data submittals.
B. Product Data: Provide submittals of the following:
   1. Laboratory Fume Exhaust Fan System
C. Product Submittals shall be approved by Owner’s Facility Engineering Department.
D. Shop Drawings: None required.
E. Reports and Certificates: Provide submittals of the following:
   1. Factory authorized service representative report.
F. Operation and Maintenance Data: For fans, to include in the maintenance manuals
   specified in Division 01.

1.5 QUALITY ASSURANCE

A. Electrical Component Standard: Provide components that comply with NFPA 70 and that
   are listed and labeled by UL.
B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled by UL.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.

D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.

E. Testing Requirements: The following factory tests are required as indicated:
   1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.
   2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

F. As a prerequisite to Substantial Completion, installed Work of this Section shall be inspected and approved in writing by Owner's Facility Engineering Department.
   1. Facility Engineering inspection shall be scheduled to occur simultaneously with Architect's inspection for Certification of Substantial Completion.
   2. Coordinate date of inspection with Contracting Officer and Architect.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements. Verify clearances.

B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

1.7 COORDINATION AND SCHEDULING

A. Coordinate the size and location of structural steel support members.

B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.

1.8 EXTRA MATERIALS

A. Furnish one set of belts for each belt-driven fan that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with moisture proof protective crating and covering.

B. Lift and support units with the manufacturer's designated lifting or supporting points.
C. Fans shall not be exposed to moisture or dust during construction or storage.

PART 2 - PRODUCTS

2.1 LABORATORY FUME EXHAUST FAN SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide SkyPlume fan by Plasticair or approved equal.

B. Description: Packaged FRP fume exhaust system with intake plenum, outside air bypass dampers, air entrainment wind band discharge section, and integral control system with all wiring required.

C. Plenum: Double wall fan inlet plenum suitable for roof curb mounting, capable of supporting entire assembly. Provide access door and safety screens at fan inlet.

D. Fans: Direct drive, mixed flow type fan with FRP impeller and fan inlet bell. Motor isolated from the primary exhaust air stream and accessible from the fan exterior for inspection and service.

E. Motor: TEFC mill and chemical duty.

F. Disconnect Switch: Located in NEMA 3R weather enclosure serving each fan.

G. Discharges: FRP construction, chemically and UV resistant.

H. Bypass Dampers: Opposed-blade low leakage air-foil dampers with extended shaft and actuator. Rain hood weather protection.

I. Finish (general): Baked polyester powder coating, electrostatically applied.

J. Accessories: The following accessories are required as indicated:
   1. Roof Curb: Provide 18-inch high roof curb to match unit.
   2. Shaft grounding kit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the fans. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fans according to manufacturer's written instructions.

B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Division 23 Section 23 0553 "Identification for Mechanical Piping and Equipment."
3.3 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Electrical: Conform to applicable requirements in Division 26 Sections.

C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer’s published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.6 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.7 START-UP PROCEDURES

A. Final Checks before Startup: Perform the following operations and checks before startup:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.

3. Perform cleaning and adjusting specified in this Section.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.

6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
7. Disable automatic temperature-control operators.

B. Starting procedures for fans are as follows:
   1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
   2. Measure and record motor voltage and amperage.

C. Shut unit down and reconnect automatic temperature-control operators.

D. Refer to Division 23 Section 23 0593 "Testing, Adjusting, and Balancing for Mechanical" for procedures for air-handling-system testing, adjusting, and balancing.

E. Replace fan and motor pulleys as required to achieve design conditions.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in the operation and maintenance manuals. Refer to Division 01.

C. Schedule 4 hours training with Owner, through Architect, with at least 7 days' advance notice.

D. Demonstrate operation of fans. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
   1. In addition to general operation and maintenance information, include the following:
      a. Instructions for resetting minimum and maximum air volumes.
      b. Instructions for adjusting software set points.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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.

2.2 SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturer: Provide terminal units by Price, Titus, or Kreuger.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.034-inch thick galvanized steel, single wall.
   2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
   3. Air Outlet: S-slip and drive connections.
   4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: AHRI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1-inch and rated for a minimum working pressure of 200-psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

F. Provide factory-mounted controller provided by DDC System manufacturer.

2.3 CASING LINER

A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
      a. Maximum Thermal Conductivity:
         1) Type II, Rigid: 0.23 Btu in./h sq. ft. deg F at 75 deg F mean temperature.
      2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
      3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

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 and for slabs more than 4-inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4-inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.
D. 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.

3.2 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.3 CONNECTIONS

A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

B. Hot-Water Piping: Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. Section Includes:
   1. Modular core ceiling diffusers.
   2. Linear slot diffusers.
   3. Fixed face grilles.
   4. Perforated Ceiling Return

B. Related Requirements:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

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 acoustic 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 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Systems Components; Krueger.
   2. Titus.
   3. Price Companies.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, construction, capacity, and with accessories and finishes as indicated.
   1. Modular Core Ceiling Diffusers:
      a. Material: 22 gauge steel, back pan shall be one piece stamped 22-gauge steel.
      b. Finish: Baked enamel, white.
      c. Face Style: Fixed louver directional modules, which can be easily repositioned without tools in the field for one, two, three or four-way discharge. Each module shall be removable.
      d. Accessories: Opposed blade damper, operable from the face of the diffuser, damper blades secured by tension wire.

2.2 SUPPLY GRILLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Systems Components; Krueger.
   2. Titus.
   3. Price Companies.
   4. Seiho.
   5. Air Concepts.
B. Performance: Provide supply grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Wall Compatibility: Provide grilles with border styles that are compatible with wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction, which will contain each type of wall grille.

D. Types: Provide supply grilles of type, construction, capacity, and with accessories and finishes as indicated.
   1. Adjustable Blade Face Grilles:
      a. Material: 0.050 Aluminum frame and heavy duty aluminum blades.
      b. Finish: Baked enamel, white.
      c. Blade Arrangement: Double deflection, face Parallel to long dimension spaced 3/4-inch apart. Blades shall extend through the side frame on each side. Blades shall be individually adjustable, held in place with tension wire, adjustable without loosening or rattling.
      d. Frame: 1-1/4-inches wide, corners assembled with full penetration resistance welds.
      e. Mounting: Countersunk screw.
      f. Accessories:
         1) Opposed blade damper, operable from the face of the grille, damper blades secured by tension wire.

2.3 EXHAUST/RETURN GRILLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Systems Components; Krueger.
   2. Titus.
   3. Price Companies.

B. Performance: Provide exhaust and return grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Ceiling Compatibility: Provide grilles with border styles that are compatible with ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of grille.

D. Wall Compatibility: Provide grilles with border styles that are compatible with wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction, which will contain each type of wall grille.
E. Types: Provide exhaust and return grilles of type, construction, capacity, and with accessories and finishes as indicated

1. Fixed Face Grilles:
   a. Material: 0.040 minimum extruded aluminum frame and blades.
   b. Finish: Aluminum colored paint.
   c. Blade Arrangement: 35 degree deflection parallel to the long dimension of the grille; spaced 3/4-inch apart.

2. Perforated Ceiling Return:
   a. Material: 22-gauge steel modular core, back pan shall be one piece stamped 22-gauge steel. 22-gauge steel perforated face with 3/16-inch diameter holes on 1/4-inch staggered centers.
   b. Finish: Baked enamel, white.
   c. Duct Inlet: Square.
   d. Face Style: Removable perforated flush type face.
   e. Pattern Controller: Fixed louver directional modules, which can be easily repositioned without tools in the field for one, two, three or four-way discharge. Each module shall be removable.
   f. Accessories:
      1) Opposed blade damper, accessible through opening perforated face removal of one of the cones, damper blades secured by tension wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers level and plumb, according to manufacturer's written instructions, project 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. Duct-Mounted Supply and Exhaust/Return Grilles: Mount to duct branch with 16-gauge steel angle collar. Mounting screws to match grille frame. Screws shall not protrude more than 1/4-inch past angle collar.

D. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

E. Install in-line multiple linear diffusers with alignment pins for a straight continuous appearance.

3.3 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers and grilles that have damaged finishes.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following:
   1. Fan Filter Units.

1.3 PERFORMANCE REQUIREMENTS
A. Refer to the Fan Filter Unit Schedule on the Drawings.

1.4 SUBMITTALS
A. General: See Section 230100 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

B. Product Data: Provide submittals of the following:
   1. Fan Filter Units

C. Product Submittals shall be approved by Owner’s Facility Engineering Department.

D. Reports and Certificates: Provide submittals of the following:
   1. Factory authorized service representative report.

E. Operation and Maintenance Data: For fan filter units, to include in the maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE
A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL.

B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled by UL.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.

D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.

E. As a prerequisite to Substantial Completion, installed Work of this Section shall be inspected and approved in writing by Owner’s Facility Engineering Department.
1. Facility Engineering inspection shall be scheduled to occur simultaneously with Architect’s inspection for Certification of Substantial Completion.

2. Coordinate date of inspection with Contracting Officer and Architect.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements. Verify clearances.

B. Do not operate units until ductwork is clean, and filters are in place.

1.7 EXTRA MATERIALS

A. Furnish one spare set of pre-filters and one spare set of HEPA filters.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver fan filter units as factory-assembled units with protective covering.

B. Do not expose fan filter units to moisture or dust during construction or storage.

PART 2 - PRODUCTS

2.1 FAN FILTER UNITS

A. General: Provide fan filter units designed for room side accessibility complete with HEPA filters and prefilters in accordance with the following specifications. Units shall be certified to UL Standard 507 and require UL 1995 rating.

B. Construction:

1. Plenum and filter housing shall be constructed of 20 gauge steel or extruded aluminum with a powder-coated finish. Provide gel knife edge seal.

2. Fan shall be forward-curved centrifugal type fan.

3. Motor shall be direct drive, high efficiency ECM brushless DC motor with internal microprocessor. Provide constant torque program to allow the ECM to vary the airflow with fluctuations in both upstream static pressure and filter pressure drop. The constant torque program shall prevent unexpected motor operation or motor shutdown due to upstream static pressure fluctuations. Motor shall be suitable for 120 volt, single phase power. Mount motor on rubber vibration isolators.

4. Provide deluxe ECM speed controller to accept 2-10 VDC signal for variable speed control. Provide controller with LED display of motor speed, motor rpm, and input voltage.

5. Provide ECM controller with digital display. Provide motor status to the Building Automation System.

6. Provide units with pre-wired disconnect switch.

7. Provide an aluminum perforated laminar flow grille with epoxy powder-coat finish, hinged to open, permitting the removal of HEPA filter from inside the room without removing the complete unit from the ceiling.

8. Provide 10 inch duct collar connection.
9. Provide UL900 HEPA filters rated 99.99 percent efficient on 0.3 micron and larger particles. HEPA filters shall include aluminum frame along with screens on the downstream face. Provide LED indication of need to change filters when the filter drop exceeds the specified limit.

10. Prefilters shall have MERV 6 efficiency rating as determined by ASHRAE Standard 52.2.

C. Performance: See schedule on drawings. The room sound level shall be less than 55 dBA when measured at 30 inches from filter face at 90 fpm. The unit shall be factory sealed and tested.

D. Manufacturer: Provide custom fan filter units by Price or Envirco. Units by alternate manufacturers meeting the above specifications will be considered for approval.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the fan filter units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fans according to manufacturer's written instructions.

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Division 23 Section 230553 "Identification for Mechanical Piping and Equipment."

3.3 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts and duct accessories.

B. Electrical: Conform to applicable requirements in Division 26 Sections.

C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fan filter units, including duct and electrical connections, and to report results in writing.
3.5 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.6 START-UP PROCEDURES

A. Final Checks before Startup: Perform the following operations and checks before startup:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure and supporting devices and that connections for ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.

B. Refer to Division 23 Section 230593 "Testing, Adjusting, and Balancing for Mechanical" for procedures for air-handling-system testing, adjusting, and balancing.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in the operation and maintenance manuals. Refer to Division 01.

C. Schedule 4 hours training with Owner, through Architect, with at least 7 days' advance notice.

D. Demonstrate operation of fans. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The current edition of all codes and standards referenced herein shall be used unless otherwise indicated on drawings.

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, 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. Filters: One set for each air-handling unit.
   2. Gaskets: One set for each access door.
   3. Fan Belts: One set for each air-handling unit fan.
1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Compressor: Five year(s) from date of Substantial Completion.
      b. For Parts: Five year(s) from date of Substantial Completion.
      c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. DAIKIN
   2. Mitsubishi Electric & Electronics USA, Inc.
   3. SANYO North America Corporation.

2.2 DUCT-FREE SPLIT-SYSTEM AIR-CONDITIONING UNITS

A. Indoor, direct-expansion, wall mounted fan coil:
   2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and with thermal-expansion valve.
   3. Fan and Motor: Centrifugal fan, directly driven by multispeed, electric motor with integral overload protection; resiliently mounted.
4. Filters: Permanent, cleanable.
5. Provide with condensate pump with internal check and sump.

B. Air-Cooled, Compressor-Condenser Components:
1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins.
4. Fan: Non-metallic, propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Controller and Winter Start Kit: Permits operation when ambient temperatures are below 40 deg F.
7. Crankcase heater.
8. Long-line refrigerant line kit.

C. Refrigerant: R-410a.

2.3 ACCESSORIES

A. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC".
B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
D. Provide accessories/controls necessary to connect controls into building DDC system and allow building DDC system to control the unit.

2.4 SHORT CIRCUIT CURRENT RATING

A. Provide air-conditioner control panel with short circuit current rating as indicated. Short Circuit Current Rating shall be included on the equipment nameplate. See Division 23 Section "Mechanical Materials and Methods" for further requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unit(s) level and plumb.
B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
C. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07. Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:
   1. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 “Vibration and Seismic Controls for HVAC.”

E. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical materials and installation instruction common to most electrical systems and components including but not limited to: equipment, raceways, fittings, sleeve/seals, sleeves, wires and connectors, conductors, demolition, equipment installation requirements common to equipment sections, painting and finishing, concrete bases, supports and anchorages, general coordination, electrical wiring and device coordination.

1.2 DEFINITIONS

A. Following is a list of abbreviations generally used in Division 26.
   1. AHJ – Authority Having Jurisdiction.
   2. ETL – Electric Testing Laboratories.
   6. OSHA – Occupational Safety and Health Administration.
   7. UL – Underwriters Laboratories Inc.

B. Terms used on the drawings or in the specifications shall have the following meanings:
   1. Approved Equal: An Item suggested by the Contractor that is allowed by the Engineer to replace an item listed in the Specifications or Drawings. The burden of proof of equality is the responsibility of the Contractor.
   2. Furnish: Supply and deliver, ready for installation, assembly or intended use, all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular work referred to.
   3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at the project site as required to complete all items of work as required for the intended use/operation including all testing, certification, commissioning, and other requirements for final turnover to the Owner.
   4. Provide: “Furnish” and “Install.”
   5. Owner Furnished, Contractor Installed: The Owner will furnish at his cost and the Contractor shall receive, protect, store and install in the performance of the Work.
   6. Finished Spaces: Spaces other than electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
   7. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
   8. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include installations above ceilings, in shafts, trenches, partitions, or other enclosures.
9. 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 embedded in or below masonry or concrete construction, earthwork/trenches, within unheated shelters, crawl spaces or enclosures.

10. Wiring: All wires, raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connectors, splices, and all other items necessary and/or required in connection with such work.

11. Raceway: All raceways, conduit, fittings, hangers, supports, sleeves, etc.

1.3 GENERAL REQUIREMENTS

A. Examine the Drawings, specifications and other Contract Documents relating to the Work and the work of all trades and become fully informed as to the extent and character of work required. Coordinate all work with that of others to ensure proper and complete installation of all materials, equipment and supports. It is the intent of the drawings, specifications and related contract Documents to provide a complete working installation of all systems and equipment called for, in proper operating condition, finished, tested and ready for its intended use (hereinafter “Design Intent”). Provide all items not specifically shown on the drawings, called for in the specifications or related Contract Documents, but required to conform to the labor, material and equipment to achieve the Design Intent and all scaffolding, access provisions, tools, appliances, consumables, fees, permits and licenses, debris removal/disposal, supervision and labor, including required start-up, check-out and training to provide complete and fully operable systems in full compliance with the Contract Documents.

B. Before submitting a bid and prior to the start of work, Contractor shall examine all conditions relating to the Work, including that associated with the work of other trades upon which Contractor’s work may rely or otherwise depend, to achieve the Design Intent, in accordance with the best trade practices, workmanship and highest quality product installation, taking into account the sequence of the work, delivery, storage and hoisting requirements, requirements for access, testing and temporary services and all other site limitations and project complexities. Report to the Architect/Engineer any conditions which might prevent installation of materials and/or equipment in the manner intended by the Contract Documents or contrary to applicable codes, standards or regulations.

C. No consideration or allowance will be granted for any alleged misunderstanding of materials, equipment or components to be furnished or work to be done; it being agreed that tender of proposal carries with it agreement to items, terms and conditions required by the Contract Documents.

D. Site Visit: Visit the site and verify the exact conditions relating to the work and obtain such information as may be necessary to present a complete and comprehensive bid. No allowance will be made for any extra expense due to Contractor’s failure to make such a visit and reasonably verify all actual/existing conditions. In the event of a conflict between existing conditions and the requirements of the Contract Documents, perform the necessary work to conform to Design Intent. The Owner or his representative will be the sole individual to interpret the intent of the Drawings in the event of a conflict between (1) existing conditions and those shown on the drawings, or (2) quality of existing material and quality of material indicated on the drawings or in the specifications. Wherever a conflict such as this occurs, the higher standard shall prevail.
1.4 SPECIAL REQUIREMENTS

A. When applicable, Contractor acknowledges the ongoing operations of the Owner at or in close proximity to the Project and agrees to coordinate the timing of the Work with the Owner’s ongoing operations; perform the Work in a manner that minimizes or eliminates an adverse impact upon the Owner’s ongoing operations; confine operations at the site to areas approved by Owner, permitted by law, permits and the Contract Documents; comply with the Owner’s standard security, health and safety policies and procedures; not unreasonably encumber the site with any materials or equipment; and not place signs or advertising on or about the site without prior approval of Owner.

B. Where applicable, all seismic construction, restraints, bracing, mounts and hanging systems shall be in full compliance with the requirements of all Authorities Having Jurisdiction (AHJ’s), pre-approval, certification and engineering (including certified engineering calculations and stamps). Contractor shall be solely responsible for obtaining and complying with all requirements of the AHJ.

1.5 SUBMITTALS

A. Reference Division 01 for submittal requirements.

B. Submittal Schedule: Provide a detailed submittal schedule including all requirements of this Division and its subdivisions to the Architect and Engineer within thirty days of contract award.

1. Contractor shall submit for the Engineer’s approval a Submittal Schedule for the performance of the work that is consistent with the requirements of the project schedule. The Submittal Schedule shall allow reasonable time for the Architect and other consultants review as specified in Division 01 Submittal Procedures. If the time for Architects/Engineers review is not otherwise specified, the review period (from date of receipt) shall be fifteen business days. Once approved by the Architect/Engineer, submittal dates and time limits established by the Submittal Schedule shall not, except for reasonable cause, be changed or exceeded by the Contractor.

2. For each submittal required by the Contract Documents the schedule shall include: specification section number, subsection/paragraph identification number, item description (as stated in the applicable specification section, subsection or other Contract Document) and the scheduled delivery date to the Architect/Engineer.

3. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project schedule resulting from any deviation to the approved Submittal Schedule, including but not limited to; payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer as may be required to perform out of sequence, stacked, critical, delayed, unscheduled or multiple reviews of required submittals necessitated by rejection of a prior submittal, (cumulatively and hereinafter, “Additional Review Costs”)

C. General:

1. Review is for general conformance with the Contract Documents and is not intended to otherwise approve or verify dimensions, quantities, or to coordinate the Work shown on shop drawings on or between Contractor and the work of other trades or Sections. Contractor is solely responsible for quantities, dimensions, means and methods. Dimensions shall be confirmed and correlated by Contractor at the jobsite prior to the start of the Work (procurement, fabrication, construction or other commencement activities). Contractor’s failure to fully verify conditions at the jobsite prior to
commencement of the work shall not relieve Contractor of its obligations under the Contract Documents and Contractor shall be responsible for all damages caused by or related to its failure to comply with the requirements of this provision.

2. Submittal review shall be performed to show compliance with the design intent. Contractor shall specifically note any deviations from the Contract Documents and explain the reason and nature of the deviation. Such deviations will be reviewed or rejected on the submittal. Deviations not so identified shall not relieve the Contractor from the requirements of the Contract Documents.

3. Resubmittals will be reviewed for compliance with comment(s) made on the original submittal only. Architect/Engineer shall not be responsible for changes made upon resubmittal that are not clearly identified (highlighted) and respond directly to the initial rejection. Resubmittals should not be packaged with non-related first time submittals; all resubmittals must be marked with the resubmittal number and date and must otherwise comply with all submittal requirements.

4. Submit shop drawings, commissioning plan(s) and checklists, penetration locations, supplemental data, etc., as may be required by the Contract Documents for all materials, equipment and other components of the work included in all Sections of this Division and other provisions of the Contract Documents in accordance with the requirements of this Division and Division 01.

5. All submittals must be reviewed by Contractor, and bear Contractors review stamp and signoff for Conformity to the Contract Documents, prior to the submission of any required submittal to Architect/Engineer. Submittals that fail to meet this requirement will be considered incomplete, will not be reviewed by Architect/Engineer and will be returned to Contractor, without review and/or rejected and resubmittal will be required. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

6. Forward all submittals to Architect/Engineer in a coherent, organized fashion, complete and packaged as required herein, Architect/Engineer may reject submittals that fail to comply with this or any other provision of the Contract Documents and Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

7. Subject to other provisions of the Contract Documents and in the absence of a more stringent requirement, Architect/Engineer will review a submittal not more than two (2) times. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

8. Identify each submittal item by reference to Specification Section paragraph in which item is specified, or drawing/detail number, as applicable. In addition, for equipment submittals, include identification numbers appearing on the equipment schedule.

9. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words “as specified” are not sufficient identification.

10. Organize submittals in same sequence as they appear in specification sections, articles or paragraphs.

11. All materials and equipment submittals shall have a summary sheet at the front complete with catalog numbers. Where materials or equipment pertain to more than one building, submittals shall clearly indicate at which locations the materials or equipment is to be installed.
12. Submittals shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping and/or conduit entrance, access requirements for installation and maintenance, physical size and dimension, electrical characteristics and requirements, foundation/curbs and all permanent and temporary support details as well as all information relating to weight, including but not limited to live and dead weights.

D. Catalog Cuts and Submittal Literature: Catalog cuts, submittal literature and published material may be included to supplement scale drawings.
   1. Prepare submittals electronically in accordance with the following and Division 01.
   2. Submittal literature, drawings and diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item.
   3. Substitutions: Comply with Division 01 Product Substitution Procedures.

E. Shop Drawings:
   1. Shop drawings shall include all significant Division systems, equipment and components, including but not limited to all terminal devices, connections and elevations. Include all related specialty rooms (i.e., electrical, data/technology). Drawings shall be at a minimum scale of 1/4 inch per 1 ft.-0 inch and shall be fully coordinated with the work of other trades and/or Sections.
   2. Identify congested areas and clearly indicate solutions to space problems, developed in conjunction with the work of other trades and/or Sections. Identification of space problems without proposed solutions is not acceptable and is grounds for rejection. For such areas indicate, superimposed, the work of all trades and/or Sections involved and:
      a. Clearly identify each area of congestion and deviations from the Contract Documents, and:
      b. Proposed solution(s), clearly documented and signed-off by all other trades and/or Sections involved.

F. Anchorage and Supports: Submit details and calculations for support and anchors that are not specifically detailed on the drawings. All calculations must meet 2010 CBC.
   1. Provide details and calculations for electrical equipment per 2010 CBC:
      a. Having an operating weight over 400 pounds or more and mounted directly to the floor.
      b. Having an operating weight over 20 pounds and suspended from the roof, floor, or wall or supported by vibration isolation devices.
   2. Where pre-approved bracing systems will be employed, submit:
      a. System component brochure describing components used and detailed installation instructions.
      b. Loads to be transmitted to the structure at anchor points.
   3. Where anchorage, support, and bracing are not detailed on the drawings, and pre-approved systems are not used, submit details and calculations of proposed systems. Include:
      a. Anchorage and Supports:
1) Where equipment substitutions change the weight, size, configuration, or other aspects of systems and equipment that will affect the performance of anchorages and/or supports, submit calculations for proposed anchors and supports, and install them as shown in these calculations.

2) Where substitutions will have no effect on anchors and supports detailed on Contract Documents, submit information on sizes, weights, center of gravity and other relevant information to demonstrate this fact.

G. Shop Fabrication Drawings: Drawings are for the Contractor's use and shall be its responsibility. Do not submit shop fabrication documents unless specifically requested.

H. Testing and Balancing: Coordinate Shop Drawings to include any additional components for proper system testing and balancing.

I. Certificates: Submit final inspection certificates signed by governing authorities.

J. Operating and Maintenance Instructions and Manuals.
   1. Instructions on major items, including but not limited to: switchgear, generators, pumps, air compressors, water heaters, water softeners, specialty units, fans, air handlers, AC units and temperature controls, shall be by representative of manufacturer of respective equipment.
   2. Submit as identified below and as directed in Division 01.
      a. Names, addresses and phone numbers of contractors and subcontractors. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
      b. Complete operating and maintenance instructions and parts lists of all equipment and component parts. Data sheets to show complete internal wiring, and electrical ratings and characteristics, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or failure, and description of operating, test, adjustment, and maintenance procedures.
         1) Where data sheets included in manual cover equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.
      c. Operating Instructions should include, but not be limited to:
         1) Normal starting, operational and shutdown procedures, including emergency procedures for each type of equipment/system.
         2) Equipment wiring diagrams.
         3) All other items as may be specified/required by this Section and the Contract Documents.
      d. Maintenance Instructions: All items as may be specified/required by this Section and the Contract Documents.
      e. Manufacturers Data (each piece of equipment):
         1) Installation instructions.
         2) Drawings and specifications.
3) Parts List, including recommended stock and long lead parts/components.

4) Wiring and riser diagrams.

5) Warranties and guarantees for all equipment, materials and components, including repair, replacement and labor from both Contractor and manufacturer as required by the Contract Documents.

6) Certificates of Installation – manufacturer’s certification of supervision during equipment installation and start-up procedures.

7) Instruction certificates – certificates of compliance with Sections specific training and instruction programs.

8) All other items as may be specified/required by this Section and the Contract Documents.

K. Record Documents:

1. Maintain one complete set of blueline prints and specifications at the job site exclusively for recording deviations from the drawings which are necessary because of job conditions, request for information and/or approved change orders. Record locations and depths of buried and concealed conduits or other systems components from fixed, easily identifiable objects, such as building walls or other fixed physical objects. Where conduits are concealed in walls or other fixed physical objects, indicate distances from building corners or other building features not likely to be disturbed by fixture alterations. Drawings, specifications (as-builts) and approved submittals.

2. Where the project uses a BIM model the Contractor shall keep the model updated in a similar fashion, maintaining the current project record as described in (a), above and submit, an addition to all other requirements of this Section and other provisions of the Contract Documents a complete and accurate BIM model for the project.

3. Prior to Substantial Completion, obtain from the Architect a complete set of electronic CAD drawings. Record all revisions to these drawings to indicate as-built conditions. Indicate all changes, including RFI’s, on this set of documents. Submit one set of blueprints of these revised drawings for review. Make necessary changes and deliver to Architect one set of reproducibles and one electronic copy, including and BIM model, upon Final Completion and Acceptance. Refer to Division 01 for additional requirements.

4. Provide full size copies of record one-line diagrams, in metal frames with glass front. Obtain Record prints from Owner’s Representative at Contractor’s cost and have prints framed by a firm normally engaged in this work. Locate diagrams as directed.

5. All test reports, certifications, and inspection reports.

6. AHJ/Specialty AHJ Approvals (i.e., Fire Marshal and/or Fire Department system approvals).

7. Substantial and Final inspection certificate signed by governing authorities.

8. All other items as may be specified/required by this Section and/or other provisions of the Contract Documents.

1.6 EQUIPMENT DEVIATIONS AND SUBSTITUTIONS

A. See Division 01 for requirements and procedures related to Deviations and Substitutions. Unless specified elsewhere in the Contract Documents, a minimum of two (2) weeks shall be allowed for evaluation. The burden of all systems re-engineering/design, testing, suitability...
and constructability is solely placed upon the Contractor for all deviations from the basis of design as reflected in the Contract Documents.

B. No substitutions will be allowed and/or considered unless the description of a product includes the phrase “approved equal” and then only upon a determination as to equivalency and impact upon the project budget, schedule and the work of others, including any redesign of the project or its system components by the Architect, Engineer or other trades. The final determination as to sufficiency or acceptance of any such substitution and/or deviation properly requested and submitted by Contractor will lie solely with the Architect/Engineer. Contractor may not implement substitutions that have not been approved by Architect/Engineer.

C. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings which requires any redesign of any portion of the project, including but not limited to the mechanical, electrical, plumbing, structure, or architectural design or any of their respective subcomponents. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project budget and/or schedule resulting from any required investigation, analysis or redesign, including but not limited to; payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer, Owner or AHJ as may be required to perform the investigation, analysis or redesign (cumulatively and hereinafter, “Deviation Review Costs”).

D. If approved by Architect/Engineer, all such redesign, including all new drawings and detailing required, will be prepared by the Architect/Engineer and their sub-consultants for Change Order documentation for approval by Owner and the Authority Having Jurisdiction will be paid by the Contractor as part of the Deviation Review Costs.

E. Were such approved deviation requires a different quantity and arrangement of equipment, wiring, conduit, supports, foundations, pads, curbs, or equipment from that specified or indicated on the drawings or other Contract Documents, Contractor shall be responsible for all such costs, including the work of other trades and shall be solely responsible to furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system at no additional cost or schedule impact to the project (cumulatively and hereinafter “Deviation Construction Costs”).

1.7 COORDINATION

A. Drawings and corresponding electronic media are diagrammatic and indicate the general arrangement of systems and work included in the Work. Consult the drawings, details and other electronic media for locations of fixtures and equipment; where same are not definitely located, obtain this information from the Architect/Engineer.

B. The drawings and related electronic media have been made to scale with the best knowledge of conditions, dimensions and space requirements available at the time of design and shall be followed as closely as possible during performance of the Work and coordination with the work of others. The foregoing however shall not relieve Contractor from its responsibility to verify all conditions. Dimensions and space requirements prior to commencement of the Work and to immediately report any errors or discrepancies to the Architect/Engineer.

C. Check drawings and related electronic media of other trades to verify spaces and conditions in which work will be performed prior to commencement of the work.
D. If directed by the Architect/Engineer or required for proper installation, execution and coordination of the work, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed.

E. Take all dimensions from Architectural and Structural Drawings, certified equipment drawings and from the actual field measurements before fabricating work. All conflicts shall immediately be reported to the Architect/Engineer. Contractor is solely responsible for conflicts known or which reasonably should have been known but not reported or resolved before commencement of the work.

F. Equipment furnished shall fit in allocated space with due provision for manufacturer’s recommended access and proper maintenance requirements. Verify and coordinate space requirements with all trades and equipment which comprise the Work.

G. Prior to construction, coordinate the Work with that of other trades and building components. Prepare coordination drawings (or other specified electronic media) for all major trades, utilities and other primary systems routing in conjunction with the contract documents to maximize the pre-installation planning and coordination of trades, utilities and systems and minimize the requirement to manage field coordination through the RFI’s, ASI’s or other similar processes.

H. Coordinate connection of systems with interior/exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

I. Before starting work, carefully examine the site and all Contract Documents. Become thoroughly familiar with new and existing conditions governing work on this project. Verify indicated elevations, building measurements, rough-in dimensions and equipment locations before proceeding with any of the work.

J. Drawings shall be accurately scaled to 1/8 inch – 1 foot or larger using the same version of AutoCAD or other electronic media as used by Architect/Engineer. Drawings shall include all addenda and Change Order items.

K. Contractor shall be solely responsible for coordination and shall bear the cost of its failure to coordinate installation or of failure to advise Architect/Engineer of installation conflicts.

L. Sequence, coordinate, and integrate installations of systems materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to building enclosure.

1.8 ELECTRICAL WIRING AND COORDINATION

A. In general, power wiring will be provided under Division 26 – Electrical, and control wiring will be provided under Division 23 – Heating Ventilating and Air Conditioning, unless otherwise specified.

B. The following schedule summarizes the Division or work and material responsibilities.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>FURNISHED UNDER</th>
<th>SET IN PLACE OR MOUNTED UNDER</th>
<th>WIRED AND CONNECTED UNDER</th>
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</thead>
<tbody>
<tr>
<td>Equipment motors</td>
<td>MD 1</td>
<td>MD 1</td>
<td>ED 2</td>
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<tr>
<td>ITEM</td>
<td>FURNISHED UNDER</td>
<td>SET IN PLACE OR MOUNTED UNDER</td>
<td>WIRED AND CONNECTED UNDER</td>
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<tr>
<td>Resistance heaters</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
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<td>Fire protection controls, including remote switches, flow switches</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
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<td>Liquid chiller starters, where specified</td>
<td>MD</td>
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<td>Motor controls where specified as an integral package</td>
<td>MD</td>
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<td>Motor controllers</td>
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<tr>
<td>Resistance type heater controllers</td>
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<td>Magnetic contactors and magnetic starters with overload trip assembly</td>
<td>ED 4</td>
<td>ED 4</td>
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<tr>
<td>Integral control transformers</td>
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<td>Manual motor starters with overload trip assembly</td>
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<td>Motor starter switches</td>
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<td>Disconnect switches fused and unfused</td>
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<td>Thermal or thermal-magnetic circuit breakers</td>
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<td>Fuses</td>
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<td>Duct smoke detectors</td>
<td>ED</td>
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<td>ED 3</td>
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<tr>
<td>Smoke and fire/smoke dampers (with and without end switches)</td>
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<td>MD</td>
<td>ED 3</td>
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<td>Control power source for temperature and equipment control panels</td>
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<td>Electric temperature control relays and miscellaneous devices</td>
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<td>MD 5</td>
<td>MD 5</td>
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<tr>
<td>Level and float switches</td>
<td>MD</td>
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<tr>
<td>Pipe mounted control devices such as flow switches, flow sensors, valves, and wells.</td>
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<td>MD 5</td>
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<tr>
<td>Thermostats and space sensors.</td>
<td>MD</td>
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<td>MD 5</td>
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<tr>
<td>Duct mounted control devices such as temperature, humidity, flow and pressure sensors.</td>
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<tr>
<td>Damper actuators.</td>
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<td>ITEM</td>
<td>FURNISHED UNDER</td>
<td>SET IN PLACE OR MOUNTED UNDER</td>
<td>WIRED AND CONNECTED UNDER</td>
</tr>
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<td>--------------------------------------------------</td>
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<tr>
<td>Control dampers.</td>
<td>MD</td>
<td>MD</td>
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</tr>
<tr>
<td>Medical Gas Alarms</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
</tr>
<tr>
<td>Variable frequency drives (VFD) specified to be mounted on or in the mechanical equipment.</td>
<td>MD</td>
<td>MD</td>
<td>ED</td>
</tr>
<tr>
<td>VFD specified to be mounted separately from the mechanical equipment</td>
<td>MD</td>
<td>ED</td>
<td>ED</td>
</tr>
</tbody>
</table>

C. Notes: (1) MD: Mechanical Divisions 21, 22, 23. (2) ED: Electrical Division 26. (3) Fire Alarm related and power wiring provided under Division 26; Control-related wiring and relays provided under Divisions 21, 22, 23. (4) If furnished as part of factory equipment under Divisions 21, 22, 23, wiring and connections only by Electrical Division 26. (5) If any control devices carry the Full Load Current to any motor, they shall be furnished under Divisions 21, 22, 23, but shall be set in place and connected under Division 26. (6) Except where indicated as part of a motor control center on the Electrical Drawings. (7) Division 26 shall provide the logic contact closure and the wiring to the local DDC temperature control panel. Division 26 shall also provide interface with the fire alarm system, proof of flow devices (duct/fan air flow switches), connecting wiring, smoke control logic, panel, relays, damper monitoring, and associated devices for a complete smoke control system.

1.9 ACCESSIBILITY

A. Contractor is responsible for verifying that equipment and devices will fit within the space shown on the drawings. Contractor shall locate all equipment which must be serviced, operated or maintained, if fully accessible positions.

B. Minor deviations from the drawings may be made to allow for better accessibility, but changes of magnitude or which involve extra cost shall not be made without approval from the Architect/Engineer.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with a minimum of five years documented experience. Company personnel shall be approved by manufacturer for all product installations and required training.

C. Conform to all applicable standards, codes and regulation and industry best practice requirements.

D. All materials and equipment shall be new, shall bear manufacturer’s name, and shall conform to the grade, quality and standards specified herein. Type, capacity and application shall be suitable and capable of satisfactory operation for the purpose intended. All equipment and components shall include UL label and/or marking on equipment body/device.
including manufacturer’s name, pressure rating(s), electrical classification(s), limits and ratings as applicable to individual components for the purpose specified and intended.

E. Equipment Selection: All items of a given type shall be the product of the same manufacturer. Equipment of greater or larger power, dimensions, capacities, and ratings may be considered provided such proposed equipment is approved in writing by Architect/Engineer and connecting electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. See Deviations and Substitutions for requirements. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings of efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

F. Listing and labeling: Provide motors that are listed and labeled. Terms “listed and labeled”: as defined by UL, NEC, Article 100 or other applicable recognized agency as specified in the Contract Documents.

G. Cutting and Patching: Unless otherwise required by the Contract Documents, Contractor shall be responsible for all cutting, fitting and patching required to complete the Work, or to make portions of the Work and existing conditions fit together properly, and all such areas shall be restored to the conditions existing prior to the cutting, fitting and patching unless otherwise provided in the Contract Documents.

H. Contractor shall promptly correct any portion of the Work that is defective or not in accordance with the Contract Documents or rejected by the Architect/Engineer or Owner. Contractor shall be responsible for, and pay for all costs arising out of, any additional testing and inspections, demolition, uncovering and replacement and additional design and consulting services required to properly correct any portion of the Work.

I. Contractor shall comply with the Contract Documents and all Laws, standards and handling criteria regarding hazardous substances, wastes and materials, including asbestos-containing materials, lead-based paints, petroleum (or any constituent thereof), mold, radon, and polychlorinated biphenyl (PCB), (“Hazardous Materials”) in performing the Work. Unless required by the Contract Documents, no Hazardous Materials shall be brought onto the Project.

J. Lead Free Requirements: Contractor shall endeavor to use lead free products and where required by law, ordinance, regulation or standard all materials products and practices shall comply with limitations and requirements as to the allowable limits and/or percentages of lead. Lead free products must be certified by and independent 3rd party.

1. This provision shall apply to any and all similarly regulated materials, products and practices that may be considered hazardous or are otherwise regulated by applicable law, ordinance regulation or standard in the project local.

1.11 DELIVERY, STORAGE, AND HANDLING

A. All materials and equipment shall be adequately covered and protected against dirt, water, chemical or mechanical damage, and theft. At completion, all work, equipment and materials shall be cleaned, and damage repaired by Contractor. Damaged equipment will be replaced by the Contractor if Owner does not accept repairs done to the equipment. Such replacement shall be scheduled to minimize building system interruption of occupied or scheduled for occupancy.
B. Material delivered at the site shall not be left exposed to the weather or left unattended. Deliver pipes, tubes and conduit with factory-applied end-caps. Contractor shall be responsible to maintain end-caps or provide temporary end caps on all open-ended piping, tubes and conduit through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

C. Protect stored material from moisture and dirt. Protect plastic pipes and materials from sunlight and support to prevent sagging and bending.

D. Elevate stored materials above grade. When stored inside, to not exceed structural capacity of the floor.

E. Provide protective coatings to materials to prevent damage and/or infiltration of moisture and dirt on all materials and equipment including but not limited to cast iron and steel valves.

F. Contractor shall check the openings in the building and the size of the doors, passages, and openings through which equipment is to be admitted. Wherever necessary, Contractor shall provide the equipment in sections or knocked down in order to admit the equipment through these openings.

G. Contractor shall provide all rigging, erection and hoisting equipment as required to handle or place equipment and piping in position. This rigging and hoisting equipment shall only be attached and placed on the structure in locations as approved by Architect/Engineer at the site.

1.12 PERMITS, FEES AND UTILITIES

A. Obtain and pay for all necessary permits, fees and utilities and inspections required to perform the Work.

B. Coordinate work with local regulatory entities, utility companies and others as required to fully comply with the requirements of this section and the Contract Documents, including those for both temporary and permanent services.

C. Permits, fees and utility expenses to be paid by Owner, if any, shall only where specifically required by the Contract Documents, and then only to the extent so specified.

1.13 DOCUMENT OWNERSHIP

A. The Drawings and Specifications, combined with the calculations, field data, notes, and reports, are the intellectual and real property of the Architect and/or Engineer. This covers all forms of written and recorded or electronic media. The reuse of these documents without specific permission of the Engineer is prohibited. The Drawings may be employed by the Owner and Contractor for the express use of constructing, commissioning and operating the facility only upon proper execution of the Agreement for Use of Electronic Files and Data.

1.14 GUARANTEE AND WARRANTY

A. Contractor warrants to Owner that the materials and equipment provided under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects. Work, materials and equipment not conforming to these requirements, including substitutions not properly approved by Change Order, shall be considered defective. This warranty excludes remedy for damage caused by improper or
insufficient maintenance, improper operation or normal wear, tear and usage. Contractor shall assign to Owner, or otherwise assure the Owner has the full benefit of, all warranties and guarantees of manufacturer, subcontractors, sub-subcontractors and suppliers, and Contractor shall perform the Work in a manner that does not adversely affect or invalidate any available warranties or guarantees.

B. Contractor shall warrant and guarantee all work against faulty material or workmanship for a period of one year from the date of final completion and written acceptance by the Owner, unless specified more stringently elsewhere in the Contract Documents.

C. If the project is occupied or the systems placed in operation in several phases at the request of the Owner, the guarantee of each system or piece of equipment used shall begin on the date each system or piece of equipment was placed in satisfactory operation, tested, commissioned and accepted, in writing, by the Owner. The use of building equipment for temporary service and testing or phases of work completed prior to the projects final completion and acceptance by the Owner does not constitute the commencement of the warranty period.

D. If a defect or deficiency in the Work is discovered within the one year Warranty and Guarantee period or within such longer period as may be prescribed by the Laws or by any specific guarantee, and Owner elects to have Contractor correct such defect or deficiency, Owner shall notify Contractor of such defect or deficiency in writing. This period of correction relates only to the specific obligation to correct defects and deficiencies and in no way otherwise limits the Contractor’s responsibility for Work that is not in accordance with the Contract Documents, If Contractor fails to timely correct defects or deficiencies in the Work, Owner may, at its sole option, correct them and charge Contractor for all cost therefore.

E. See Division 01 – Closeout Submittals for additional warranty requirements.

F. Specific exclusions, if any, from this one year warrantee and guarantee period are listed in the individual specification sections.

1.15 LIMITATIONS OF LIABILITY

A. To the extent any of the following provisions are not more stringently included in the Contract Document the following Limitations of Liability shall apply:

B. Architect/Engineer is not responsible for Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and is not responsible for Contractor’s failure to perform or furnish the work in accordance with the Contract Documents.

C. In the event that Architect/Engineer's employees or sub-consultants make comments or issue warnings about safety issues, such comments and warnings shall be considered to have been offered by a Good Samaritan and shall not impose any obligation or responsibility.

D. Engineer will not be responsible for the acts or omissions of Owner, Contractor, any subcontractor, any supplier, or of any other person or organization performing or furnishing any of the portions of the work.

E. Contractor understands and acknowledges that Engineer is not authorized to order extra work or issue Change Orders to the work, however in the event and to the degree that Engineer may offer advice, suggestions, and opinions Contractor shall not rely on such
advice, suggestions, and opinions unless directed in writing by Owner or its designated representative, and shall, in no event, make any claim against the Engineer for any such advice, suggestions, and opinions.

F. To the fullest extent permitted by law, Contractor shall indemnify and hold harmless Architect, Engineer, and their joint ventures, officers, directors, partners, employees and agents from and against any and all claims, costs, losses and damages (including but not limited to all fees and charge of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused in whole or in part by the negligent acts or omissions of Contractor, Contractor’s officers, directors, partners, employees, agents; or Contractor’s subcontractors or material men in the performance of Work. Contractor shall direct its insurer to list Architect, Engineer, and their joint ventures, as Additional Insureds on general liability insurance policies covering this project. Prior to commencing work, Contractor shall submit copies of its certificate of insurance to both Architect and Engineer.

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. Manufacturer: Unless otherwise specified, company specializing in manufacturing specified products for at least three years.

2.2 MATERIALS AND EQUIPMENT

A. The device numbers noted in this specification are generally those of a specific manufacturer and represent the minimum quality required as the basis of design for this project. Subject to the Substitutions and other provisions of the Contract Documents, Contractor may submit equivalent devices from the other manufacturers listed in the section.

B. Materials and equipment used in carrying out these specifications shall be new and have UL listing, or listing by other recognized testing laboratory when such listings are available.

C. All material shall bear manufacturer’s name, model number, electrical characteristics and other identification and shall be the standard product of manufacturer regularly engaged in production of similar material.

D. Construction of equipment shall be as follows:

1. All prefabricated equipment shall be designed and constructed in such a manner that all parts of said equipment and the equipment as a whole, including attachments, will resist the forces (including seismic where applicable) to which they may be subjected.

2. Unless otherwise specified or required, design criteria shall be no less than 1.5g for lateral forces and 0.6g for vertical forces.

3. Provisions for support and anchorage of equipment shall be an integral part of each item and shall include the fastening means and all necessary internal and external bracing, brackets and connections.
E. Specifications for many items are or may be described on the drawings, including but not limited to wiring devices, lighting fixtures, control devices, etc., are or may be described on the drawings. Contractor shall promptly advise Architect of any conflicts or discrepancies.

F. Except for conduit, conduit fittings, outlet boxes, wire and cable (600V and below only), all items of equipment or material shall be the product of one manufacturer throughout.

G. The documents contain specifications regarding equipment design, including BIL levels, AIC ratings, and series ratings. In all cases provide equipment sufficient for the use intended. Do not provide materials whose ratings fall below those included in the Documents.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Refer to Division 01 Sections for “Cutting and Patching” and “Selective Demolition” and “Minor Demolition” in this Section for general demolition requirements and procedures.

B. Disconnect, demolish, and remove systems, equipment, and components indicated to be removed.

1. Raceways to Be Removed: Remove portion of raceways and wire indicated to be removed and cap or plug remaining piping with same or compatible material.

2. Raceways to Be Abandoned in Place: Remove wire, cap or plug 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.

   a. If raceways, wire or other components 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 CONTINUITY OF SERVICES AND CONNECTION TO EXISTING WORK

A. Contractor, in the performance of the Work shall plan for and incorporate into the work the continuity of services. Where the continuity of service(s) is required to be interrupted Contractor shall plan and schedule the work to minimize interruptions to the facility and its normal operations, prearrange and coordinate all outages/interruptions with Owner’s representative, utilities and the work of others. Requests for system interruptions/outages must be submitted at least five days prior to intended shutdown time and then subject to Owner’s adjustment and/or approval.

B. For connections that require a significant down-time or interruption to facility operations (as determined by the Owner), Contractor shall provide for Owner’s written approval a detailed plan, schedule and description of the work for each system interruption. The plan shall include a description and schedule of each work item to be completed, designation of site supervisor and contact information, designated work crew as well as facility access and egress points for materials, manpower and equipment, contingency plan for parts, materials
and equipment as well as a program to restore systems in the event of unplanned disruption or inability to complete the work in the timeframe scheduled and approved by Owner. Contractor shall confirm scheduled dates with the Owner and provide a minimum of five days advance notice for each operation.

C. Tap connections shall not be performed on “live,” “wet” or “hot,” systems.

D. Contractor shall include all costs for overtime labor, expedited materials, equipment and contingency planning as necessary to maintain continuity of services, schedule and complete necessary connections. Contractor shall also include provisions for maintaining any and all supplemental systems that may be required to remain in service for the safety, protection and critical operations of the facility and its occupants including but not limited to: Fire Alarm, Security, Phone/Data, BAS, Emergency Power and similarly related critical or emergency systems. Such provisions shall include but not be limited to temporary power, lighting, materials, equipment and/or installations (including removal and cleanup thereof) required to maintain such systems and as required to safely and properly complete the work.

E. Contractor shall be liable for any and all damages resulting from unscheduled outages/interruptions or for those not confined to the pre-approved timeframes to complete the work.

3.3 UTILITY SERVICE(S)

A. Contractor shall be responsible for verifying and coordinating the work with local utility companies providing service to the facility and/or site and coordination with the work of others. This shall include, but not be limited to:

1. Confirmation of schedule and service routing and sequence of the work to be performed by each utility, Contractor, subcontractor or others to ensure that the work can be performed without impact to the project schedule and with minimum interruption to services.

2. Verification of utility services point of entry to the facility, including applicable invert elevations, proper placement of sleeves and/or penetrations and sealant thereof.

3. Establishing utility point of contact, documenting the local utility company representatives:
   a. Company:
   b. Contact Person:
   c. Contact Telephone Number:
   d. Provide required connections for each incoming utility service.

3.4 ELECTRICAL SYSTEMS

A. Visit site and observe conditions under which work must be performed.

B. Before starting work, carefully examine Architectural, Civil, Landscape, Structural, Plumbing, Heating, Ventilating and Air Conditioning drawings to become thoroughly familiar with conditions governing work on this project. Verify elevations, measurements, rough-in requirements of equipment and it installation location before proceeding with the work. Install equipment with access as required by the NEC.
C. Circuit "tags" on the Electrical Drawings in the form of arrows are used to indicate home runs of raceways to electrical distribution points. These tags show the circuits in each home run and the panel designation. Do not combine circuits other than those shown or allowed on the Drawings. Show the actual circuit numbers on the finished record drawing, and on the panel directory card. Provide an insulated grounding conductor sized in accordance with NEC in every power circuit.

D. The general directions and location of homeruns are indicated on Drawings and are to be extended to panels as though routes were completely shown. Items which are installed other than as shown on Drawings and without receiving prior written approval will be ordered removed and installed as shown without additional cost to Owner.

E. The Drawings do not indicate the exact number of wires in each conduit for the branch circuit wiring. Provide the correct quantity of wires as indicated by: the circuit numbers indicated, wiring diagrams, and by applicable requirements of the NEC.

F. Electrical Drawings are diagrammatic and shall not be scaled for exact sizes. Adjust location of conduits, panels, equipment, pull boxes and fixtures to accommodate the work and to prevent interferences.
   1. Lines which pitch have right-of-way over those that do not. Lines whose elevation cannot be changed have right-of-way over lines whose elevations can.
   2. Make offsets, transitions, and changes in direction in raceways as required to maintain proper headroom pitch of sloping lines.

G. Wire and cable routing shown on the Drawings is approximate. Route wire and cable as required to meet Project Conditions.

H. When wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

I. The Drawings are diagrammatic. They do not show every offset, bend, conduit body, elbow or junction box that may be required to install work in the space provided and avoid conflicts. Follow the Drawings as closely as is practical and install additional bends, offsets and elbows where needed by local job site conditions. Provide necessary junction boxes to meet code regulations for the allowed number of conduit bends.

J. Establish sizes and locations of the various concrete bases required. Coordinate and provide all necessary anchor bolts together with templates for holding these bolts in position.

K. Provide supports, blocking, hangers, and auxiliary structural members required for support of work.

L. Furnish and set all sleeves for passage of raceways through structural, masonry, and concrete walls, floors, and elsewhere for proper protection of the raceways.

M. Establish size, location, and count of cast-in conduits or conduits to be concealed underneath the foundations. Coordinate with steel reinforcing.

N. The architectural drawings govern the locations and elevations of all electrical equipment, devices and fixtures. Resolve conflicts with the Architect prior to rough-in.
O. Verify that the physical dimension of each item of electrical equipment will fit the available space. Coordinate electrical equipment space requirements with the allotted space provisions, and access routes through the construction area.

P. Coordinate rough-in and wiring requirements for all mechanical, kitchen and other equipment with equipment supplier and installer. Make installation in accordance with rough-in and wiring diagrams provided by equipment supplier and installer.

Q. Coordinate all aspects of the electrical, telephone and other utility services with the appropriate serving utility company.

R. Coordinate underground work with other contractors working on the site. Common trenches may be used with other trades. In such areas, maintain clearances as required by codes and ordinances.

S. Coordinate underground work with foundation plans and work.

T. Existing wires, conduits, pipes, ducts or other service facilities are shown in a general way only. The Contractor shall visit the site and make exact determination of the existence of any such facilities prior to submission of his bid. It is understood that he will be responsible for making the exact determination of the location and condition of these facilities.

U. The location of utilities indicated on the plans is taken from existing public records. The exact location and elevation of public utilities must be determined by the Contractor. The Contractor shall ascertain whether any additional facilities other than those shown on the Drawings may be present.

V. Call to the attention of the Architect any error, conflict or discrepancy in Plans and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made. Supplementary Details and Plans may be supplied as required and they will become a part of the Contract Documents.

W. Arrange work to reduce interruption of any existing service to minimum. When interruptions are unavoidable, consult Owner or Utility involved and agree in writing, with copy to the Architect, upon a mutually satisfactory time and duration.

X. No circuits shall be turned off without prior approval from Owner. Coordinate with the operations, normal activities, building access, etc. Coordinate work with other crafts for proper scheduling.

3.5 EQUIPMENT INSTALLATION

A. Follow manufacturer's instructions.

B. Where the product has no manufacturer's instructions, follow these specifications. Where neither the manufacturer nor these specifications contain such instructions, install in accordance with the standards listed above. No allowance of any kind will be made for negligence on part of Contractor to foresee means of bringing in or installing equipment into position.

1. Verify all dimensions by field measurements.

2. Install systems, materials, and equipment to provide the maximum headroom possible.
3. Install systems, materials, and equipment to comply with approved submittal data, including coordination drawings.

4. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

5. Fit surface panels, devices and outlets with neat, appropriate trims, plates or covers, without over-hanging edges, protruding corners or raw edges, to leave a finished appearance.

6. Extend maintenance and access components (i.e., grease fittings, service panels, and similar items) to accessible locations.

7. Install equipment to allow right of way for piping installed at required slope.

C. Locations:

1. Verify all locations with actual field conditions, architectural, structural, electrical, plumbing, heating and ventilating plans to avert possible installation conflicts.

2. Architect reserves the right to make minor changes prior to installation without cost to Owner.

3. Coordinate work with that of other trades to assure symmetrical placing of fixtures, sprinkler heads and other exposed components with respect to ceiling tile, grilles, etc. See Architectural reflected ceiling plan for exact location of light fixtures and other equipment.

4. Any work which is incorrectly installed without prior verification without required coordination will be ordered removed and relocated and any changes or damage resulting to other work shall be repaired and/or replaced at no cost to the Owner.

5. In general, locate all finished devices or other exposed finished devices as indicated on or by symbols on drawings. Where devices or other exposed finished components occur in face, decks or base millwork, walls, ceilings or other finished surfaces carefully coordinate with details and arrangements of same.

6. All mounting heights shown on drawings are from finish floor to centerline unless otherwise indicated or required by code. Mounting heights at non-typical locations shown with (+) sign and height required noted adjacent to such device. Devices located in concrete block, brick or tile walls are to be adjusted in height to coordinate with modular joints of the materials. Verify requirements with Architect prior to installation.

7. Wiring Requirements: Install wiring complete to every outlet with all devices shown and/or required. All wiring to be in raceways and concealed throughout finished areas unless specifically noted otherwise. For the purpose of electrical specifications, all areas, with the exception of boiler rooms, mechanical rooms and mechanical spaces, are to be considered as finished areas.

D. Equipment Connections:

1. Coordinate the work with that of other trades to ensure all required connections are provided to ensure proper installation and operation.

2. Provide complete electrical connections for all items of equipment requiring such connections, including incidental wiring, materials, devices and labor necessary for a finished working installation.

3. Verify the location and method for connecting to each item of equipment prior to roughing-in. Check voltage and phase of each item of equipment before connection.
4. Make motor connections for the proper direction of rotation.

3.6 NOISE CONTROL

A. Provide insulation, isolators and other sound attenuation requirements as specified by Contract Documents.

B. Back to back or straight through boxes are not permitted unless specifically noted on the drawings.

C. Contactors, transformers, starters and similar noise producing devices shall not be placed on walls which are common to occupied spaces unless specifically called for on the drawings. Where equipment is mounted on wall common to occupied spaces, provide shock mounting or noise isolators to effectively prevent transmission to occupied spaces.

D. Ballasts, contactors, starters transformers and like equipment found noticeably noisier than similar equipment of same type are to be removed and replaced as directed by Architect at no cost to Owner.

E. Route raceways along corridors or other noncritical noise space to minimize penetrations through sound rated walls. Seal raceway penetrations through sound rated walls.

3.7 FIRE WALL PENETRATIONS

A. Perform necessary fire rated wall sealing for the work in accordance with Division 07 - Thermal and Moisture Protection.

B. Provide necessary wall material to maintain fire wall rating where flush mounted equipment or components installed.

C. Where systems or components penetrate floors, ceilings, ducts, chases and fire walls, provide fire stopping to maintain integrity of the fire assembly. Fire stopping method shall be approved by the authority having jurisdiction.

D. Where electrical boxes with total area exceeding 16 sq inches are located in fire resistive walls, fire stopping shall be provided to maintain integrity of the fire assembly.

E. Where electrical boxes are installed on opposite sides of a rated wall, horizontal separation between the boxes shall be a minimum of 24 inches. Horizontal separation of these boxes may be less than 24 inches if a UL approved protective material is utilized.

1. Electrical boxes shall not be installed back to back in rated walls.
   a. The aggregate surface area of the boxes shall not exceed 100 sq inches per 100 sq ft. of wall surface.

3.8 EQUIPMENT SUPPORT

A. General:

1. Provide a system of supporting devices and hangers for support and bracing of piping, conduit and equipment as required by code or as provided under this Division as indicated on plans and as described herein.

2. Do not install supporting devices so as to obstruct access to equipment.
3. Floor-mounted equipment shall not be held in place solely by its own dead weight. Include floor anchor fastening in all cases.

4. Do not support ductwork, piping, conduits, conductors, or equipment from other piping, conduits, ceiling grids, equipment, ductwork, or ceiling supports. In all cases, provide independent supports for such components and equipment.

B . Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to code (including seismic codes where applicable).

1. Construct concrete bases and form equipment anchorages as detailed in the structural drawings.
2. Construct concrete bases of dimensions indicated, but not less than 4-inches larger in both directions than supported unit.
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 concrete and reinforcement as specified in Division 03 Sections and the Structural Drawings.

C . Metal Supports and Anchorages:

1. Refer to local codes, practices and standards for installation and material requirements and limitations relating to the use of metal supports and anchorages (including applicable seismic requirements).
2. Refer to Division 05 Section "Metal Fabrications" for structural steel.
3. Field Welding: Comply with AWS D1.1.

D . Wood Supports and Anchorages:

1. Refer to local codes, practices and standards for installation and material requirements and limitations relating to the use of wood supports and anchorages (i.e., fire retardant materials).
2. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor materials and equipment.
3. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
4. Attach to substrates as required to support applied loads.

E . Grouting:

1. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
2. Clean surfaces that will come into contact with grout.
3. Provide forms as required for placement of grout.
4. Avoid air entrapment during placement of grout.
5. Place grout, completely filling equipment bases.
6. Place grout on concrete bases and provide smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout.

3.9 PAINTING

A. Painting of systems, equipment, and components is specified in Division 09. Unless and to the extent that painting is not specified elsewhere in the Contract Documents, all exposed materials in finished areas and on exterior walls shall be painted to match surrounding surfaces.

B. Contractor shall be responsible for and shall coordinate the timing of painting with the work of other trades and to minimize the requirements for damage and touchup to the work.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 CUTTING, PATCHING AND CORE DRILLING

A. General:
   1. Refer to Divisions 01, 03, and other related provision of the Contract Documents, including Structural Drawings and Specifications for requirements relating to cutting, patching and core drilling of walls, floors and other surfaces.
   2. Do not cut or break any steel or wood framing, concrete, masonry, or partitions, etc., without permission from the Architect or as shown on the Drawings.
   3. Subject to the provisions of this Section and other portions of the Contract Documents cut, channel, chase and drill floors, walls, partitions and ceilings as necessary for the proper installation, support and anchorage of piping, ductwork, raceway, boxes, and other equipment.
   4. Repair any damage to the building, piping, equipment, or finish.
   5. Perform repairs with materials matching the original and install in accordance with appropriate sections of the Contract Documents.
   6. Where trenching is done through existing paving, walks, curbs, etc., Contractor is responsible for patching and repairs to original condition.
   7. In new work, patch and refinish all finished surfaces damaged by this Contractor to match adjacent surface.
   8. Where new work is installed in the existing building, patch and refinish surfaces damaged to match existing. Refinishing to be as directed by the Architect.
   9. All related refinishing to be as directed by the Architect.

B. All cutting, patching and/or core drilling of structural systems that are do not appear on or that deviate in any way from the Structural Drawings must be preapproved by the Structural Engineer and Contractor shall provide all data, calculations and/or other requirements as...
maybe required by the Structural Engineer, prior to commencement of the work, including but not limited to:

1. X-Ray of structural systems to show the actual location of reinforcement.
2. Size and dimensions of penetrating ductwork, piping or conduit including placement within desired opening and required clearances, means of fastening and/or support including all anchoring systems and fasteners.
3. As a general rule, subject to adjustment by Structural Engineer, penetrating ductwork, piping or conduit shall pass through the center of all structural openings, avoiding structural members by minimums specified on the Structural Drawings.

C . Core Drilling Layouts: Unless otherwise specified in the Contract Documents Contractor shall provide to the Structural Engineer a complete floor by floor core drilling layout for all required floor core penetrations in advance of the work for Structural Engineer’s review and approval. Core drilling layouts shall include size, dimension and specific locations of core drilling for all trades. Contractor shall not be permitted to conduct independent coring without providing such layout to Structural Engineer.

3.11 EXCAVATION, BACKFILL AND WATERPROOFING

A . Refer to Divisions 01, 02, and other related provisions of the Contract Documents, including but not limited to Sitework and Structural Drawings and related specifications for requirements relating to excavation, backfill and waterproofing for each trade.

B . Do necessary trenching and excavating for installation of underground piping, raceways and equipment. Use necessary precautions not to affect the bearing value of soil under and near footings. Excavate trenches with proper pitch 6-inches deeper than required by line grade and prefilt to line grade with pea gravel. Where trenching occurs through existing paving, walks, curbs, etc., patch and repair to original conditions. Compact backfill with vibratory or roller compaction equipment in 9-inch layers to 90 percent density. Dispose of excess excavated material as directed. Backfill under floor slabs and under hard surfaced yard areas (i.e., walks, drives, parking areas) to be crushed rock unless otherwise indicated, compacted in 9-inch layers. Backfill material and compaction to comply with Site Work Section of these Specifications.

C . Provide and maintain ample means and devices with which to promptly remove and dispose of water entering the excavation during the time it is being prepared for the piping, raceways or equipment laying, during the laying of materials or equipment and until the backfill has been completed.

D . Avoid, if possible, penetrations of waterproof membranes. Where such penetration is required, perform it prior to waterproofing and in accordance with Architectural details. Where penetrations are not detailed or must be conducted through waterproof membranes, provide a detail of the penetrations for approval of the Architect.

3.12 SAFETY AND PROTECTION

A . The Contract Documents do not include nor is Architect/Engineer responsible for the design of construction details or instructions relating to Contractor’ safety or protective measures or precautions or as it pertains to its means, methods, techniques, sequences or procedures required for to perform the work.
B. Provide necessary shoring, railing, barricades, protective devices, temporary systems/supports, safety instructions and procedures to perform the work safely and to comply with the Safety Requirements of the governing authorities.

C. Unless otherwise specifically detailed and included, the Contract Documents represent the finished state of all systems and components related to the work and it is Contractor’s sole responsibility to provide the necessary means, methods, equipment and protection of the work and those performing the work during construction. Neither Architect/Engineer nor any of their respective subconsultants shall be responsible or liable for Contractors failure to adequately protect the work or those performing the work during construction.

3.13 FUTURE PROVISIONS TO BE INCLUDED IN THE WORK

A. The following provisions shall be provided for and included in the work:
   1. Provide pull line in each empty conduit provided for future installation of wiring.
   2. At all systems such as fire alarm, clock and program, intercom, etc., where future stations are to be fed from adjacent outlets or terminal cabinets, all conductors required for complete installation of additional units are to be provided to nearest outlet or terminal cabinet as required. In general, all wiring installed so it will not be necessary to remove existing conductors and re-pull additional wiring to install additional units. All spare conductors properly labeled and terminated in outlet boxes or at terminals in terminal cabinets.

3.14 CLEANING

A. General:
   1. At all times keep the premises free from accumulation of waste materials or rubbish caused by the employees or the work. At the completion of the work, remove all superfluous materials, equipment and debris related to or resulting from the work.
   2. All systems, equipment and component including but not limited to all panels, compartments, points of access, surface areas, panels, whether concealed or not shall be free from debris, filings, clippings, dirt, dust and debris and in a new condition. Touch up paint where necessary.
   3. Where existing systems are expanded and/or remodeled, clean the new installation prior to making final connection to the existing systems.

3.15 ASBESTOS OR OTHER HAZARDOUS BEARING MATERIAL

A. If during the course of work, the Contractor observes the existence of asbestos, asbestos bearing material or other hazardous material, the Contractor shall immediately terminate further work and notify the Owner of the condition. The Owner will, after consultation with the Architect, determine a further course of action.

3.16 COOPERATION WITH OTHER TRADES

A. Contractor shall cooperate with and coordinate the work with that of all other trades in the performance of the work, including but not limited to; delivery of equipment and materials, furnishing material and location requirements of sleeves, bucks, chases, supports, mountings, backings, inserts, anchor bolts, cast-in-place box-out or steel embeds, routings, sequencing, locations, finished devices, etc., for proper installation of its work. Contractor
shall be responsible for any and all removal, replacement or repairs to its work or the work of others for its failure to fully comply with this provision.

3.17 OPERATION AND INSTRUCTION

A. Upon completion of the work and prior to final acceptance, Contractor shall operate the equipment for a period as required to fully instruct the Owner and its authorized representatives in all details of operation, adjustment and maintenance. Absent more stringent requirements found elsewhere in the Contract Documents, Contractor shall, at a minimum:

1. Schedule with Owner and its designated representatives a single time and location for a one-day instruction class and submit three copies of certificate, signed by Owner's representatives, attesting to the Owner's authorized representatives having been so instructed. All arrangements shall be made through Architect and Owner's Representative.

2. Thoroughly review and instruct Owner and its designated representatives on all aspects of systems and facilities operations and maintenance utilizing the Instructions and Manuals submitted under the provisions of this Section. Any required instructions from manufacturer’s representatives shall be given during this period.

3. This requirement is in addition to any “Operation Test” specified in the Contract Documents.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Copper building wire.
      2. Metal-clad cable, Type MC, HCF rated.
      3. Connectors and splices.

1.3 SUBMITTALS
   A. Product Data: For each type of product.
   B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE
   A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600-V or less.
   B. Standards:
      1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
      2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
   C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
   D. Conductor Insulation:
      1. Type THHN and Type THWN-2: Comply with UL 83.
   E. Standards:
      1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
      2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
   F. Conductor Insulation:
      1. Type THHN and Type THWN-2: Comply with UL 83.
2.2 METAL-CLAD CABLE, TYPE MC, HCF RATED

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath. Assembly shall be Hospital Care Facility (HCF) rated and include redundant grounding provided by an armor assembly comprised of interlocked armor with a bare aluminum grounding/bonding conductor, and a green insulated copper grounding conductor.

B. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. Comply with UL 1569.
   3. Conductor and Cable Marking: Comply with wire and cable marking according to UL’s “Wire and Cable Marking and Application Guide.”


D. Circuit Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:
   1. Type TFN/THHN/THWN-2: Comply with UL 83.

F. Equipment Ground Conductor: Insulated copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

G. Grounding / Bonding Conductor: Bare Aluminum, complying with ASTM B800 and ASTM B801.

H. Armor: Aluminum, interlocked.

2.3 COLOR CODING

A. All power conductors identified as to phase and voltage by means of color impregnated insulation, as follows:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>ØA</th>
<th>ØB</th>
<th>ØC</th>
<th>Neutral</th>
<th>Ground</th>
<th>Travelers</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120V</td>
<td>Black</td>
<td>Red</td>
<td>Blue</td>
<td>White</td>
<td>Green</td>
<td>Yellow</td>
</tr>
<tr>
<td>480Y/277V</td>
<td>Brown</td>
<td>Orange</td>
<td>Yellow</td>
<td>Gray</td>
<td>Green</td>
<td>Lavender</td>
</tr>
</tbody>
</table>

Note: Travelers are for 3 and 4-way switching.

2. Class 1 and 2 Control Cables: Black.

3. For wire sizes No. 8 AWG and larger, color banding tape, minimum 2-inches wide, may be used at all accessible locations in lieu of colored insulation.

2.4 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Homerun Circuits: Type THHN-THWN, single conductors in raceway.

C. Branch Circuits (from wiring device to homerun junction box): Metal-clad cable, Type MC, HCF rated.

D. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

E. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.

3.2 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.3 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-486B.

B. Make splices, terminations, 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 of slack.

3.4 IDENTIFICATION

A. Identify and color-code conductors and cables according to this specification and Section 260553 "Identification for Electrical Systems."
B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. 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.
   2. Perform each of the following visual and electrical tests:
      a. Test bolted connections for high resistance using one of the following:
         1) A low-resistance ohmmeter.
         2) Calibrated torque wrench.
      b. Inspect compression-applied connectors for correct cable match and indentation.
      c. Inspect for correct identification.
      d. Inspect cable jacket and condition.
      e. Insulation-resistance (Megger) test on each conductor for ground and adjacent conductors. Apply a potential of 1000-V dc for 600-V rated cable for a one-minute duration.
      f. Continuity test on each conductor and cable.
      g. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes grounding and bonding systems and equipment.

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

1.4 INFORMATIONAL SUBMITTALS
A. Field quality-control reports indicating overall resistance to ground and resistance of each electrode.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION
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.
C. Comply with NFPA 99 – Health Care Facilities

2.2 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB (Electrification Products Division).
   4. nVent (ERICO).

2.3 CONDUCTORS
A. Insulated Conductors: Copper wire or cable insulated for 600-V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:
   2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4- by 4-inches in cross section, with 9/32-inch holes spaced 1-1/8-inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600-V and shall be Lexan or PVC, impulse tested at 5000-V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

K. Straps: Solid copper, copper lugs. Rated for 600-A.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

M. Water Pipe Clamps:
   1. Mechanical type, two pieces with stainless-steel bolts.
      b. Listed for direct burial.
   2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4-inch by 10-ft.
PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 30-inches below grade.

C. Grounding Conductors: Green-colored insulation.

D. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape.

E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2-inches minimum from wall, 18-inches above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

F. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

B. Transformers: Connect ground electrode to building steel or main service ground bus bar.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.5 ADDITIONAL REQUIREMENTS FOR HEALTHCARE FACILITIES

A. Install insulated grounding conductor in accordance with NEC 517.14 between normal and essential branch-circuit panelboards serving the same individual patient care vicinity.
3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2-inches below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. Use exothermic welds for all below-grade connections.
   3. For grounding electrode system, install at least two rods spaced at least two-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20-ft. of bare copper conductor not smaller than No. 4 AWG.
   1. If concrete foundation is less than 20-ft. long, coil excess conductor within base of foundation.
   2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.


5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer’s written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

   b. Perform tests by fall-of-potential method according to IEEE 81.

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 5 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
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. Steel slotted support systems.
   2. Aluminum slotted support systems.
   3. Nonmetallic slotted support systems.
   4. Conduit and cable support devices.
   5. Support for conductors in vertical conduit.
   6. Structural steel for fabricated supports and restraints.
   7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
   8. Fabricated metal equipment support assemblies.

B. Related Requirements:
   1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Slotted support systems, hardware, and accessories.
      b. Clamps.
      c. Hangers.
      d. Sockets.
      e. Eye nuts.
      f. Fasteners.
      g. Anchors.
      h. Saddles.
      i. Brackets.
   2. Include rated capacities and furnished specialties and accessories.
B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
   2. Slotted support systems.
   3. Equipment supports.
   4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.
   1. Include design calculations and details of hangers.
   2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Ductwork, piping, fittings, and supports.
   3. Structural members to which hangers and supports will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Items penetrating finished ceiling, including the following:
      a. Luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Projectors.

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
   2. Component Importance Factor: 1.5.

C. 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 Rating: Class 1.
   2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch diameter holes at a maximum of 8-inches o.c. in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   4. Channel Width: Selected for applicable load criteria.
   5. Retain one or more of "Metallic Coatings," "Nonmetallic Coatings," and "Painted Coatings" subparagraphs below. Coordinate with appropriate coating or painting Section.
   7. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   8. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   9. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch diameter holes at a maximum of 8-inches o.c. in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, provide products by available manufacturers.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
5. Channel Width: Selected for applicable load criteria.
6. Retain "Nonmetallic Coatings" or "Painted Coatings" Subparagraph below, or both. Coordinate with appropriate coating or painting Section.
7. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
8. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
9. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C . Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch diameter holes at a maximum of 8-inches o.c., in at least one surface.
1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channel Width: Selected for applicable load criteria.
4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
5. Fitting and Accessory Materials: Same as those for channels and angles.
6. Rated Strength: Selected to suit applicable load criteria.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D . Conduit and Cable Support Devices: Steel Stainless-steel 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 nonarmored 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 made of malleable iron.

F . Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

G . Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Approved for the application.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2.3 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 Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as NFPA 70. Minimum rod size shall be 1/4-inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. 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 may be supported by openings through structure members, according to 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4-inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4-inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.
3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4-inches larger in both directions than supported unit, and so anchors will be a minimum of ten bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Metal conduits, tubing, and fittings.
   2. Nonmetal conduits, tubing, and fittings.
   3. Metal wireways and auxiliary gutters.
   4. Nonmetal wireways and auxiliary gutters.
   5. Surface raceways.
   7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:
   1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.
   2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit and IMC.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040-inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. **Fittings for EMT:**
   a. **Material:** Steel.
   b. **Type:** Compression.

3. **Expansion Fittings:** PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

4. **Coating for Fittings for PVC-Coated Conduit:** Minimum thickness of 0.040-inch, with overlapping sleeves protecting threaded joints.

### 2.2 NONMETALLIC CONDUITS AND FITTINGS

A. **Listing and Labeling:** Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. **Fiberglass:**
   2. Comply with UL 2515 for aboveground raceways.
   3. Comply with UL 2420 for belowground raceways.

C. **ENT:** Comply with NEMA TC 13 and UL 1653.

D. **RNC:** Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. **LFNC:** Comply with UL 1660.

F. **Rigid HDPE:** Comply with UL 651A.

G. **Continuous HDPE:** Comply with UL 651A.

H. **Coilable HDPE:** Preassembled with conductors or cables and complying with ASTM D 3485.

I. **RTRC:** Comply with UL 2515A and NEMA TC 14.

J. **Fittings for ENT and RNC:** Comply with NEMA TC 3; match to conduit or tubing type and material.

K. **Fittings for LFNC:** Comply with UL 514B.

L. **Solvents and Adhesives:** As recommended by conduit manufacturer.

### 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. **Description:** Sheet metal, complying with UL 870 and NEMA 250, Type as required by the installation environment unless otherwise indicated, and sized according to NFPA 70.

   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Fittings and Accessories: Include covers, 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.

C. Wireway Covers: Hinged type Screw-cover type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets or PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish or as otherwise specified.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:
   1. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable
   1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50-lb. Outlet boxes designed for attachment of luminaires weighing more than 50-lb shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70-lb.
   1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250 and environment installed.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic or Fiberglass.
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:
   1. NEMA 250, NEMA type for environment installed 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.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT 4.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
   d. Gymnasiums.
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: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6-inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12-inches of enclosures to which attached.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-ft. intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 2-inches of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
   5. Change from ENT to GRC before rising above floor.
I. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

M. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12-inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

O. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch radius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48-inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer’s written instructions. Tape and glue are not acceptable support methods.

P. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service raceway enters a building or structure.
   3. Where otherwise required by NFPA 70.

R. Comply with manufacturer’s written instructions for solvent welding RNC and fittings.

S. Expansion-Joint Fittings:
   1. Install in each run of above ground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25-ft. Install in each run of aboveground conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100-ft..
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041-inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078-inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72-inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

V. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

X. Locate boxes so that cover or plate will not span different building finishes.

Y. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

AA. Set metal floor boxes level and flush with finished floor surface.

BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A . Section Includes:
1. Sleeves.
2. Sleeve-seal systems.
5. Silicone sealants.

B . Related Requirements:
1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A . Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A . Cast in place floor or wall sleeves: plastic pipe sleeve.

B . Sleeves for Rectangular Openings:
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50-inches and with no side larger than 16-inches, thickness shall be 0.052-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.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. BWM Company.
b. CALPICO, Inc.
c. Flexicraft Industries.

2. Link-Seal or equal

3. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

4. Pressure Plates: Carbon steel.

5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. HOLDRITE; Reliance Worldwide Company.

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

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.
C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
   a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall, so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2-inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables and refer to architectural documents for waterproofing.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using mechanical sleeve seals. Allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION
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. Color and legend requirements for raceways, conductors, and warning labels and signs.
   2. Labels.
   4. Tapes and stencils.
   5. Tags.
   7. Cable ties.
   9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS


B. Comply with NFPA 70.


D. Comply with ANSI Z535.4 for safety signs and labels.
E. Comply with NFPA 70E and Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600-V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase-and Voltage-Level Identification, 600-V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
   1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Color for Neutral: White
      e. Color for Equipment Grounds: Green.
   3. Colors for 480/277-V Circuits:
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Color for Neutral: Gray.
      e. Color for Equipment Grounds: Green with a yellow stripe.

C. Raceways and Cables Carrying Circuits at More Than 600-V:
   1. Black letters on an orange field.
   2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:
   1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
   1. Manufacturers: Provide products designated for the application.

B. Snap-around Labels: Slit, pretension, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
   1. Manufacturers: Provide products designated for the application.

C. Self-Adhesive Wraparound Labels: Preprinted 3-mil thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
   1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
   2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
   1. Minimum Nominal Size:
      a. 1-1/2- by 6-inches for raceway and conductors
      b. 3-1/2- by 5-inches for equipment.
      c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretension, flexible, solid-colored acrylic sleeves, 2-inches long, with diameters sized to suit diameters and that stay in place by gripping action

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3-mil thick by 1- to 2-inches wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch wide black stripes on 10-inch centers placed diagonally over orange background and is 12-inches wide. Stop stripes at legends.
D. Floor Marking Tape: 2-inchwide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:
   1. Tape:
      a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
      b. Printing on tape shall be permanent and shall not be damaged by burial operations.
      c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
   2. Color and Printing:
      b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
      c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
   3. Tag:
      a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
      b. Width: 3-inches.
      c. Thickness: 4-mils.
      d. Weight: 18.5 lb/1000 sq. ft.
      e. Tensile according to ASTM D 882: 30-lbf and 2500-psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1-inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2- by 2- by 0.05-inch with stamped legend, punched for use with self-locking cable tie fastener.
   1. Manufacturers: Subject to compliance with requirements.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015-inch thick, color-coded for phase and voltage level, with factory screened or printed permanent designations; punched for use with self-locking cable tie fastener.

C. Write-on tags not permitted.

2.7 SIGNS

A. Baked-Enamel Signs:
   1. Manufacturers: Subject to compliance with requirements
   2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7- by 10-inches

B. Metal-Backed Butyrate Signs:
1. Manufacturers: Subject to compliance with requirements.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.

C. Laminated Acrylic or Melamine Plastic Signs:
1. Manufacturers: Subject to compliance with requirements.
2. Engraved legend.
3. Thickness:
   a. For signs up to 20-sq. inch, minimum 1/16-inch.
   b. For signs larger than 20-sq. inch, 1/8-inch thick.
   c. Engraved legend with black letters on white face.
   d. Drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. Manufacturers: Subject to compliance with requirements.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and 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.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and 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.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
   2. Tensile Strength at 73 deg F according to ASTM D 638: 7000-psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600-V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600-V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer and load shedding.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."

M. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2-inches high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6-inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
W. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6- to 8-inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16-inches overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:
1. Place in a location with high visibility and accessibility.
2. Secure using cable ties.

Y. Nonmetallic Preprinted Tags:
1. Place in a location with high visibility and accessibility.
2. Secure using cable ties.

Z. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on minimum 1-1/2-inch high sign; where two lines of text are required, use signs minimum 2-inches high.

AA. Metal-Backed Butyrate Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high sign; where two lines of text are required, use labels 2-inches high.

BB. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high sign; where two lines of text are required, use labels 2-inches high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
C. Concealed Raceways, Duct Banks, more than 600-V, within buildings: Tape and stencil.
  Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch high, black letters on 20-inch centers.
   1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-ft. maximum intervals.

D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600-V: Vinyl wraparound labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-ft. maximum intervals in straight runs, and at 25-ft. maximum intervals in congested areas.

E. Accessible Raceways and Metal-Clad Cables, 600-V or Less, for Service, Feeder, and Branch Circuits, More Than 30-A and 120-V to Ground: Identify with self-adhesive raceway labels vinyl tape applied in bands.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-ft. maximum intervals in straight runs, and at 25-ft. maximum intervals in congested areas.

F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."

G. Power-Circuit Conductor Identification, 600-V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-ft. maximum intervals in straight runs, and at 25-ft. maximum intervals in congested areas.

H. Power-Circuit Conductor Identification, More Than 600-V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

K. Conductors to Be Extended in the Future: Attach marker tape to conductors.

L. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
N. Concealed Raceways and Duct Banks, More Than 600-V, within Buildings: Apply floor marking tape to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12-inches of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

O. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

P. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

Q. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
   1. Apply to exterior of door, cover, or other access.
   2. 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.


S. Operating Instruction Signs: Baked-enamel warning signs or laminated acrylic or melamine plastic signs.

T. Emergency Operating Instruction Signs: Baked-enamel warning signs or laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer and load shedding.

U. Equipment Identification Labels:
   1. Indoor Equipment: Baked-enamel signs or laminated acrylic or melamine plastic sign.
   2. Outdoor Equipment: Laminated acrylic or melamine sign.
   3. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Switchgear.
      e. Switchboards.
      f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
g. Substations.
h. Emergency system boxes and enclosures.
i. Motor-control centers.
j. Enclosed switches.
k. Enclosed circuit breakers.
l. Enclosed controllers.
m. Variable-speed controllers.
n. Push-button stations.
o. Power-transfer equipment.
p. Contactors.
q. Remote-controlled switches, dimmer modules, and control devices.
r. Battery-inverter units.
s. Battery racks.
t. Power-generating units.
u. Monitoring and control equipment.
v. UPS equipment.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. The purpose of this section is to specify the Contractor's responsibilities relative to Division 26 and participation in the commissioning process. See Division 1, Section 019100, “Commissioning,” for Contractor-related commissioning requirements.
   1. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from the Division 26 for:
      a. Testing and start-up of the electrical equipment.
      b. Completion and endorsement of pre-functional test checklists provided by the Commissioning Authority to assure that Division 26 equipment and systems are fully operational and ready for functional testing.
      c. Providing qualified personnel to assist the Commissioning Authority with functional testing to verify equipment/system performance.
      d. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
      e. Providing training for the systems specified in Division 26 with coordination of Owner by the Commissioning Authority.

B. Division 26 shall cooperate with the Commissioning Authority in the following manner:
   1. Allow sufficient time before final completion dates so that electrical testing, lighting control checkout, and functional testing can be accomplished.
   2. Provide labor and material to make corrections when required without undue delay.
   3. Put all electrical systems and equipment into full operation and continue the operation of the same during each working day of commissioning.

C. Related Sections
   1. Section 019100 - Commissioning
   2. Division 22 - Plumbing
   3. Division 23 - Mechanical
   4. Division 26 - Electrical

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Standard certified test equipment for commissioning will be provided by the Commissioning Authority.

B. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.
PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

A. Specific pre-commissioning responsibilities of Division 26 are as follows:
   1. Normal start-up services required to bring each system into a fully operational state.
   2. Complete pre-functional test checklists for all equipment and systems to be commissioned.
   3. Portions of mechanical equipment start-up requiring electrical connections and metering.
   4. Factory start-up services for key equipment and systems specified in Division 26. The Division 26 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.
   5. Demonstrate system readings as requested by the Commissioning Authority and adjust units to achieve specified operation.

3.2 PARTICIPATION IN COMMISSIONING

A. The Division 26 Contractor shall provide skilled technicians to start-up and debug all systems within the Division 26 work (particularly with lighting equipment). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed upon schedules, and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

C. Provide skilled technicians to manipulate the following equipment and systems to be commissioned for functional testing:
   1. Power for mechanical systems
   2. Lighting control systems
   3. Day lighting control system
   4. Emergency power system and restart testing

3.3 WORK TO RESOLVE DEFICIENCIES

A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet Acceptable Performance. Correction of
work will be completed under the direction of the Owner/Architect, with input from the Contractor, Equipment Supplier, and Commissioning Authority. Whereas, all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer-of-Record will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

3.4 ELECTRICAL SYSTEM TESTING

A. Electrical system testing as required in other sections of this specification shall be coordinated with the Commissioning Authority. The Commissioning Authority may witness testing performed by the Division 26 Contractor.

B. All testing documentation related to Division 26 equipment and systems, as specified in other sections of this specification, will be provided to the Commissioning Authority for use and review.

3.5 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes, with a fully occupied building. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required demonstrating performance.

B. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum, and at peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.6 TRAINING

A. The Division 26 Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each electrical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Description:

1. Furnish and install a complete system for the control of lighting and other equipment as indicated on the plans, and as further defined herein. This specification is based on the system referenced in the drawings. An AutoCAD drawing of the facility showing coverage patterns and technical data must be provided with substitution request. All substitutions must clearly identify any and all exceptions to the specifications, with a detailed explanation as to the exception. If substitution is approved, the contractor shall bear the responsibility of a fully functional system to the Owner’s and an Architect’s satisfaction.

2. The lighting control system specified in this section shall provide time-based, sensor-based (both vacancy/occupancy and daylight), and manual lighting control without the use of any centrally hardwired switching equipment (relay panels). The system’s control shall be exerted by directly switching lighting loads on and off and/or dimming.

3. The system shall include but not be limited by the following list: digital switches, digital photocells, Digital Time Clock (DTC) and interface cards to dimming systems, building automation systems, and other devices. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring. They are not the work of this section.

4. The lighting control system shall include the ability to network lighting control devices and relays in multiple areas and or buildings. The system shall include the ability for remote access and control. Specific relays shall be able to be controlled remotely from multiple locations.

B. Section Includes:

1. Wall Switch Sensors
2. Ceiling and Corner Mount Sensors
3. Daylight (Photocell) Sensors
4. Power (Relay) Packs and Supplies
5. Scene Controllers
6. Communication Bridges
7. Sensors to perform vacancy and occupancy modes of control
8. Outdoor motion sensors
9. Emergency shunt relays

C. Related Requirements:
1. Section 265000 “General Lighting Provisions”
2. Section 260943 “Digital Network Lighting Controls”
3. Section 265100 “Interior Lighting Systems”
4. Section 265600 “Exterior Lighting Systems”
5. Section 262726 “Wiring Devices” for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 SUBMITTALS

A. Shop Drawings: Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay devices, switches, DTC, photocells, network interface devices, remote access, dimming modules and other interfaces. Shop drawings shall indicate exact location of each device or an RFI to confirm location. Plans are diagrammatical. EC to verify all lighting control material requirements from approved shop drawings. “Cut Sheet” submittal not acceptable.

B. Product Data: Submit for approval manufacturer's data on the specific lighting control system and components. Submittal shall be electronic format with hard copy available. To prevent departures from approved system operation, electronic files submitted shall be able to be directly downloaded to the specified system at manufacturer facility. Submit a complete bill of materials with part numbers, description and voltage specifications.

C. Manufacturer shall provide free software that can be used to specify the system, detail all programming and generate a single line in a format that can be dropped into industry standard CAD packages.

D. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component if it differs from that illustrated in the riser diagram in these specifications. Submittals that show typical riser diagrams are not acceptable.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: Provide names, versions, and website addresses for locations of installed software.
   3. Device address list.
   4. Printout of software application and graphic screens.
   5. Provide video of training session for Owner.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Faulty operation of lighting control software.
   b. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OCCUPANCY AND PHOTOCELLS

   A. Passive Infrared (PIR) or PIR/Ultrasonic Dual Technology and Microphonic detection technologies shall be acceptable.

   B. Sensors shall be available with zero, one, or two integrated Class 1 switching relays.

   C. Sensors shall be available with one or two occupancy “poles,” each of which provides a programmable time delay.

   D. Sensors shall be available in multiple lens options which are customized for specific applications.

   E. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors, or similar low voltage connection.

   F. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.

   G. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.

   H. Sensors shall be equipped with an automatic override for 100-hour burn-in of lamps. This feature must be available at any time for lamp.

2.2 WALL SWITCH SENSORS

   A. Sensor shall recess into single-gang switch box and fit a standard GFI opening.

   B. Sensor must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.

   C. Sensor shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.

   D. Sensors shall be available in four colors (Ivory, White, Almond, Gray).

2.3 CEILING AND CORNER MOUNT SENSORS

   A. Sensor shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
B. Sensors with dimming control can control 0- to 10-V dc dimmable ballasts by sinking up to 20-mA of Class 2 current (typically forty or more ballasts).

C. All sensors have at least one or two occupancy poles, each of which provides a programmable time delay.

2.4 DAYLIGHT (PHOTOCELL) SENSORS

A. Sensor shall provide for an On/Off set-point, and a deadband to prevent the electric light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

B. Sensors’ set-point and deadband shall be automatically calibrated through the sensor’s micro-controller by initiating the “Automatic Set-point Programming” subroutine. Further adjustment may be made manually if needed. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

C. Sensors with dimming control can control 0- to 10-V dc dimmable ballasts by sinking up to 20 mA of Class 2 current (typically forty or more ballasts).

D. Photocell sensor’s set point shall be automatically calibrated through the sensor’s micro-controller by initiating the “Automatic Set-point Programming” subroutine. Min and Max dim settings as well as set-point may be manually entered.

E. Dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.

2.5 POWER (RELAY) PACKS AND SUPPLIES

A. Power Packs shall accept 120- or 277-V ac (or optionally 347-V ac), be plenum rated, and provide Class 2 power to the system.

B. All devices shall have two RJ-45 ports.

C. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device pushbutton.

D. Power Pack shall securely mount to junction location through a threaded 1/2-inch chase nipple. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

E. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

F. Power Pack shall incorporate a Class 1 relay and contribute low voltage power to the rest of the system. Slave Packs shall incorporate the relay but shall not be required to contribute system power. Power Supplies shall provide system power only but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
G. Class 1 Relays used in Power (Slave) Packs shall provide 16-Amp switching of all load types and be rated for 400,000 cycles.

2.6 SCENE CONTROLLERS

A. Device shall recess into single-gang switch box and fit a standard GFI opening.

B. Device shall provide user control via pushbuttons. Touch screens are also acceptable in larger formats.

C. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

D. All sensors shall have two RJ-45 ports.

E. Device shall have two or four buttons for selecting programmable lighting control profiles. Touch screens are also acceptable.

F. Device shall have LEDs indicating current selection.

2.7 COMMUNICATION BRIDGES

A. Device shall surface mount to a standard 4-inch x 4-inch square junction box.

B. Device shall have 8 RJ-45 ports.

C. Device shall be capable of aggregating communication with connected daisy-chains of system devices.

D. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that ratings and configurations of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 EQUIPMENT INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable.

B. Install products in accordance with manufacturer's instructions.

C. Define each dimmer/relay load type, assign each load to a zone, and set control functions.
D. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.

E. LED Light Engine/Array Lead Length: Do not exceed 100-ft.

F. Switches: Provide outlet boxes, single or multi-gang, as shown on the plans for the low voltage digital switches. Mount switches as per plans. Supply faceplates per plans and specifications. EC is specifically responsible to supply and install the required low voltage cable between all switches and panels. All low voltage wire to be run in conduit, per local codes.

3.3 WIRING

A. Do not mix low voltage and high voltage conductors in the same conduit. No exceptions without written authorization from manufacturer.

B. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.

C. Follow manufacturer recommendations for all systems low voltage wiring. Contact manufacturer for maximum run lengths as needed.

D. The specified lighting control system shall be installed by the electrical contractor who shall make all necessary wiring connections to external devices and equipment, to include photocell. EC to wire per manufacturer instructions.

3.4 INSTALLATION AND SET-UP

A. Contractor to test all low voltage cable for integrity and proper operation prior to turn over. Verify with system manufacturer all wiring and testing requirements.

B. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, commissioning of the lighting control system and Owner instruction includes:

1. Confirmation of entire system operation and communication to each device.
2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.
3. Confirmation of system Programming, photocell settings, override settings, etc.
4. Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.
5. Controls manufacturer to provide advanced on-site commissioning services. Controls manufacturer to provide commissioning schedule to Lighting Designer (or Architect) three weeks ahead of visit. Lighting Designer (or architect) to be on-site to provide final approval of lighting scenes, dimming ranges and lighting control function. Contractor to coordinate services at appropriate stages of construction.
6. Controls manufacturer to provide on-site training for facilities personnel and staff. Training to take place sixty to ninety days after system has been commissioned as stated in Section E. Contractor to coordinate services at appropriate stages of construction.
C. All devices shall be located so that they are readily accessible and not exposed to physical damage.

3.5 SERVICE AND OPERATION MANUALS

A. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted. Electronic copies shall also be provided to the Owner.

B. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built color coding used on cables. Programming forms of systems shall be submitted with complete information.

C. Comply with energy code lighting control system “Acceptance Requirements.” Acceptance tests are used to verify that lighting controls were installed and calibrated correctly. These tests may require that a responsible party certify that controls are installed and calibrated properly. This is the installing contractor’s responsibility. Verify requirements with building authority.

3.6 DOCUMENTATION

A. Each relay shall have an identification label indicating the originating branch circuit number and panelboard name as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.

B. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate “as-built” shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to Owner, copies placed inside the door of each PLCP.

3.7 SERVICE AND SUPPORT

A. Start Up: EC shall contact and schedule Start-up with manufacturer. EC is responsible for coordinating with GC and the Owner the installation any communication devices needed for startup.

B. EC shall verify communication (telephone, internet, Ethernet, etc.) links and protocol needed for remote or on-site programming by manufacturer.

C. Provide a factory technician for on-site training of the Owners’ representatives and maintenance personnel. Coordinate timing with General Contractor. Provide one to two days of factory on-site training. Video record training session and provide digital copy to Owner.

3.8 CLEANING

A. Division 01 General Requirements: Section 017700, “Final Cleaning” article.

B. Clean photocell lens as recommended by manufacturer.
C. Clean all switch faceplates.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600-V and less, with capacities up to 1500-kVA.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
   2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

1.4 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Data: Certificates, for transformers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
   4. Certification: Indicate that equipment meets equipment seismic requirements.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB (Electrification Products Division).
2. Eaton.
3. Powersmiths International Corp.
4. Schneider Electric USA (Square D).

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified."

2.3 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Comply with NFPA 70.
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Transformers Rated 15-kVA and Larger:
   1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
   2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.4 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces based on the Seismic Zone of the project location.

C. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
   1. One leg per phase.
   2. Grounded to enclosure.

D. Coils: Continuous windings without splices except for taps.
   2. Internal Coil Connections: Brazed or pressure type.
3. Terminal Connections: Bolted.

E. Enclosure: Ventilated.
   1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
   2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
   3. Wiring Compartment: Sized for conduit entry and wiring installation.
   4. Finish: Comply with NEMA 250.
      a. Finish Color: Manufacturer’s standard factory gray weather-resistant enamel.

F. Taps for Transformers 3-kVA and Smaller: None.

G. Taps for Transformers 7.5 to 24-kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25-kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class, Smaller Than 30-kVA: UL-component-recognized insulation system with a maximum of rise above ambient temperature.

J. Insulation Class, 30-kVA and Larger: UL-component-recognized insulation system with a maximum of rise above ambient temperature.

K. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

2.5 IDENTIFICATION

   A. Nameplates: Self-adhesive label for each distribution transformer. Self-adhesive labels are specified in Section 260553 "Identification for Electrical Systems."

2.6 VIBRATION ISOLATORS

   A. Neoprene Pads: Neoprene pad, 3/8 inch thick.

2.7 SOURCE QUALITY CONTROL

   A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
      1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
      2. Ratio tests at rated voltage connections and at all tap connections.
      3. Phase relation and polarity tests at rated voltage connections.
      4. No load losses, and excitation current and rated voltage at rated voltage connections.
      5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
      6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:
   a. High-voltage to ground.
   b. Low-voltage to ground.
   c. High-voltage to low-voltage.
9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
E. Environment: Enclosures shall be rated for the environment in which they are located.
F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
B. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
   1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
C. Secure transformer to concrete base according to manufacturer's written instructions.
D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
E. Remove shipping bolts, blocking, and wedges.
3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. 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-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Visual and Mechanical Inspection.
   a. Inspect physical and mechanical condition.
   b. Inspect anchorage, alignment, and grounding.
   c. Verify that resilient mounts are free and that any shipping brackets have been removed.
   d. Verify the unit is clean.
   e. Perform specific inspections and mechanical tests recommended by manufacturer.
   f. Verify that as-left tap connections are as specified.

2. Electrical Tests:
   a. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

B. Remove and replace units that do not pass tests or inspections and retest as specified above.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS
A. ATS: Acceptance testing specification.
B. GFCI: Ground-fault circuit interrupter.
C. GFEP: Ground-fault equipment protection.
D. HID: High-intensity discharge.
E. MCCB: Molded-case circuit breaker.
F. SPD: Surge protective device.
G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of panelboard.
   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. 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.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.
   5. Short-circuit current rating of panelboards and overcurrent protective devices.
   6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 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 Section 017823 "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.7 FIELD CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Architect Construction Manager Owner no fewer than two days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without Architect's Construction Manager's Owner's written permission.
   3. Comply with NFPA 70E.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
   1. Panelboard Warranty Period: Twelve months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
   1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
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.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2. Height: 84-inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Finishes:
   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

   F. Incoming Mains:
   1. Location: Top or Bottom, as needed for each panel's specific installation.
   2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

   G. Phase, Neutral, and Ground Buses:
      a. Bus shall be fully rated the entire length.
   2. Interiors shall be factory assembled into a unit. Replacing protective devices shall not disturb adjacent units or require removing the main bus connectors.
   3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

   H. Conductor Connectors: Suitable for use with conductor material and sizes.
   2. Terminations shall allow use of 75 deg C rated conductors without derating.
   3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
   4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
   5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
   1. Refer to spares and spaces shown on the one-line diagram and/or panel schedules.

J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
   1. Panelboards and overcurrent protective devices rated 240-V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000-A rms symmetrical.
   2. Panelboards and overcurrent protective devices rated above 240-V and less than 600-V shall have short-circuit ratings as shown on Drawings, but not less than 14,000-A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton.
   2. Schneider Electric USA (Square D).

B. Panelboards: NEMA PB 1, distribution typewith factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.

C. Mains: Circuit breaker.


F. SPD: As indicated on the one-line diagram.
   1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100-kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
   2. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277-V 208Y/120-V, three-phase, four-wire circuits shall not exceed the following:
      a. Line to Neutral: 1200-V for 480Y/277-V 700-V for 208Y/120-V.
b. Line to Ground: 1200-V for 480Y/277-V 700-V for 208Y/120-V.

c. Neutral to Ground: 1200-V for 480Y/277-V 700-V for 208Y/120-V.


3. SCCR: Equal to or exceed 200-kA.

4. Innominal Rating: 20-kA.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Eaton.
   2. Schneider Electric USA (Square D).

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: As shown on the drawings and/or on the panel schedules.

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.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

G. SPD.

   1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100-kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

   2. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277-V 208Y/120-V, three-phase, four-wire circuits shall not exceed the following:

      a. Line to Neutral: 1200-V for 480Y/277-V 700-V for 208Y/120-V.
      b. Line to Ground: 1200-V for 480Y/277-V 700-V for 208Y/120-V.
      c. Neutral to Ground: 1200-V for 480Y/277-V 700-V for 208Y/120-V.

   3. SCCR: Equal to or exceed 100-kA.

   4. Innominal Rating: 10-kA.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Eaton.
2. **Schneider Electric USA (Square D).**
3. **Siemens Industry, Inc., Energy Management Division.**

**B. MCCB:** Comply with UL 489, with interrupting capacity to meet available fault currents.

1. **Thermal-Magnetic Circuit Breakers:**
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable instantaneous magnetic trip setting for circuit-breaker frame sizes 250-A and larger.

2. **Electronic Trip Circuit Breakers:**
   a. RMS sensing.
   b. Field-replaceable rating plug or electronic trip.
   c. Digital display of settings, trip targets, and indicated metering displays.
   d. Multi-button keypad to access programmable functions and monitored data.
   e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
   f. Integral test jack for connection to portable test set or laptop computer.
   g. Field-Adjustable Settings:
      1) Instantaneous trip.
      2) Long- and short-time pickup levels.
      3) Long and short time adjustments.
      4) Ground-fault pickup level, time delay, and I squared T response.

3. **GFCI Circuit Breakers:** Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
4. **GFEP Circuit Breakers:** Class B ground-fault protection (30-mA trip).
5. **Arc-Fault Circuit Interrupter Circuit Breakers:** Comply with UL 1699; 120/240-V, single-pole configuration.
6. **MCCB Features and Accessories:**
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
   e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   f. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
   g. Multipole units enclosed in a factory assembled to operate as a single unit.
2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer’s name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover.
   1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407 NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

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. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407 NEMA PB 1.1.

D. Equipment Mounting:
   1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
   2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90-inches above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.


K. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.
   2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. 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.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION
**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

   A. Section Includes:
      1. Straight-blade convenience, hospital-grade, and tamper-resistant receptacles.
      2. GFCI receptacles.
      3. SPD receptacles.
      4. Hazardous (classified) location receptacles.
      5. Pendant cord-connector devices.
      6. Cord and plug sets.
      7. Toggle switches.
      8. Decorator-style convenience.
      9. Wall switch sensor light switches with dual technology sensors.
     10. Wall switch sensor light switches with passive infrared sensors.
     11. Wall switch sensor light switches with ultrasonic sensors.
     15. Wall plates.
     16. Floor service outlets.
     17. Poke-through assemblies.
     18. Prefabricated multioutlet assemblies.
     19. Service poles.

1.3 DEFINITIONS

   A. Abbreviations of Manufacturers' Names:
      1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.

   B. BAS: Building automation system.

   C. EMI: Electromagnetic interference.
D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

H. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers’ packing-label warnings and instruction manuals that include labeling conditions.

1.6 MAINTENANCE MATERIAL SUBMITTALS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Service-Outlet Assemblies: One for every ten.
3. SPD Receptacles: One for every ten.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, 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 NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
   2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:
   1. Receptacles: Match plug configurations.
   2. Cord and Plug Sets: Match equipment requirements.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.
2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles: 125-V, 20-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour/Legrand (Pass & Seymour).

B. Hospital-Grade, Duplex Convenience Receptacles: 125-V, 20-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
      d. Manufactures: Approved for the application.

C. Isolated-Ground, Duplex Convenience Receptacles: 125-V, 20-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.

D. Tamper-Resistant Convenience Receptacles: 125-V, 20-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
   1. Description: Labeled and complying with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles: 12-V dc, 2.0-A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
3. USB Receptacles: as identified on the drawings Type A.
4. Line Voltage Receptacles: as identified on the drawings, two pole, three wire, and self-grounding.

B. Hospital-Grade, USB Charger Receptacles: 12-V dc, 2.0-A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
   2. Description: Labeled and complying with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.
   3. USB Receptacles: as identified on the drawings Type A.
   4. Line Voltage Receptacles: as identified on the drawings, two pole, three wire, and self-grounding.

2.4 GFCI RECEPTACLES

A. General Description:
   1. 125-V, 20-A, straight blade, feed and non-feed-through type as required by the application.
   2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
   3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Tamper-Resistant, Duplex GFCI Convenience Receptacles:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.

C. Hospital-Grade, Duplex GFCI Convenience Receptacles: Comply with UL 498 Supplement.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.

2.5 SPD RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1449, and FS W-C-596, with integral SPD in line to ground, line to neutral, and neutral to ground.
1. 125-V, 20-A, straight-blade type.

2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400-V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex SPD Convenience Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

C. Isolated-Ground, Duplex SPD Convenience Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

2. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Hospital-Grade, Duplex SPD Convenience Receptacles: Comply with UL 498 Supplement sd.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

E. Isolated-Ground Hospital-Grade Duplex SPD Convenience Receptacles: Comply with UL 498 Supplement.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

2. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
2.6  CORD AND PLUG SETS

A. Description:
   1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

2.7  TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277-V, 20-A:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
   2. Description: Single pole, with LED-lighted handle, illuminated when switch is off.

D. Key-Operated Switches: 120/277-V, 20-A.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
   2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277-V, 20-A; for use with mechanically held lighting contactors.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277-V, 20-A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.

2.8 DECORA-STYLE DEVICES

A. Convenience Receptacles: Square face (Decora style), 125-V, 15-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.

B. Tamper-Resistant Convenience Receptacles: Square face, 125-V, 15-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
   2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

C. Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125-V, 15-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
   2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

D. GFCI, Feed Through Type, Convenience Receptacles: Square face, 125-V, 15-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

E. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125-V, 15-A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.

2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

F. Toggle Switches: Square Face, 120/277-V, 15-A; comply with NEMA WD 1, UL 20, and FS W-S-896.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

G. Lighted Toggle Switches: Square Face, 120-V, 15-A; comply with NEMA WD 1 and UL 20.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

Description: With LED-lighted handle, illuminated when switch is off.

2.9 LIGHTING CONTROL DEVICES

A. Reference lighting control device sections for the following lighting control devices:

1. Wall Switch Sensor Light Switch, Dual Technology.
2. Wall Switch Sensor Light Switch, Passive Infrared.
3. Wall Switch Sensor Light Switch, Ultrasonic.
4. Digital Timer Light Switch.
5. Wall box dimmers.
2.10 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: As required by Division 01 of this specification.
   3. Material for Unfinished Spaces: As required by Division 01 of this specification.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant die-cast aluminum with lockable cover.

2.11 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

   Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

2.12 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Incorporated; Wiring Device-Kellems.
   2. Pass & Seymour/Legrand (Pass & Seymour).
   3. Square D; by Schneider Electric.

B. Description:
   1. Factory-fabricated and wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
   2. Comply with UL 514 scrub water exclusion requirements.
   3. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
   4. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

2.13 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Hubbell Incorporated; Wiring Device-Kellems.

B. Description:
   1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
   2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.
D. Multioutlet Harness:
   1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
   2. Receptacle Spacing: 6-inches.
   3. Wiring: No. 12 AWG solid, Type THHN copper, circuiting as indicated on the drawings.

2.14 FINISHES

A. 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.
   3. SPD Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
   1. Protect installed devices and their boxes. 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 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 right 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 devices that have been in temporary use during construction and that 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 in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

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. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors online and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. 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.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.
3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Perform the following tests and inspections.
   1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.

C. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Receptacle switches.
   4. Molded-case circuit breakers (MCCBs).
   5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, 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 a nationally recognized testing laboratory (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. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
      b. 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. Provide in PDF electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. 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.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD 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 and not exceeding 104 deg F.
1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, 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 an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:


3. Schneider Electric; Square D Products: www.schneider-electric.us.

B. Type HD, Heavy Duty:

1. Double throw.

2. Three pole.

3. 240-600 V ac.

4. 1200-A and smaller.

5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.

6. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.
C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
   4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
   6. Hookstick Handle: Allows use of a hookstick to operate the handle.
   7. Lugs: Mechanical type, suitable for number, size, and conductor material.
   8. Service-Rated Switches: Labeled for use as service equipment.

2.4 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Schneider Electric; Square D Products: www.schneider-electric.us.

B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 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, Three Pole, Single Throw, 240 600-V ac, 1200-A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
   4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
   5. Hookstick Handle: Allows use of a hookstick to operate the handle.
   6. Lugs: Mechanical type, suitable for number, size, and conductor material.
   7. Service-Rated Switches: Labeled for use as service equipment.
2.5 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Schneider Electric; Square D Products: www.schneider-electric.us.

B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 240 600-V ac, 30 60 100 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 240 600-V ac, 30 60 100 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

F. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
   4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
   6. Hookstick Handle: Allows use of a hookstick to operate the handle.
   7. Lugs: Mechanical type, suitable for number, size, and conductor material.
   8. Service-Rated Switches: Labeled for use as service equipment.

2.6 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Schneider Electric; Square D Products: www.schneider-electric.us.
B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated. Circuit breaker/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____-Amps Available. Identical Replacement Component Required."

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 194 deg F rated wire, sized according to the 167 deg F temperature rating in NFPA 70.

G. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.


I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400-A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

O. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.

2.7 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1). The cover interlock mechanism shall have an externally operated override. The override shall not permanentlydisable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

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.
   1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Architect Construction Manager Owner no fewer than seven days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Architect's Construction Manager's Owner's written permission.
   4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
   6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 Type 9 with cover attached by Type 316 stainless steel bolts.
3.4 INSTALLATION

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.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "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.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the two following methods:
1) Use a low-resistance ohmmeter.
   a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
   a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.

i. Verify correct phase barrier installation.

j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:
   a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.

e. Operate the circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the two following methods:
   1) Use a low-resistance ohmmeter.
a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.

e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.

h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than sixty days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker eleven months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.
   1. Test procedures used.
   2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
   3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 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 to values indicated on the Drawings.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general information related to providing and installing all interior and exterior lighting systems throughout the project.

1.3 RELATED REQUIREMENTS

1. Section 260923 “Lighting Control Devices.”
2. Section 260943 “Digital Lighting Controls - Central Panel.”
3. Section 265100 “Interior Lighting Systems.”
4. Section 265600 “LED Exterior Lighting Systems.”

1.4 DEFINITIONS

A. Fixture: See "Luminaire."
B. IP: International Protection or Ingress Protection Rating.
C. LED: Light-emitting diode.
D. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.5 WARRANTIES

A. Submit a copy of manufacturers’ written guarantees for each manufacturer for transmittal to the Owner, agreeing to repair or replace any and all defects in workmanship and/or materials for a period of two years, or as otherwise specified, from the date of final acceptance of the installation, without cost to the Owner.

B. Submit the Contractor's written guarantee for a period of one year after the date of final acceptance, all apparatus installed by the Contractor to be free of mechanical and electrical defects in workmanship, and to replace the same if, in the opinion of the Architect, the responsibility lies with the Contractor.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. All equipment covered in this section shall comply with all applicable standards of IESNA, National Electrical Code and all laws, codes and regulations of Federal, State, County and City authorities having jurisdiction over this work.

B. All equipment shall be UL Listed. Equipment shall be listed for Wet or Damp locations, as stated in the luminaire schedule, or as specified by the luminaire catalog number.

C. Luminares shall be located so as not to provide any conflicts with barrier free spaces: Public Law 90-480 and American National Standards Institute A1117.1-1961
D. NEMA WD 6 – Wiring Devices-Dimensional Requirements

E. All work shall be inspected and approved by the appropriate authorities.

1.7 MATERIALS AND WORKMANSHIP

A. All materials and apparatus required for the work, except as specified otherwise, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the spaces. Where no specific kind or quality of material is given, an article acceptable to the Architect shall be furnished.

B. All component parts of each item of equipment or device shall bear the Manufacturer's Nameplate, giving at least the name of the manufacturer, description, size, type, serial number, and electrical characteristics in order to facilitate maintenance or replacement. This nameplate shall not be visible during normal operation of the equipment.

C. Blemished, damaged, or unsatisfactory luminaires shall be replaced at the direction of the Architect in a satisfactory manner at no cost to the Owner. This includes manufacturer defects as well as damage or blemishes to luminaires during handling and installation. Special attention should be paid to the blades and baffles of luminaires.

D. Luminaires that are installed and or used during construction must be protected from the construction activities, dirt and debris. Any luminaires showing dirt or debris must be cleaned prior to turnover of the area to the Owner.

E. Whenever possible luminaires should not be used during construction. Whenever luminaires are used for work lights during construction, light sources shall be replaced according to the project specifications and/or luminaire schedule prior to turnover of area to Owner. All luminaires installed during construction must be sealed, bagged, and covered in plastic to prevent dirt and construction debris from entering the luminaire and accumulating on the reflector.

1.8 SUBMITTALS

A. Cost Estimate:
   1. Contractor to provide line item pricing for each luminaire type listed in the luminaire schedule. Contractor to specify if labor is included.
   2. Contractor to provide line item pricing for each control type listed in the luminaire schedule. Contractor to specify if labor is included.

B. Substitute Products Approval During Bidding:
   1. Substitutions for lighting equipment other than that specified will be considered if equal (or better and/or higher) in quality, performance, ratings and function; and similar in type, size and appearance.
   2. Substitutions are to be provided to the Architect, Electrical Engineer and Lighting Consultant at least fourteen days prior to proposals being presented to the Owner. Said substitution package shall include data on both the proposed substitution and the specified product in such detail as to permit the two products to be adequately compared. Said substitution package shall include samples of each substitution being proposed. Substitutions are solely at the proposer's risk and should not be considered as being acceptable until a written approval from the Architect, Electrical Engineer, or
Lighting Consultant is issued to that effect. In the absence of approval not occurring prior to bid, the substitution should be considered as not being approved.

3. Submit Electronic Submittals or four hard copies on request, of the substitution requests to the Architect. The Architect will distribute to the Owner, Electrical Engineer and Lighting Consultant. Contractor shall submit bid alternates for approval prior to bidding. Proposed alternates shall include specification sheets with adequate information for comparison. The Architect, Electrical Engineer or Lighting Consultant will issue a statement of approval or rejection within fourteen days of receiving the substitution documents.

C. Shop Drawings and Product Submittals:

1. Before releasing any materials, the Contractor shall submit manufacturers catalog cut sheets, diagrams, and a complete list of all of the equipment and materials which the Contractor intends to install. This list shall include, but is not limited to, the following:
   a. Light standards and anchor bolts.
   b. Bases including elevations showing depth into soil, depth above finished surface, interface with adjacent surface elements, reinforcing steel, and concrete mix and strength.
   c. Details on backing to be provided for wall mounted fixtures over 10 pounds to be wall mounted.
   d. Luminaire mountings, luminaires, finishes, light sources, fixture hickey’s, fixture studs, visible chains, visible cables, seismic supports, and ballasts.
   e. Bolt plate covers.
   f. Performance and Photometric data, and UL listing.
   g. Wiring and connection diagrams of all luminaires, etc.
   h. Lighting dimming control components specifications, if applicable.

2. The list shall include the brand name, any identifying numbers, relevant technical data, and any other information necessary for the agency responsible for maintenance of the system to procure exact replacements of any and all equipment and material used on the project. All equipment shall be new, first quality and approved by Underwriter's Laboratories, Inc.

3. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

4. All luminaires of the same type classification shall be provided by the same manufacturer.

5. Before releasing any non-standard, modification of standard specification product, semi-custom, or custom luminaires, the Contractor shall submit shop drawings which detail methods of assembly and fastening. Shop drawings shall also indicate colors and their locations on each lighting element for review and approval prior to releasing. Contractor shall also supply manufacturer descriptions on luminaires, light standard materials, fabrication performance, and installation.

6. The Contractor shall submit all Certificates of Compliance supplied by the manufacturer of the equipment. This equipment shall include, but is not limited to, the following:
   a. Luminaire mountings.
   b. Luminaire standards and accessories.
   c. Pole base and accessories.
d. Luminaires, light sources, drivers and ballasts.
e. Photometric data (if requested).

D. Samples (when requested by the Architect, Electrical Engineer or Lighting Consultant):
   1. Submit samples of finishes and also submit photometric data in electronic format from an independent testing laboratory to completely describe luminaire performance. Unless otherwise indicated, samples shall be as follows:
      a. For standard catalog types: complete, production line samples, with all installation hardware, proper lamp(s), and equipped with a cord and plug.
      b. Sample of a specially designed or developed luminaire shall be submitted for the purpose of ascertaining its photometric performance, quality of visible parts and details, maintenance features (including relamping process), method of installation, and safety features.
      c. Luminaire samples shall be submitted for final review within thirty days after review of shop drawings. If, after a period of thirty days from rejection of samples, the luminaire cannot be made acceptable, then a luminaire (shop drawing and sample) by an alternative manufacturer shall be submitted at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENTS

A. Provide accessories as required for compatibility with installation requirements. Luminaire catalog numbers do not necessarily denote specific mounting accessories for where/how luminaire is to be installed.

B. All materials used in fabrication and mounting luminaires shall be of a non-corrosive nature.

C. Luminaires shall be free of light leaks. Luminaires shall be designed to provide adequate ventilation for both light sources and drivers or transformers.

D. Luminaires shall be designed to hide mounting hardware from view when luminaire is completely installed. Exposed fasteners shall not be acceptable, except as noted on details.

E. Wiring channels and lamp holder mountings shall be rigid and accurately manufactured.

F. In adjustable luminaires, aiming and positive locking devices shall be provided.

G. All luminaires when installed shall be set true and free of warps, dents, or other irregularities. The finish of exposed parts or trims shall be as specified or as directed by the Architect/Engineer.

H. All lamp holders shall be of high quality and shall securely hold light sources preventing vibration.

I. Rivets, springs, and other hardware shall not be visible after installation.

2.2 PRODUCT DELIVERY AND STORAGE

A. All components shall be packed in a manner consistent with ICC regulations to minimize damage during shipping.
B. Store all luminaires, light sources, drivers and hardware flat, in a clean, dry area off the ground under watertight cover.

PART 3 - EXECUTION

3.1 PREPARATION

A. Report all defects. Contractor shall be held responsible for any existing defects that adversely affect the luminaire or its performance.

B. Upon Architect’s request, Contractor shall provide one sample of selected luminaires.

3.2 INSTALLATION

A. The installation shall be in accordance with all governing local ordinances and regulations, the Drawings, these special provisions and those sections of the Standard Specifications which apply. All workmanship shall be first class and finished work shall present a neat, uncluttered appearance. The Contractor shall coordinate his work with other construction phases so as to provide a minimum of interference to the combined operations. Contractor shall also coordinate their work with the work on adjacent projects where required.

B. Provide seismic calculations as necessary to validate the installation of all fixtures as appropriate for the seismic zone into which they are being installed. Furnish and install seismic components as necessary to complete the installation.

C. Clean the housing, trim, reflector surfaces, lens of all luminaires after construction is complete, so as to render them free of any material.

D. Any luminaire or lamp or lighting device damaged during construction shall be replaced without cost to the Owner.

E. Replace all inoperative light sources, ballasts, drivers and transformers just prior to acceptance of Project by Owner. Verify that all light sources are installed are exactly as specified for each luminaire type.

F. Notify Owner and/or Architect about field conditions at variance with contract documents before commencing installation. This includes but is not inclusive of changes in landscape type and location, and field verification of walls, boundary markers, signs, walkways, and other changes that affect location of equipment.

G. It shall be the Contractor's responsibility to replace and restore all surface materials in kind, equal to, or exceeding those disturbed by trenching, excavation or backfilling operations. This includes but is not limited to seeding, sodding, replacement of subbase, pavement, trees, and shrubs. All excess materials shall be disposed of as directed by the Architect.

H. It is the Contractor’s responsibility to review and coordinate with the Architectural drawings for placement of luminaires and lighting control devices. The Contractor shall also coordinate with Landscape drawings for location of luminaires at the exterior of the project.

I. It is the Contractor’s responsibility to coordinate with other trades and with the local utility locator service.
3.3 LIGHTING AIM AND FOCUS

A. It is the Contractor’s responsibility to provide all necessary labor and materials for final focusing of all adjustable luminaires under the Architect’s and/or Lighting Consultant’s observation. The focusing of all adjustable luminaires will take place in a night test of system.

B. Focusing shall take place immediately before the Project is turned over to the Owner. Focusing shall be complete after approval by the Architect and/or Lighting Consultant.

C. All track mounted luminaires and accessories shall be stored by the contractor during construction and only installed during the focusing period. Track mounted luminaires should not be installed prior to the focusing period unless directed by the Architect and/or Lighting Consultant.

D. Prior to the focusing, the Contractor shall verify in writing to the Architect and/or Lighting Consultant that all materials stored on site, including track luminaires, accessories and light sources are accounted for and ready for the focusing procedure.

3.4 TESTS

A. Prior to final acceptance, the Contractor shall demonstrate by test to the Architect’s and/or Lighting Consultant's satisfaction that all the electrical and lighting equipment installations are in proper condition per drawings and specifications. The Contractor shall furnish all equipment and appliances to make the test.

B. The Architect shall be notified at least two working days prior to energizing the lighting system and the system shall not be put into operation before the Architect is present. All lighting circuits and equipment shall be given an initial operational test, consisting of having the entire system energized for seventy-two consecutive hours without any failures of any type occurring anywhere in the system. All circuits shall test clear of faults, grounds and open circuits to the satisfaction of the Architect.

1. Submit information of witness participation for all testing including but not limited to:
   a. Witness(s) name, title, employer, address of the associated business, e-mail, and telephone information.
      1) Date, and time of arrival
      2) Date and time of departure

C. After satisfactory completion of all tests, the illumination system shall be placed in operation. Final acceptance will not be made until the system has operated satisfactory for a period of not less than fourteen days.

D. The Contractor shall be fully responsible for the system during this period of operation and he shall make any adjustment or repairs which may be required, and remedy any defects or damages which may occur, at Contractor’s expense.

E. Operation of the system shall not in any way be construed as an acceptance of the system or any part of it or as a waiver of any of the provision of the contract. Acceptance of the system is to occur when the Owner accepts the building.
F. The Contractor shall not be required to pay for electrical energy consumed by the system during the period of trial operation.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the all Luminaires used on the interior of the building.

B. Related Requirements:
   1. Section 260923 “Lighting Control Devices.”
   2. Section 260943 “Digital Lighting Controls - Central Panel.”
   4. Section 265600 “LED Exterior Lighting Systems.”

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS, SAMPLES, HANDLING AND SHOP DRAWINGS

A. See Section 265000 “General Lighting Provisions.”

B. See Luminaire Schedule located on drawings for additional information.

1.5 WARRANTY

A. See Section 265000 “General Lighting Provisions.”

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.
B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
   1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Manufacturers: See Luminaire Schedule on drawings for acceptable manufacturers of individual luminaires.

B. General:
   1. Furnish all luminaires of type, kind and with the light sources as indicated in the Luminaire Schedule, on drawings and/or specified herein.
   2. All luminaires shall be free of light leaks, warps, or other irregularities. Lenses shall be free of cracks, chips or discolorations.
   3. All metal surfaces shall be bonderized, galvanized, or sheradized after fabrication and treated to provide rust inhibiting and finish coat adherence properties.
   4. All luminaires installed where exposed to weather and/or cold temperatures shall be weatherproof and suitable for efficient operation at the temperatures and conditions encountered.

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

A. Comply with Division 26 Section "Basic Electrical Materials and Methods" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Provide luminaire hickeys, fixture studs, seismic components, emergency lighting components, "red iron" supports, etc., as required for appropriate installation.

C. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by luminaire manufacturer.

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 luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. General:
   1. Comply with NECA 1.
   2. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
   3. Completely connect and securely mount all luminaires. Provide all additional supports and hangers as may be necessary to securely fasten and support all luminaires to ceiling or structure, adhering to all local codes and conditions.
   4. Clean luminaires, remove construction dirt, dust, paints, etc., and leave luminaires in first class condition upon completion of work.
   5. Continuous rows of luminaires shall be installed such that the rows of the continuous system are without visible vertical or horizontal undulation.

B. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   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.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   
   A. Chain link fence with swing gate.

1.2 RELATED REQUIREMENTS
   
   A. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.
   
   B. Section 08 71 00 - Door Hardware: Gate locking device.

1.3 SUBMITTALS
   
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   
   B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
   
   C. Manufacturer's Installation Instructions: Indicate installation requirements.

PART 2 - PRODUCTS

2.1 MATERIALS
   
   A. Chain Link Fences: Chain link fences with support framing and swinging gates.
      
      1. Application: Cylinder and equipment storage area.
      
      2. Configuration:
         
         a. Height: Continuous height up to 6-feet or as indicated on drawings.
         
         b. Top and bottom rails: intermediate horizontals as recommended by manufacturer; consistent diameter dimension.

      3. Components:
         
         a. Metal Type: Steel.
         
         b. Wire: 9-gauge core, minimum.
         
         c. Posts: 2 7/8" outer diameter pipe.
         
         d. Terminal/End/Corner: 2 3/8" outer diameter pipe.
         
         e. Top Rail: 1 5/8" outer diameter pipe.
         
         f. Middle Rail: 1 5/8" outer diameter pipe.
         
         g. Bottom Rail: 1 5/8" outer diameter pipe.
         
         h. Post Caps: Dome Style or Slip Sleeve for header attachment.
         
         i. Ties: 7GA Polymer Coated.
         
         j. Locking Swing Gates: To be selected by Architect.

      4. Finish: Manufacturer's standard polymer coating over metallic coating.
5. Location: Garage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that areas are clear of obstructions or debris.

3.2 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

3.4 CLEANING

A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

B. Clean fence with mild household detergent and clean water rinse well.

END OF SECTION