Request for Competitive Sealed Proposals

UNT CLARK HALL MEP (Mechanical, Electrical & Plumbing)

RFCSP752-24-979ER

PROJECT MANUAL

UNIVERSITY OF NORTH TEXAS

CLARK HALL MEP UPGRADES

1717 MAPLE STREET

DENTON, TEXAS

DATE: 05-09-2023

PREPARED BY:

CAMPOS ENGINEERING

1331 RIVERBEND DRIVE

DALLAS, TEXAS 75247

TEXAS FIRM F-001731

END OF SECTION

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5/9/2023

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DOCUMENT 001100
RFCSP752-24-979ER
ADVERTISEMENT FOR COMPETITIVE SEALED PROPOSAL

University of North Texas
UNT Clark Hall MEP (Mechanical, Electrical & Plumbing)
Response due: October 2, 2023, at 2:00PM CDT
HUB Plan due: October 3, 2023 at 2:00PM CDT
Date of Virtual Opening: October 5, 2023 at 2:00PM CDT

In accordance with Education Code 51.783, the University of North Texas (UNT), subsequently referred to as Owner, is accepting proposals and intends to enter into an agreement with a vendor that specializes in General Construction in accordance with the terms and conditions and requirements set forth in this RFCSP. Sealed proposals for **RFCSP752-24-979ER** will only be received by the Owner electronically through Jaggaer link provided below.

Proposals will be received up to 2:00p.m. CDT on **October 2, 2023.** HUB Sub-contracting Plans must be received up to 2:00p.m. CDT on **October 3, 2023.** Proposals received after the date and hour above stated will not receive consideration. Proposals will then be virtually opened and read aloud promptly at 2:00p.m. CDT on **October 5, 2023, via Teams meeting:**

Microsoft Teams meeting
Join on your computer, mobile app or room device
Click here to join the meeting
Meeting ID: 240 652 965 800
Passcode: A46oKx
Download Teams | Join on the web
Or call in (audio only)
+1 940-304-2772,,292324499# United States, Denton
Phone Conference ID: 292 324 499#
Find a local number | Reset PIN
Learn More | Meeting options

Project Description

Clark Hall is a building on the UNT campus housing students throughout the year, located at 1717 West Maple St., Denton, Texas 76201. The building was built in 1966 and is in need of large scale upgrades to the Mechanical, Electrical, Plumbing (MEP) systems due to ongoing maintenance and operational issues. UNT would like to replace or upgrade the MEP systems to alleviate these issues and provide more reliability and energy efficiency of the building.

The project will include replacement of all AHUs (Air Handler Units) serving the dormitory areas and all associated ductwork, controls, piping, and electrical within the AHU mechanical rooms. Project will include replacement of heating and hot water boilers, building exhaust fans, all horizontally run sanitary waste pipe in the crawl space and underground, and HW, CHW, and CDW pumps. In addition to replacement of equipment, additional associated accessories will need to be modified such as exhaust duct, ventilation duct, and piping.

This project will need to be phased in construction to accommodate the heavy use of the building. Construction periods of no more than two (2) months will be available at any one (1) time for this work. This phasing will occur over a two (2) year period. Phasing windows will follow the academic calendar and will occur in the summer and winter breaks. Other construction windows may be available throughout the year provided no disruptions to the occupants occur. The UNT Academic calendar can be found at this link http://catalog.unt.edu/content.php?catoid=33&navoid=3710.

The goal of this project is to complete all construction by December 2025 through a phased approach that will keep the building in operation for the majority of the year.

Questions

Questions concerning this proposal should be directed to:

Elaine Robbins
Construction Contract Coordinator II
University of North Texas System
Office of Strategic Infrastructure, Planning & Construction

Elaine.robbins@untsystem.edu

All questions must be received no later than 2:00 p.m. CDT on September 18, 2023. All questions and answers will be posted to the website by 5:00 p.m. CDT on September 20, 2023.

The Owner may in its sole discretion respond in writing to questions concerning this Proposal. Only the Owner's responses made by formal written Addendum to this Proposal shall be binding and shall be posted on the UNT System's website located at https://finance.untsystem.edu/vendor-resources/bid-inquiry/bid-opportunities.php . Oral or other written interpretations or clarifications shall be without legal effect.

Pre-Proposal Meeting

The pre-proposal meeting will be held virtually via Microsoft Teams at **2:00p.m. CDT** on **September 7, 2023.**

Microsoft Teams meeting
Join on your computer, mobile app or room device
Click here to join the meeting
Meeting ID: 253 839 902 682
Passcode: s3QwGc
Download Teams | Join on the web
Or call in (audio only)
+1 940-304-2772,,740446544# United States, Denton
Phone Conference ID: 740 446 544#
Find a local number | Reset PIN
Learn More | Meeting options

Site Visit: Site visit will be conducted on **September 8, 2023** beginning at **10:00a.m.** We will meet at the **UNT Clark Hall, 1717 West Maple Street, Denton, Texas 76201.** This will be the only site visit conducted.

Bid Documents

Proposers may obtain or access plans, specifications, and addenda for this project through the following sources:

Online - Proposers can view bid documents at Electronic State Business Daily (http://www.txsmartbuy.com/sp), at the UNT System website at https://finance.untsystem.edu/vendor-resources/bid-inquiry/bid-opportunities.php and the UNTS Jaggaer website: https://bids.sciquest.com/apps/Router/PublicEvent?CustomerOrg=UNTS .

Plan Rooms with bid documents on file include: McGraw-Hill Construction Plan Center (Irving), ABC Plan Room (Irving), DFW Minority (Dallas), AGC TEXO and iSqFt Plan Room (Dallas). Contact information for the plan rooms can be found at http://www.untsystem.edu/unt-plan-rooms.

Historically Underutilized Business (HUB)

In accordance with Texas Government Code 2161, RFCSP for contracts with an expected value of $100,000 or more will require HUB Subcontracting Plan. All subcontracted work whether identified by the Owner or not, are required to be identified in the HUB Subcontracting Plan. The Plan should reflect all subcontracting opportunities to be utilized in this project and can be found online at (http://www.window.state.tx.us/procurement/prog/hub/hub-forms/hub-sbcont-plan--allfms.pdf). Complete, print, sign and submit the HUB Subcontracting Plan form with the proposal response.

Only RFCSP responses with approved HUB Subcontracting Plans will be opened. Please upload your HUB Subcontracting plan as a separate attachment from your RFCSP response through the UNTS Jaggaer link provided above. You will have two(2) files to upload, your Proposal and then your HUB Subcontracting Plan.

Questions regarding the completion of the HUB Subcontracting Plan should be directed to Rosa Violante or Sony Simon at hub@untsystem.edu.

The Owner is not bound to accept the lowest priced offer if that offer is not in its best interest, as determined by the Owner. The Owner reserves the right to: (a) enter into agreements or other contractual arrangements for all or any portion of the Scope of Work set forth in this Proposal with one or more respondents; (b) reject any and all offers and re-solicit offers; or (c) reject any and all offers and temporarily or permanently abandon this procurement, if deemed to be in the best interest of the Owner.

END OF SECTION

DOCUMENT 002100
RFCSP752-24-979ER
INSTRUCTIONS FOR PROPOSAL

University of North Texas (UNT), subsequently referred to as the Owner, is accepting sealed proposals from contractors for a General Construction project, pursuant to Sec. 51.783, *Texas Education Code*, in accordance with the terms and conditions and requirements set forth in this Request for Competitive Sealed Proposal (RFCSP).

1. PRE-PROPOSAL MEETING:

A virtual pre-proposal meeting will be conducted to answer any questions regarding the scope of the project and the submission of the HUB Subcontracting Plan. Attendance is not mandatory but highly recommended. The pre-proposal meeting will be held virtually via Microsoft Teams.

September 7, 2023, at 2:00p.m. CDT

Microsoft Teams meeting
Join on your computer, mobile app or room device
Click here to join the meeting
Meeting ID: 253 839 902 682
Passcode: s3QwGc
Download Teams | Join on the web
Or call in (audio only)
+1 940-304-2772,,740446544# United States, Denton
Phone Conference ID: 740 446 544#
Find a local number | Reset PIN
Learn More | Meeting options

There will be a site visit on **September 8, 2023 at 10:00a.m.** This will be the only site visit conducted. We will meet at the site, UNT Clark Hall, 1717 West Maple Street, Denton, Texas 76201.

2. PROJECT PROPOSED SCHEDULE

August 30, 2023		Issue RFCSP
September 7, 2023	2:00p.m.	Pre-Proposal Conference - Virtual
September 8, 2023	10:00a.m.	Site Visit
September 18, 2023	2:00 p.m.	Deadline for Submission of Questions
September 20, 2023	5:00 p.m.	Responses to Questions Post on Website
October 2, 2023	2:00 p.m.	Deadline for Submission of Proposal
October 3, 2023	2:00 p.m.	Deadline for HUB Sub-Contracting Plan
October 5, 2023	2:00 p.m.	Public Opening - Virtual
October 2023		Formal Contract Award Notification
October 2023		Agreement Authorized
November 2023		Anticipated Notice to Proceed
December 2025		Final Completion

3. GENERAL REQUIREMENTS

3.1 Pricing

Your proposal must include all labor, material, equipment and services necessary to complete the work required by the construction documents. Pricing reflects the full Scope of Work defined herein; inclusive of all associated cost for delivery, labor, insurance, taxes, overhead and profit, or as otherwise defined, as appropriate. The Contractor shall base their base proposal price on the set of 100 percent Construction Documents and Specification. Contractor must complete Division 00, Section 004100, *Proposal Form*. Proposal must also include all alternates.

3.2 Unit Prices

When requested, Respondents must price per unit shown. Unit prices shall govern in the event of extension errors. Respondents must give unit prices for each item to be purchased. An “All or None” response by Respondent may be rejected at the option of the Owner. Quote F.O.B destination, freight prepaid and allowed. Otherwise, specify exact delivery cost and terms.

3.3 Schedule

Time is of the essence in the performance of the Contractor’s duties. It is critical that a realistic expedited schedule is provided.

3.4 Purchasing Items

A. Catalogs, brand names or manufacturer’s references are descriptive only, and indicate type and quality desired. Substitution requests of like nature and quality will be considered if response specifies such. If responding on other than referenced, response should show manufacturer, brand or trade name, and other description of product offered. If other than brand(s) specified is offered, illustrations and a complete description of product offered are requested to be made part of the response. Failure to take exception to specifications or reference data will require respondent to furnish specified brand names, numbers, etc.

B. Unless otherwise specified, all material shall be new and unused.

C. In addition, all electrical items must meet all applicable state and federal standards and regulations, and bear the appropriate listing such as ANSI, FCC, NEMA, NTRL, and OSHA standards.

D. Samples, when requested, must be furnished free of expense to the Owner. If not destroyed in examination, they will be returned to Respondent, on request, at Respondent’s expense. Each sample should be marked with Respondent’s name, address, and requisition number. Do not enclose in or attach offer to sample.

E. A one (1) year warranty from substantial completion is required.

F. Delivery

i. Show number of days required to complete project under normal conditions.
ii. No substitutions permitted without written approval of Owner.

G. Inspection and Tests

All work will be subject to inspection and test by the Owner. All costs shall be borne by the respondent in the event of failed inspection or tests.

3.5 Eligible Respondents

Only individual firms or formal joint ventures may apply. Two (2) firms may not apply jointly unless they have formed a joint venture. Any associates will be disqualified. (This does not preclude a respondent from having consultants.)

4. SUBMISSION OF PROPOSALS

4.1 Submit a total of one (1) complete signed copy of the entire response including the questionnaire. Responses are limited to no more than twenty-five (25) pages. Please submit (1) copy of your signed HSP the following day. No QR codes will be accepted as part of your response and may disqualify your response. An original signature must appear on the Proposal Form (Division 00, Section 004100).

4.2 You must submit your response and HSP electronically through the UNTS Jaggaer website link as follows:

https://bids.sciquest.com/apps/Router/PublicEvent?CustomerOrg=UNTS

In order to submit proposals electronically, Proposer must have a working, registered vendor username and password to login. If this is the first time Proposer has attempted to submit a response electronically, please register at:
https://bids.sciquest.com/apps/Router/PublicEvent?CustomerOrg=UNTS
Proposers are highly encouraged to ensure you have a working login in advance of the submission deadline.
Proposer is responsible for ensuring it has the technical capability to submit its proposal via electronic submission.
Browser requirements: Chrome
Proposer shall be solely responsible for ensuring timely submission of the Proposal.
UNTS is not responsible for equipment or software failure, internet or website downtime, corrupt or unreadable data, or other technical issues that may cause delay or non-delivery of a Proposal of inaccessibility of the submitted data. **Proposers are highly encouraged to prepare and allow for sufficient time to familiarize themselves with the electronic submission requirements and to address any technical or data issues Prior to the Proposal due date and time**.

A. Late proposals will not be considered under any circumstances.

B. The Owner reserves the right to accept late proposals; however, proposals received after opening time will not be accepted.

C. Facsimile ("FAX") or emailed proposals are not acceptable.

D. **The Proposal must be submitted no later than 2:00p.m. CDT on October 2, 2023. Proposals received after the date and hour previously stated will not receive consideration. The HUB Sub-Contracting Plan must be submitted no later than 2:00p.m. CDT on October 3, 2023. Failure to submit the HUB Sub-contracting plan will disqualify your proposal.**

Your Proposal and HUB Plan must be submitted electronically thru the UNT System Jaggaer site at: https://bids.sciquest.com/apps/Router/PublicEvent?CustomerOrg=UNTS

TO: Elaine Robbins
Construction Contract Coordinator II
University of North Texas System

Proposals will be received until the date and time established for receipt, then opened. The names of the respondents who submitted proposals will be made public. **A public opening shall be held virtually on October 5, 2023, promptly at 2:00p.m. CDT. Public bid opening will be held virtually via Microsoft Teams meeting:**

Microsoft Teams meeting
Join on your computer, mobile app or room device
Click here to join the meeting
Meeting ID: 240 652 965 800
Passcode: A46oKx
Download Teams | Join on the web
Or call in (audio only)
+1 940-304-2772,,292324499# United States, Denton
Phone Conference ID: 292 324 499#
Find a local number | Reset PIN
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4.3 After proposals are received in response hereto and notice of intent to award a contract is made, the successful Contractor will be required to enter into a contract in the form of the Owner's standard General Construction Agreement. The Contractor should review the contract (Division 00, Section 005200, *Agreement Forms*). No changes to the standard contract will be accepted.

Any questions or concerns regarding this Request for Proposals shall be directed to:

Elaine Robbins –Construction Contract Coordinator II
University of North Texas System
Office of Strategic Infrastructure, Planning & Construction

Please submit solicitation questions to: elaine.robbins@untsystem.edu

All questions must be received no later than September 18, 2023, at 2:00p.m. CDT. All questions and answers will be posted to the website by 5:00p.m. CDT, September 20, 2023.

The Owner specifically requests that Respondents restrict all contact and questions regarding this RFCSP to the above-named individual except as provided in 4.2 above.

Responses to inquiries which directly affect an interpretation or change to this RFCSP will be issued in electronically by addendum (amendment) and posted at:
https://finance.untsystem.edu/vendor-resources/bid-inquiry/bid-opportunities.php ,
https://bids.sciquest.com/apps/Router/PublicEvent?CustomerOrg=UNTS ,
and http://www.txsmartbuy.com/sp

All such addenda issued by the Owner prior to the time that proposals are received shall be considered part of the RFCSP, and the Respondent shall be required to consider and acknowledge receipt of such on the proposal form. Contractors are responsible for obtaining any addenda posted on the websites listed above.

Only those inquiries the Owner replies to which are made by formal written addenda shall be binding. Oral and other interpretations or clarifications will be without legal effect. The Respondent must acknowledge all addenda in Division 00, Section 004100, *Proposal Form*.

4.4 Compliance with Law

Contractor is aware of, is fully informed about, and in full compliance with its obligations under existing applicable law and regulations, including Title VI of the Civil Rights Act of 1964, as amended (42 USC 2000(D)), Executive Order 11246, as amended (41 CFR 60-1 and 60-2), Vietnam Era Veterans Readjustment Act of 1974, as amended (41 CFR 60-250), Rehabilitation Act of 1973, as amended (41 CFR 60-741), Age Discrimination Act of 1975 (42 USC 6101 et seq.), Non-segregated Facilities (41 CFR 60-1), Omnibus Budget Reconciliation Provision, Section 952, Fair Labor Standards Act of 1938, Sections 6, 7, and 12, as amended, Immigration Reform and Control Act of 1986, and Utilization of Small Business Concerns and Small Business Concerns Owned and Controlled by Socially and Economically Disadvantaged Individuals (PL 96-507), the Americans with Disabilities Act of 1990 (42 USC 12101 et seq.), the Civil Rights Act of 1991, and all other laws and regulations and executive orders as are applicable.

4.5 University's Right to Audit

At any time during the term of any Contract resulting from this solicitation and for a period of seven (7) years thereafter, the Owner or a duly-authorized audit representative of the Owner or the State of Texas, at its expense and at reasonable times, reserves the right to audit Contractor's records and books relevant to all services provided under this Contract. In the event such an audit by the Owner reveals any errors/overpayments by the Owner, Contractor shall refund the Owner the full amount of such overpayments within thirty (30) days of such audit findings, or the Owner, at its option, reserves the right to deduct such amounts owing the Owner from any payments due Contractor.

4.6 Access to Documents

To the extent applicable to this procurement, in accordance with Public Law 99-499 under TEFRA, Contractor agrees to allow, during and for a period of not less than seven (7) years after the Contract term, access to this Contract and its books, documents, and records; and contracts between Contractor and its subcontractors or related organizations, including books, documents and records relating to same, by the Comptroller General of the United States, the U.S. Department of Health and Human Services, and their duly authorized representatives.

4.7 Insurance and Bonds

The Contractor shall provide and maintain insurance, performance bond, and payment bond as required. The minimum insurance coverage and bonding requirements are stated in Division 00, Section 007000, *UGC*.

4.8 Other Benefits

It is understood and agreed that no benefits, payments or considerations received by Contractor for the performance of services associated with and pertinent to the resultant Agreement shall accrue, directly, or indirectly, to any employees, elected or appointed officers or representatives, or any other person identified as agents of, or who are, by definition, an employee of the State.

4.9 Non-Disclosure

Contractor and Owner acknowledge that they or their employees may, in the performance of the resultant Contract, come into the possession of proprietary or confidential information owned by or in the possession of the other. Neither party shall use any such information for its own benefit or make such information available to any person, firm, corporation, or other organization, regardless of whether directly or indirectly affiliated with Contractor or Owner, unless (i) required by law, (ii) required by order of any court or tribunal, (iii) such disclosure is necessary for the assertion of a right, or defense of an assertion of a right, by one party against the other party hereto, or (iv) such information has been acquired from other sources.

4.10 Publicity

Contractor agrees that it shall not publicize this potential Contract or disclose, confirm or deny any details thereof to third parties or use any photographs or video recordings of the Owner's employees or use the Owner's name in connection with any sales promotion or publicity event without prior written approval.

4.11 Assignment

The potential agreement with Contractor resulting from this RFCSP is a personal service contract for the services of Contractor, and Contractor's interest in such agreement, duties thereunder and/or fees due thereunder may not be assigned or delegated to a third party without the Owner's prior written consent. The benefits and burdens of such agreement are, however, assignable by the Owner.

4.12 Assignment of Overcharge Claims

Contractor hereby assigns to the Owner any and all claims for overcharges associated with the Contract arising under the antitrust laws of the United States, 15 U.S.C.A., Sec. 1 et seq. (1973), or arising under the antitrust laws of the State of Texas, Texas Business and Commerce Code Annotated, Sec. 15.01, et seq. (1967).

4.13 Patent and Copyright

Contractor shall pay for any royalties, license fees, copyrights or trade and service marks required to perform the services required by any resulting Contract.

4.14 Texas Public Information Act

The Owner considers all information, documentation and other materials requested to be submitted in response to this solicitation to be of a non-confidential and/or non-proprietary nature and therefore shall be subject to public disclosure under the Texas Public Information Act (Texas Government Code, Chapter 552.001, et seq.) after a contract is awarded.

Respondents are hereby notified that the Owner strictly adheres to all statutes, court decisions, and opinions of the Texas Attorney General regarding the disclosure of RFCSP information.

4.15 Freedom of Access and Use of Facilities

Contractor's employees shall have reasonable and free access to use only those facilities of the Owner that are necessary to perform services under a resulting Contract and shall have no right of access to any other facilities of the Owner.

4.16 Observance of University Rules and Regulations

Contractor agrees that at all times its employees will observe and comply with all regulations of the facilities, including but not limited to, no smoking, parking and security regulations.

4.17 Section Headings

All section headings are for convenience of reference only and are not intended to define or limit the scope of any provisions of this RFCSP.

4.18 Governing Law

A. This RFCSP, and any resulting Contract, agreement or purchase order shall be construed and governed by the laws of the State of Texas.

B. The parties understand and agree that any purchase order/contract may be subject to the Health Insurance Portability and Accountability Act of 1996 (HIPAA), the administrative regulations and/or guidance which have been issued or may in the future be issued pursuant to HIPAA, including, but not limited to, the Department of Health and Human Services regulations on privacy and security, and Texas state laws pertaining to medical privacy (collectively, "Privacy Laws"). Vendor agrees to comply with all Privacy Laws that are applicable to this purchase order/contract and to negotiate in good faith to execute any amendment to this purchase order/contract that is required for the terms of this purchase order/contract to comply with applicable Privacy Laws. In the event the parties are unable to agree on the terms of an amendment pursuant to this paragraph within thirty (30) days of the date the amendment request is delivered by one party to the other, this order may be terminated by either party upon written notice to the other party.

C. **Important Notice:** Any purchase order may be funded wholly or partially with federal funds subject to the American Recovery and Reinvestment Act of 2009 (ARRA). The vendor shall comply with all applicable provisions of ARRA, which may include, but are not limited to, the provision of Division A, Titles XV and XVI (e.g., audit provisions, whistleblower protection, and preferences for American products).

D. **Federal Funds:** All procurements of supplies equipment, and services utilizing Federal Funds (e.g. Federal Grant or Contract) shall be made in accordance with all applicable federal rules and regulations: Federal Acquisition Regulations (FAR), Federal Office of Management and Budget (OMB) Educational Institutions, even if part of a State or local government follow: OMB A-21 for cost principles, A-110 for administrative requirements, and A-133 for audit requirements. All procurement requirements contained in the above referenced circulars are incorporated herein by reference. By signing this solicitation document, vendor certifies that vendor is in compliance with OMB A-110 and that vendor is not on the Debarred Bidders List.

4.19 Owner's Special Conditions

The Owner requires full compliance with Division 00 and Division 01 Specifications, Contract and General Requirements. The documents shall be a part of this RFCSP and the Contract.

4.20 Prevailing Wage Schedule, University of North Texas System

Prevailing wage schedule shall in accordance with Texas Government Code, Chapter 2258. The hourly wage rate for work over forty (40) hours a week and work on legal holidays shall be not less than one and one-half (1.5) times the hourly rates.

Respondents shall base their proposals on rates they expect to pay. The Owner will not consider claims for extra payment to the Contractor on account of payment of wages higher than those required by Texas Government Code, Chapter 2258.

4.21 Pursuant to Section 231.006 of the Family Code, response must include names and social security numbers of each person with at least twenty-five (25) percent ownership of the business entity submitting the response. Vendors that have pre-registered this information on the Texas Comptroller of Public Accounts Centralized Master Bidders List (CMBL) have satisfied this requirement. If not pre-registered, list the name and social security numbers for each person. Otherwise, this information must be provided prior to contract award.

4.22 **Note to Vendors: Any terms and conditions attached to any response will not be considered unless specifically referred to on the Solicitation and may result in disqualification of the response.**

A. **Dispute Resolution:** Chapter 2260 of the Texas Government Code establishes a dispute resolution process for contracts involving goods, services, and certain types of projects. If Chapter 2260 applies to this Purchase Order, then the statutory dispute resolution process must be used by the vendor to attempt to resolve all of its disputes arising under this Purchase Order.

B. **Excess Obligations Prohibited**: The Texas Constitution (Article XVI, Section 10) prohibits obligators beyond the current appropriations, which the Owner applies annually. Any purchase order may be canceled at any time without penalty if legislative and/or Owner funds are not appropriated for goods or services obligated on any purchase order beyond the current fiscal year (September 1 through August 31 of any given year.)

C. **Cancellation**: Items or orders may be canceled without the consent of the vendor due to failure to fulfill their contractual obligations. If cancellation is requested by the Owner for some other reason through no fault of the vendor, the vendor will be contacted. The Owner reserves the right to cancel this contract upon thirty (30) days written notice to the Contractor. The Contractor must request and secure in writing the approval of the Purchasing Department to be released from this contract or any portion thereof should unforeseeable conditions occur.

D. **Miscellaneous:** The laws of the State of Texas shall prevail, including the Public Information Act. Any Order is not confidential. All transactions associated with this Order may be subject to audit. Vendor, by accepting this Order agrees to allow access to all records regarding this transaction upon written request by UNTS Internal Auditors and/or UNTS Business Support Services Procurement department.

5. EVALUATION

5.1 The successful offer will be the offer that is submitted in response to this Proposal by the Submittal Deadline and provides the Best Value to the Owner in the Owner's sole discretion. Offers will be evaluated by an evaluation committee that will include employees of the Owner and other persons invited by the Owner to participate. The evaluation of offers and the selection of the Successful Offer will be based on the information provided to the Owner by the respondent in response to the Specifications section of this Proposal. Consideration may also be given to any additional information and comments if such information or comments increase the benefits to the Owner. The successful respondent will be required to enter into a contract acceptable to the Owner.

The evaluation committee will determine if Best and Final Offers are necessary. Award of a contract may be made without Best and Final Offers. The Owner may, at its discretion, elect to have Respondents provide oral presentations and respond to inquiries from the evaluation committee related to their Proposals. A request for a Best and Final Offer is at the sole discretion of the Owner and will be extended in writing

In evaluating Proposals to determine the best value for the State, the Owner may consider information related to past contract performance of a Respondent including, but not limited to, Texas Comptroller of Public Account's Vendor Performance Tracking System.

5.2 Evaluation Criteria

Proposals will be opened publicly to identify the names of the proposers and their respective proposed agreement amounts. Other contents of the Proposals will be afforded security sufficient to preclude disclosure of the contents prior to award. Proposals will be evaluated by the Owner. The criteria for evaluation, Best Value determination using Education Code 51.783 and selection of the successful proposer for this award, will be based upon the equally weighted factors listed below:

A. Proposed agreement amount listed on Proposal form.
B. Proposed number of calendar days indicated on Proposal form.
C. The qualifications and experience of the proposer's key personnel and subcontractors committed to the project. Project leader and key personnel with minimum five (5) years experience with similar scale projects that are MEP renovations at universities in actively occupied spaces. Provide resumes of key team members working on project, complexity and schedule along with previous experience with construction on a University campus with heavy foot and vehicular traffic.
D. Proposer's current workload and availability of personnel and equipment. Provide information as to contractor's ability to provide adequate manpower to complete the project in the allotted time schedule. Provide existing project loading and projected manpower availability for this project in concurrence with other projects scheduled to be completed by the contractor in the same time frame. Please include a list of proposed subcontractors and their qualifications and any licenses as required.
E. The quality of references from owners and architects for similar projects completed by the proposer within the last five (5) years.
F. The proposer's proposed project schedule and the demonstrated ability to have met expedited schedules on similar projects. Please provide a detailed schedule of work and timeline for the project from start to final completion.
G. The responsibility and reputation of the proposer, including claims and litigation experiences.
H. The proposer's safety record.
I. The sufficiency of the proposer's financial resources.

6. **AWARD PROCESS**

6.1 After the opening of the offers and upon completion of the initial review and evaluation of the offers submitted, selected respondents may be invited to participate in oral presentations. The selection of the Successful Offer may be made by the Owner on the basis of the offers initially submitted, without discussion, clarification or modification. In the alternative, selection of the Successful Offer may be made by the Owner on the basis of negotiation with any of the respondents. At the Owner's sole option and discretion, it may discuss and negotiate all elements of the offers submitted by selected respondents within a specified competitive range. For purposes of negotiation, a competitive range of acceptable or potentially acceptable offers may be established comprising the highest-rated offers. The Owner will provide each respondent within the competitive range with an equal opportunity for discussion and revision of its offer. The Owner will not disclose any information derived from the offers submitted by competing respondents in conducting such discussions. Further action on offers not included within the competitive range will be deferred pending the selection of the Successful Offer; however, the Owner reserves the right to include additional offers in the competitive range if deemed to be in its best interest.

After the submission of offers but before final selection of the Successful Offer is made, the Owner may permit a respondent to revise its offer in order to obtain the respondent's best final offer. The Owner is not bound to accept the lowest-priced offer if that offer is not in its best interest, as determined by the Owner.

The Owner reserves the right to: (a) enter into agreements or other contractual arrangements for all or any portion of the Scope of Work set forth in this Proposal with one or more respondents; (b) reject any and all offers and re-solicit offers; or (c) reject any and all offers and temporarily or permanently abandon this procurement, if deemed to be in the best interest of the Owner.

6.2 Respondent's Acceptance of Evaluation Methodology

Submission of an offer by a respondent indicates: (1) the respondent's acceptance of the Selection Process, the Evaluation of Criteria for selection, and all other requirements and specifications set forth in this Proposal; and (2) the respondent's recognition that some subjective judgments must be made by the Owner during this Proposal process.

6.3 Contract

A. A response to this Solicitation is an offer to contract based upon the terms, conditions and specifications contained herein. Responses do not become contracts until a UNTS Agreement is issued and accepted. The contract shall be governed, construed, and interpreted under the laws of the State of Texas as the same may be amended from time to time. The Education Code 51.9335 shall be considered in making an award when specified. Venue for any suit filed against UNTS shall be subject to the mandatory venue statute set forth in §105.151 of the Texas Education Code.

i. An award is made to the Vendor submitting the lowest and/or best value response conforming to this specification. To determine the lowest and/or best value response, in addition to price, BEST VALUE may be considered.
ii. DEBTS TO THE STATE: Any party indebted to the State of Texas or any party who is more than thirty (30) days delinquent for Child Support is not entitled to payment on this purchase order or any accompanying contract.
iii. If a "best offer" vendor shows not to be in "good standing," this agency may reject the response and award to the next best response.
iv. The Owner reserves the right to award the entire contract to a single Vendor or to award different components to different Vendors, whichever the Owner, at its sole discretion, determines to be in its overall best interest, as solely determined by the responsible parties of the Owner.

B. Respondent understands that acceptance of funds under this contract acts as acceptance of the authority of the State Auditor's Office, or any successor agency, to conduct an audit or investigation in connection with those funds. Respondent further agrees to cooperate fully with the State Auditor's Office or its successor in the conduct of the audit or investigation, including providing all records requested. Respondent will ensure that this clause concerning the authority to audit funds received indirectly by subcontractors through proposer and the requirement to cooperate is included in any subcontract it awards

6.4 Response Results: It is not the policy of the Owner to furnish results over the telephone. Bid tabulations may be requested by email to elaine.robbins@untsystem.edu .

6.5 Historically Underutilized Businesses (HUB)

A. If Owner elects to award the future Construction Phase Services to the Construction Manager, the proposed contract is expected to exceed $100,000.00. A Good Faith Effort Program in the form of a HUB Subcontracting Plan (HSP) is a mandatory condition precedent to the award of any such extension of the contract. The HSP will become a part of the General Construction Agreement Refer to Division 00, Section 006000, *Project Forms* herein for HSP Forms.

B. Centralized Master Bidders List (CBML): The Owner utilizes the Texas Comptroller of Public Accounts CMBL to locate potential HUB vendors. The CMBL is located at: http://comptroller.texas.gov/purchasing/vendor/cmbl/. Non-HUB respondents are identified from various sources including the CBML.

C. Questions regarding completing the HSP should be directed to Rosa Violante or Sony Simon, Assistant HUB Coordinators at 940-369-5500 or hub@untsystem.edu. Additional information can also be found at the Texas Comptroller for the Public Accounts website at:

http://www.window.state.tx.us/procurement/prog/hub/hub-forms/ .

FAILURE TO MEET HUB REQUIREMENTS MAY RESULT IN THE TERMINATION OF THE CONTRACT.

END OF SECTION

DOCUMENT 004100
RFCSP752-24-979ER
UNT Clark Hall MEP

PROPOSAL FORM

Proposal of: _____
(Company Name)

In accordance with Education Code 51.783, the University of North (UNT), subsequently referred to as the Owner, is accepting proposals and intends to enter into an agreement with a General Construction contractor in accordance with the terms, conditions and requirements set forth in this Request for Competitive Sealed Proposal (RFCSP).

UNTS is accepting sealed bids no later than 2:00 p.m. CDT on October 2, 2023. Bids received after the date and hour previously stated will not receive consideration. The HUB Sub-Contracting Plan is due no later than 2:00 p.m. CDT on October 3, 2023. Failure to submit the HUB plan will disqualify your proposal.

The scope of work of this RFCSP is General Construction for the UNT Clark Hall MEP project. A set of the one hundred percent (100%) Construction Documents and Specifications have been included for use in preparation of the proposal. A sample copy of the agreement has been included (Division 00, Section 005200, *Agreement Forms*) for review.

PROPOSERS ARE CAUTIONED TO READ THE INFORMATION CONTAINED OR REFERRED TO IN THIS RFCSP CAREFULLY AND TO SUBMIT A COMPLETE RESPONSE TO ALL REQUIREMENTS AS DIRECTED.

TO: Elaine Robbins
Construction Contract Coordinator II
University of North Texas System

Via Electronic Delivery through Jaegger Website Link below:

https://bids.sciquest.com/apps/Router/PublicEvent?CustomerOrg=UNTS

BASE BID

Pursuant to and in compliance with the Contract Documents and any attachments thereto, including the Advertisement for Competitive Sealed Proposal and Instruction for Proposals, the Proposer hereby certifies that it has, carefully examined the Contract Documents entitled:

UNT Clark Hall MEP **Prepared by: Campos Engineering**

Base Bid: 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 referenced project for the following sum **(Not including bond cost)**:

$

***Please provide a breakdown of your cost as included in your Base Bid.**

ALTERNATE BIDS

Number	Description of Alternate Bid:	Additive/Deductive	Bid Amount:
1	Hydronic Heating Boiler Replacement	☐ Additive ☐ Deductive	$
2	Heating Water Pump Replacement	☐ Additive ☐ Deductive	$
3	Sanitary Sewer Replacement	☐ Additive ☐ Deductive	$
4	Domestic Water Heater Replacement	☐ Additive ☐ Deductive	$
5	Chilled Water Condenser Pump Replacement	☐ Additive ☐ Deductive	$
6	Exhaust Fan Replacement and Rebalance	☐ Additive ☐ Deductive	$

PAYMENT TERMS

The Owner shall be billed in accordance with Chapter 2251 of the Texas Government Code and payment shall be made no later than thirty (30) days following the later of (i) delivery of the goods or completion of the services and (ii) delivery of an invoice to Customer; and (c) interest, if any, on past due payments shall accrue and be paid in accordance with Chapter 2251 of the Texas Government Code. Payee must be in good standing, not indebted to the State of Texas, and current on all taxes owed to the State of Texas for payment to occur. Payment Applications and any required supporting documents must be presented to: University of North Texas System Facilities; 1155 Union Circle #311040, Denton, Texas 76203-5017.

a. Payment on any contract will be withheld from Proposer if Proposer is determined to be more than thirty (30) days delinquent for Child Support.
b. Successful Proposer shall be responsible for referencing the purchase order number(s) resulting from this proposal on any invoice(s), packing list(s), correspondence, etc. Invoicing must correlate to prices quoted either on a unit, hourly, etc. basis.
c. **DISQUALIFICATION**: Response is subject to disqualification if Proposer provides revisions and/or exclusions to the terms and conditions listed in this solicitation that the Owner is limited by law from accepting (i.e. offers with the laws of a State other than Texas), requirements for prepayment not defined in or allowed for in this Solicitation, limitations on remedies, any revision to stated terms and conditions of the Solicitation, etc.
d. Proposer agrees that any payments due under this contract may be applied towards any debt, including but not limited to delinquent taxes and child support that is owed to the State of Texas.

SALES TAX

Purchases made for the Owner's use are exempt from the State Sales tax and Federal Excise tax. Do not include tax in response. Excise Tax Exemption Certificates are available upon request.

INSURANCE

The Proposer shall provide and maintain, until the work covered in this Contract is completed and accepted by the Owner, the minimum insurance coverage as stated in Division 00, Section 007000, *UGC*.

TIME OF COMPLETION

Consecutive Calendar Days needed to complete the project: _____ calendar days

LIQUIDATED DAMAGES

Liquidated damages will be in accordance with Division 00, Section 007000 "UGC".

BOND

In accordance with Texas Government Code 2253, a Payment Bond is required for all public works agreements over $25,000.00 and a Performance Bond for all public works agreements over $100,000.00. It is estimated that this agreement will be over $100,000.00 so a Payment and Performance Bond is required. Please provide the amount as a total bond cost. The Owner will pay bonding costs to the awarded vendor as a pass-through amount with proper documentation provided along with an invoice.

Payment and Performance Bond cost: $ _____

ADDENDA

Receipt is hereby acknowledged of the following addenda to this RFCSP. (Initial, if applicable)

No. 1: _____ No. 2: _____ No. 3: _____ No. 4: _____ No. 5: _____ No. 6: _____

Dated: _____ Dated: _____ Dated: _____ Dated: _____ Dated: _____ Dated: _____

QUALIFICATIONS

Refer to Attachment A of this document. Qualifications must be submitted on the enclosed form and no other document will be accepted. Not providing qualifications on the provided form will be cause for disqualification.

An incomplete proposal or one having additional information or other modifications inscribed thereon, may be cause for rejections of the entire proposal. This proposal is valid and will be honored for a period of one hundred eighty (180) days following the proposal opening.

THIS SECTION MUST BE COMPLETED, SIGNED, AND RETURNED WITH RESPONDENT'S PROPOSAL. FAILURE TO SIGN AND RETURN THIS SECTION WILL RESULT IN DISQUALIFICATION OF YOUR FIRM.

1. By signature hereon, Respondent offers and agrees to furnish the products and/or services in compliance with all terms, conditions, requirements set forth per the RFP documents and contained herein.

2. By signature hereon, Respondent affirms that it has not given, nor intends to give at any time hereafter, any economic opportunity, future employment, gift, loan, gratuity, special discount, trip, favor or service to a public servant in connection with the submitted proposal. Failure to sign hereon, or signing with a false statement, shall void the submitted proposal or any resulting contracts, and the Respondent shall be removed from all proposal lists at this Agency.

3. By signature hereon, a corporate Respondent certifies that it is not currently delinquent in the payment of any Franchise Taxes due under Chapter 171, Texas Tax Code, or that the corporation is exempt from the payment of such taxes, or that the corporation is an out-of-state corporation that is not subject to the Texas Franchise Tax, whichever is applicable. A false certification shall be deemed a material breach of contract and, at UNTS's option, may result in cancellation of any resulting contract or purchase order.

4. By signature hereon, the Respondent hereby certifies that neither the Respondent nor the firm, corporation, partnership or institution represented by the Respondent, or anyone acting for such firm, corporation, or institution has violated the antitrust laws of this state, codified in Section 15.01, et. seq., Texas Business and Commerce Code, or the Federal antitrust laws, nor communicated directly or indirectly the proposal made to any competitor or any other person engaged in such line of business.

5. By signature hereon, Respondent certifies that all statements and information prepared and submitted in response to this solicitation are current, complete and accurate.

6. By signature hereon, Respondent certifies that the individual signing this document and the documents made part of the RFP is authorized to sign such documents on behalf of the company and to bind the company under any contract which may result from the submission of this proposal. Unsigned responses will not be considered under any circumstances.

7. By signature hereon, Respondent certifies that if a Texas address is shown as the address of the Respondent, Respondent qualifies as a Texas Resident Respondent as defined in Texas Administrative Code (TAC) Title 34. In the case of a tie, the award will be made in accordance with TAC, Title 34, amended. Check below preference claimed under TAC, Title 34, amended:

   ☐ Supplies, materials, or equipment produced in Texas/offered by Texas bidders
   ☐ Agricultural products produced or grown in Texas
   ☐ Agricultural products and services offered by Texas bidders
   ☐ USA produced supplies, materials, or equipment
   ☐ Products of persons with mental or physical disabilities
   ☐ Recycled, remanufactured, or environmentally sensitive products, including recycled steel products
   ☐ Energy efficient products
   ☐ Rubberized asphalt paving material
   ☐ Recycled motor oil and lubricants
   ☐ Products produced at facilities located on formerly contaminated property
   ☐ Products and services from economically depressed or blighted areas
   ☐ Vendors that meet or exceed air quality standards

   Consistent and continued tie Responses could cause rejection of offers by UNTS and/or investigation for antitrust violations.

8. By signature hereon, Respondent certifies it is a small business and/or minority/female owned business as defined by the State of Texas. Check status below:

   ☐ Historically Underutilized Business
   ☐ Small Business (House Bill 366, 64th Legislature)
   ☐ Minority/Female Owned Business (House Bill 2626, 73rd Legislature)
   ☐ Certified by Texas Department of Commerce
   ☐ Status not claimed

9. By signature hereon, Respondent certifies as follows:

   "Under Section 231.006, Texas Family Code, the vendor or applicant certifies that the individual or business entity named in this contract, bid, or application is not ineligible to receive the specified grant, loan, or payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate."

   "Under Section 2155.004, Texas Government Code, the vendor or applicant certifies that the individual or business entity named in this bid or contract is not ineligible to receive the specified contract and acknowledges that this contract may be terminated and payment withheld if this certification is inaccurate."

10. By signature hereon, Respondent certifies that no relationship, whether by relative, business associate, capital funding agreement or by any other such kinship, exist between Respondent and an employee of any UNTS component, or Respondent has not been an employee of any UNTS component within the immediate twelve (12) months prior to RFP response. All such disclosures will be subject to administrative review and approval prior to UNTS entering into any contract with Respondent.

11. Respondent certifies that they are in compliance with Section 669.003 of the Texas Government Code, relating to contracting with the executive head of a State agency. If Section 669.003 applies, respondent will complete the following information in order for the response to be evaluated:

    Name of former Executive: _____

    Name of State Agency: _____

    Date of separation from State agency: _____

    Position with Respondent: _____ Date of employment with Respondent: _____

12. By signature hereon, Respondent affirms that no compensation has been received for participation in the preparation of the specifications for this RFP. (ref. Section 2155.004, Texas Government Code).

13. Respondent represents and warrants that all articles and services quoted in response to this RFP meet or exceed the safety standards established and promulgated under the Federal Occupational Safety and Health Law (Public Law 91-596) and its regulations in effect or proposed as of the date of this solicitation.

14. **Suspension, Debarment, and Terrorism:** Respondent further certifies that the Respondent and its principals are eligible to participate in this transaction and have not been subjected to suspension, debarment, or similar ineligibility determined by any federal, state or local governmental entity and that Respondent is in compliance with the State of Texas statutes and rules relating to procurement and that Respondent is not listed on the federal government's terrorism watch list as described in Executive Order 13224. Entities ineligible for federal procurement are listed at http://www.epls.gov.

15. By signature hereon, Respondent signifies his compliance with all federal laws and regulations pertaining to Equal Employment Opportunities and Affirmative Action.

16. By signature hereon, Respondent will comply with and agree to use E-Verify System in accordance with State of Texas Executive Order RP-80 throughout this project as appropriate.

17. Respondent affirmatively states that it does not boycott Israel, pursuant to Texas Gov't Code, Section 2270.002. Additionally, Respondent shall not engage in a boycott of Israel during the term of this agreement.

18. Respondent hereby represents, verifies, and warrants, pursuant to Texas Gov't Code 2272.02, that it does not have a practive, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association and willnot discriminate against a firearm entity or firearm trade association during the term of this agreement.

19. Respondent hereby represents, verifies, and warrants, pursuant to Texas Gov't Code 2274.02, that it does not boycott energy companies and will not boycott energy companies during the term of this agreement.

20. By signature hereon, Respondent hereby represents, verifies, and warrants, pursuant to Texas Gov't Code 2252.201-2252.205, that is is in compliance with the requirement that any iron or steel project produced through a manufacturing process and used in the Project is produced in the United States.

21. Respondents should give Payee ID Number, full firm name, and address of Respondent below in the space provided. The Payee ID Number is the taxpayer number assigned and used by the Texas Comptroller of Public Accounts. If this number is not known, complete the Federal Employer's Identification Number.

Complete the following:

Payee ID No. _____

FEI No. _____

Company Information:

_____
(Company Name)

_____
(Street Address Line 1)

_____
(Street Address Line 2)

_____
(City, State, Zip Code)

If a Corporation
State of Incorporation: _____
Charter No: _____

Submitted by:

_____
(Authorized Signature)

_____
(Printed Name/Title)

_____
(Date)

_____
(Telephone Number)

(Facsimile Number) _____

_____
(Email Address)

ATTACHMENT A

QUALIFICATIONS
RFCSP752-24-979ER
UNT Clark Hall MEP

ITEMS 1 THROUGH 5 TO BE SUBMITTED WITH PROPOSAL

Proposer's Name:_____

Point of Contact:_____

Address:_____

City, State, Zip:_____

Telephone No.:_____ Fax No._____

Email:_____

State Comptroller Vendor Identification Number:_____

1. GENERAL

A. Qualification information submitted shall be applicable only to the company entity or branch that will perform this Work.

B. Attach your Project Organization Chart and resumes of individuals who would be assigned to this project.

C. Proposed demolition schedule (Bar chart acceptable).

2. HISTORY

A. ☐Corporation ☐Partnership ☐Sole Proprietorship ☐Joint Venture

State of Incorporation:_____

B. In continuous business since:_____

Remarks (if required):

_____

_____

_____

C. Corporate Officers, Partners or Owners of Organization:

Name Branch Manager Telephone Number

_____

_____

_____

_____

D. Check box(es) corresponding to the nature of your business:

☐ Large Business (100 or more employees)

☐ Small Business (fewer than 100 employees)

☐ HUB Business

☐ Other (Define) _____

E. Has your organization ever defaulted or failed to complete any work awarded?

☐ Yes ☐ No

If yes, stipulate where and why:_____

_____

_____

F. Has your organization ever paid liquidated damages or a penalty for failure to complete a contract on time?

☐ Yes ☐ No

If yes, stipulate where and why:_____

_____

_____

3. EXPERIENCE

A. Normally performs _____ % of the work with own forces. List trades below:

_____

_____

B. Propose to perform _____% of the work for project with own forces. List trades below:

_____

_____

C. List all major projects of your organization has in-progress. If more space is needed attach pages to this form using format below identified by item and sub-item:

i. Name, Location and Description of Project:_____

_____

_____

_____

Contract Amount:_____

Percent Complete:_____

Project Completion Date:_____

Owner Reference Contact and Telephone Number:

_____

_____

Architect Reference Contact and Telephone Number:

_____

_____

ii. Name, Location and Description of Project:_____

_____

_____

_____

Contract Amount:_____

Percent Complete:_____

Project Completion Date:_____

Owner Reference Contact and Telephone Number:

_____

_____

Architect Reference Contact and Telephone Number:

_____

_____

iii. Name, Location and Description of Project:_____

_____

_____

_____

Contract Amount:_____

Percent Complete:_____

Project Completion Date:_____

Owner Reference Contact and Telephone Number:

_____

_____

Architect Reference Contact and Telephone Number:

_____

_____

D. Total number and dollar amount of contracts currently in progress:

Number_____ $_____

E. Largest contract currently in-process: _____

Anticipated date of completion: _____

F. Volume of work completed over last five (5) years: (Through 12/31)

Year _____ $_____

_____ $_____

_____ $_____

_____ $_____

_____ $_____

G. List five (5) major projects of similar scope your organization has completed in the last five (5) years with completion date, photos and references. Other projects of particular significance may also be listed.

i. Name, Location and Description of Project:_____

_____

_____

_____

_____

Contract Amount:_____

Percent Complete:_____

Project Completion Date:_____

Owner Reference Contact and Telephone Number:

_____

Name Telephone Number

Architect Reference Contract and Telephone Number:

_____

Name Telephone Number

ii. Name, Location and Description of Project:_____

_____

_____

_____

_____

Contract Amount:_____

Percent Complete:_____

Project Completion Date:_____

Owner Reference Contact and Telephone Number:

_____

Name Telephone Number

Architect Reference Contract and Telephone Number:

_____

Name Telephone Number

iii. Name, Location and Description of Project:_____

_____

_____

_____

_____

Contract Amount:_____

Percent Complete:_____

Project Completion Date:_____

Owner Reference Contact and Telephone Number:

_____

Name Telephone Number

Architect Reference Contract and Telephone Number:

_____

Name Telephone Number

iv. Name, Location and Description of Project:_____

_____

_____

_____

_____

Contract Amount:_____

Percent Complete:_____

Project Completion Date:_____

Owner Reference Contact and Telephone Number:

_____

Name Telephone Number

Architect Reference Contract and Telephone Number:

_____

Name Telephone Number

v. Name, Location and Description of Project:_____

_____

_____

_____

_____

Contract Amount:_____

Percent Complete:_____

Project Completion Date:_____

Owner Reference Contact and Telephone Number:

_____
Name Telephone Number

Architect Reference Contract and Telephone Number:

_____
Name Telephone Number

H. Has your organization had any claims and/or litigations in the last five (5) years?

_____

If yes, attach a list with project name, date or project, owner, owner's contact person with telephone number and summary explanation.

4. SAFETY PROGRAM

A. List your organization's Workers Compensation Experience Modification Rate (EMR) for the last three (3) years, as obtained from your insurance agent.

YEAR			
EMR			

B. Complete matrix for the three (3) past years, as obtained from OSHA N. 200 Log:

Year			
Number of injuries and illness			
Number of lost time accidents			
Number of recordable cases			
Number of fatalities			
Total Injury & illness rate from OSHA 300 log			

Please provide your SIC Code _____

C. Are regular project safety meetings held for Field Supervisor(s)?

☐ Yes ☐No

If yes, frequency:

☐Weekly ☐Bi-monthly ☐Monthly ☐As Needed

D. Are project safety inspections conducted? ☐Yes ☐No

If yes, who performs inspection? How often?

_____ _____

E. Does organization have a written safety program? ☐Yes ☐No

If yes, provide a copy. It will become a compliance document upon contract award.

F. Does your organization have a safety orientation program for new employees? ☐Yes ☐No

For employees promoted to Field Supervisors? ☐Yes ☐No

If yes, does your Supervisor Safety Program include instructions on the following:

	Yes	No
Safety work practices	☐	☐
Tool box safety meetings	☐	☐
First aid procedures	☐	☐
Accident investigation	☐	☐
Fire protection	☐	☐
New worker's orientation	☐	☐

5. FINANCIAL

A. Attach an audited Financial Statement, including a profit and loss statement and other supporting schedules. If the last audited statement is over twelve (12) months old, include the most current unaudited statement.

B. Surety Company:_____

Agent:_____

Name of Contact:_____Telephone No._____

C. Bonding Capacity:_____

Limit per project:_____

Unencumbered bonding capacity:_____

D. Trade References (Additional references may be included as attached sheets.)

i. Organization:_____

Agent:_____

Name of Contract:_____Telephone No._____

ii. Organization:_____

Agent:_____

Name of Contract:_____Telephone No._____

iii. Organization:_____

Agent:_____

Name of Contract:_____Telephone No._____

DOCUMENT 006000

PROJECT FORMS

PAYMENT BOND

Surety Bond No.

STATE OF TEXAS §
COUNTY OF §

KNOW ALL MEN BY THESE PRESENT: That we, _____, as Principal, and_____, as Surety, are hereby held and firmly bound unto the University of North Texas System, as Obligee, in the sum of Dollars ($_____) for payment whereof the said Principal and Surety bind themselves, their heirs, executors, administrators, and successors, jointly and severally, by the terms and conditions herein.

The conditions of this obligation are such that whereas the Principal entered into a certain contract with the Obligee, as an entity of the State of Texas, dated the ____day of ___, 200_ ("Contract"), which is hereto attached and made a part hereof for all purposes, for the purpose of _____
_____.

NOW THEREFORE, the condition of this obligation is such that this Payment Bond shall remain in full force and effect unless and until 120 days after Principal has faithfully performed the Contract in accordance with the Contract documents and Principal has executed a copy of the attached Payment Affidavit and provided it to Obligee.

In the event that the Principal fails to promptly pay when due any amount owed to persons who have supplied labor, materials, or supplies used in Principal's performance of the said Contract, the Surety will, upon receipt of notice from the Obligee or a claim in the form required by law, satisfy all undisputed balances due, and make arrangements satisfactory to the interested parties to resolve all amounts disputed in good faith, but in no event shall the liability of the Surety for the Principal's failure to promptly pay for labor, materials, or supplies exceed the amount of this bond.

The Surety agrees to pay to the Obligee upon demand all loss and expense, including attorney's fees, incurred by the Obligee by reason of or on account of any breach of this obligation by the Principal or the Surety.

Provided further, that this bond is made and entered into for the protection of all parties supplying labor or materials in the prosecution of the work provided for in the said Contract, and all such parties shall have a direct right of action under this bond as provided in Chapter 2253 of the Texas Government Code. If any legal action is filed upon this bond, venue shall lie in Denton County, Texas.

The liabilities, rights, limitations and remedies concerning this Bond shall be determined in accordance with the provisions of Chapter 2253 of the Texas Government Code, pursuant to which this bond is executed.

IN WITNESS WHEREOF, the above parties have executed this instrument under their several seals this _____ day of _____ in the year 20___, the name and seal of each party being hereto affixed, and duly signed by its undersigned representative pursuant to authority of its governing body.

CONSTRUCTION MANAGER-AT-RISK

_____ (Firm Name)	_____ (Address)
_____ (Signature)	_____ (City, State, Zip)
_____ (Typed Name and Title)	_____ (Telephone)
_____ (Texas Vendor ID No.)	

PERFORMANCE BOND

Surety Bond No.

STATE OF TEXAS §
COUNTY OF §

LET IT BE KNOWN BY THIS INSTRUMENT: That we, _____ , as Principal, and _____ a corporation duly authorized to do business in the State of Texas, as Surety, are hereby held and firmly bound unto the University of North Texas System, as Obligee, in the sum of _____ Dollars ($_____) for payment whereof the said Principal and Surety bind themselves, their heirs, executors, administrators, and successors, jointly and severally, by the terms and conditions herein.

The conditions of this obligation are such that whereas the Principal entered into a certain contract with the Obligee, as an entity of the State of Texas, dated the _____day of _____, 20 ("Contract"), which is hereto attached and made a part hereof for all purposes, for the purpose of_____ _____.

NOW THEREFORE, the condition of this obligation is such that this Performance Bond shall remain in full force and effect unless and until the Principal has faithfully performed the Contract in accordance with the Plans, Specifications and Contract documents. Further, under the terms of this Performance Bond, Principal shall fully indemnify and save harmless the Obligee from all cost and damage which the Obligee may suffer by reason of Principal's default or failure to perform and shall fully reimburse and repay the Obligee all outlay and expense which the Obligee may incur in making good any such default.

In the event that the Principal's failure as defined by the Contract Documents, to faithfully perform the Contract, Surety will within fifteen (15) days of determination of default, assume full responsibility for completion of said Contract and become entitled to payment of the balance of the Contract amount. Conditioned upon the Surety's faithful performance of its obligations, the liability of the Surety for the Principal's default shall not exceed the penalty of this Bond.

The Surety agrees to pay to the Obligee upon demand all loss and expense, including attorney's fees, incurred by the Obligee by reason of or on account of any breach of this obligation by the Principal or the Surety.

Provided further, that the Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the said Contract, or to the work to be performed thereunder, or the Specifications accompanying the same, shall in anyway affect its obligation on this Bond, and it does hereby waive notice of any such change, extension of time, alteration or addition, to the terms of the said Contract or to the work or to the Specifications.

Provided further, that if any legal action be filed upon this Bond, venue shall lie in Denton County, Texas.

The liabilities, rights, limitations and remedies concerning this Bond shall be determined in accordance with the provisions of Chapter 2253 of the Texas Government Code, pursuant to which this Bond is executed.

IN WITNESS WHEREOF, the above parties have executed this instrument under their several seals this _____ day of _____ in the year 20___, the name and corporate seal of each corporate party being hereto affixed, and these present duly signed by its undersigned representative pursuant to authority of its governing body.

ATTEST:

_____
(Principal)

_____
(Signature)

_____
(Signature)

_____
(Typed Name and Title)

_____
(Typed Name and Title)

(SEAL)

ATTEST:

_____
(Surety)

_____
(Signature)

_____
(Signature)

_____
(Typed Name and Title)

_____
(Typed Name and Title)

(SEAL)

Surety's Texas Local Recording Agent or Resident Agent:

_____
(Signature)

_____
(Typed Name)

_____
(License No.)

_____
(File No)

_____
(Address)

_____
(City, State, Zip)

_____
(Telephone)

Surety's Home Office Agent or Servicing Agent:

_____
(Name)

_____
(Title)

_____
(Address)

_____
(City, State, Zip)

_____
(Telephone)

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HUB Subcontracting Plan (HSP)

QUICK CHECKLIST

While this HSP Quick Checklist is being provided to merely assist you in readily identifying the sections of the HSP form that you will need to complete, it is very important that you adhere to the instructions in the HSP form and instructions provided by the contracting agency.

➤ **If you will be awarding <u>all</u> of the subcontracting work you have to offer under the contract to <u>only</u> Texas certified HUB vendors, complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors.
- ☐ Section 2 c. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you <u>do not</u> have a *<u>continuous contract</u>** in place for more than five (5) years *<u>meets or exceeds</u>* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors or only to Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you <u>do not</u> have a *<u>continuous contract</u>** in place for more than five (5) years *<u>does not meet or exceed</u>* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - No
- ☐ Section 4 - Affirmation
- ☐ GFE Method B (Attachment B) - Complete an Attachment B for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will not be subcontracting any portion of the contract and will be fulfilling the entire contract with your own resources (i.e., employees, supplies, materials and/or equipment), complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - No, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources.
- ☐ Section 3 - Self Performing Justification
- ☐ Section 4 - Affirmation

***<u>Continuous Contract</u>:** Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.284 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.285(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

SECTION 1: RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: _____ State of Texas VID #: _____

Point of Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

b. Is your company a State of Texas certified HUB? ☐ **- Yes** ☐ **- No**

c. Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

Enter your company's name here: _____ Requisition #: _____

SECTION 2: RESPONDENT'S SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods and services will be subcontracted**. Note: In accordance with 34 TAC §20.282, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☐ - *Yes*, I will be subcontracting portions of the contract. (If *Yes*, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - *No*, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods and services. (If *No*, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	Percentage of the contract expected to be subcontracted to non-HUBs.
1		%	%	%
2		%	%	%
3		%	%	%
4		%	%	%
5		%	%	%
6		%	%	%
7		%	%	%
8		%	%	%
9		%	%	%
10		%	%	%
11		%	%	%
12		%	%	%
13		%	%	%
14		%	%	%
15		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	**%**	**%**	**%**

(Note: If you have more than fifteen subcontracting opportunities, a continuation sheet is available online at https://www.comptroller.texas.gov/purchasing/vendor/hub/forms.php).

c. Check the appropriate box (Yes or No) that indicates whether you will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities you listed in SECTION 2, Item b.

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - *No* (If *No*, continue to Item d, of this SECTION.)

d. Check the appropriate box (Yes or No) that indicates whether the aggregate expected percentage of the contract you will subcontract **with Texas certified HUBs** with which you **do not** have a **continuous contract*** in place with for **more than five (5) years**, **meets or exceeds** the HUB goal the contracting agency identified on page 1 in the "**Agency Special Instructions/Additional Requirements**."

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - *No* (If *No*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed.)

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: _____ Requisition #: _____

SECTION 2: RESPONDENT's SUBCONTRACTING INTENTIONS (CONTINUATION SHEET)

This page can be used as a continuation sheet to the HSP Form's page 2, Section 2, Item b. Continue listing the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	**Percentage of the contract expected to be subcontracted to non-HUBs.**
16		%	%	%
17		%	%	%
18		%	%	%
19		%	%	%
20		%	%	%
21		%	%	%
22		%	%	%
23		%	%	%
24		%	%	%
25		%	%	%
26		%	%	%
27		%	%	%
28		%	%	%
29		%	%	%
30		%	%	%
31		%	%	%
32		%	%	%
33		%	%	%
34		%	%	%
35		%	%	%
36		%	%	%
37		%	%	%
38		%	%	%
39		%	%	%
40		%	%	%
41		%	%	%
42		%	%	%
43		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	**%**	**%**	**%**

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: _____ Requisition #: _____

SECTION 3: SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.) If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment.

SECTION 4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/ProgressAssessmentReportForm.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

Signature	Printed Name	Title	Date (mm/dd/yyyy)

Reminder:

- If you responded "Yes" to SECTION 2, Items c or d, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded "No" SECTION 2, Items c and d, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.

HSP Good Faith Effort - Method A (Attachment A)

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Enter your company's name here: ______________________ Requisition #: ______________

IMPORTANT: If you responded "*Yes*" to **SECTION 2, Items c** or **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/hub-sbcont-plan-gfe-achm-a.pdf

SECTION A-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: ______________________________

SECTION A-2: SUBCONTRACTOR SELECTION

List the subcontractor(s) you selected to perform the subcontracting opportunity you listed above in SECTION A-1. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

HSP Good Faith Effort - Method B (Attachment B) Cont.

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Enter your company's name here: _____ Requisition #: _____

SECTION B-4: SUBCONTRACTOR SELECTION

Enter the item number and description of the subcontracting opportunity you listed in **SECTION 2, Item b,** of the completed HSP form for which you are completing the attachment.

a. Enter the item number and description of the subcontracting opportunity for which you are completing this Attachment B continuation page.

Item Number: _____ Description: _____

b. List the subcontractor(s) you selected to perform the subcontracting opportunity you listed in **SECTION B-1**. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Emplioyer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

c. If any of the subcontractors you have selected to perform the subcontracting opportunity you listed in **SECTION B-1** is **not** a Texas certified HUB, provide written justification for your selection process (attach additional page if necessary):

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to **all** the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity it (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

HSP Good Faith Effort - Method B (Attachment B)

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Enter your company's name here: _____ Requisition #: _____

IMPORTANT*:** If you responded "No***" to **SECTION 2, Items c** and **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/hub-sbcont-plan-gfe-achm-b.pdf..

SECTION B-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: _____

SECTION B-2: MENTOR PROTÉGÉ PROGRAM

If respondent is participating as a Mentor in a State of Texas Mentor Protégé Program, submitting its Protégé (Protégé must be a State of Texas certified HUB) as a subcontractor to perform the subcontracting opportunity listed in **SECTION B-1**, constitutes a good faith effort to subcontract with a Texas certified HUB towards that specific portion of work.

Check the appropriate box (Yes or No) that indicates whether you will be subcontracting the portion of work you listed in SECTION B-1 to your Protégé.

☐ - Yes (If *Yes*, continue to SECTION B-4.)

☐ - No / Not Applicable (If *No* or *Not Applicable*, continue to SECTION B-3 and SECTION B-4.)

SECTION B-3: NOTIFICATION OF SUBCONTRACTING OPPORTUNITY

When completing this section you MUST comply with items a, b, c and d, thereby demonstrating your Good Faith Effort of having notified Texas certified HUBs and trade organizations or development centers about the subcontracting opportunity you listed in SECTION B-1. Your notice should include the scope of work, information regarding the location to review plans and specifications, bonding and insurance requirements, required qualifications, and identify a contact person. When sending notice of your subcontracting opportunity, you are encouraged to use the attached HUB Subcontracting Opportunity Notice form, which is also available online at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/HUBSubcontractingOpportunityNotificationForm.pdf.

Retain supporting documentation (i.e., certified letter, fax, e-mail) demonstrating evidence of your good faith effort to notify the Texas certified HUBs and trade organizations or development centers. Also, be mindful that a working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.

a. Provide written notification of the subcontracting opportunity you listed in SECTION B-1, to three (3) or more Texas certified HUBs. Unless the contracting agency specified a different time period, you must allow the HUBs at least seven (7) working days to respond to the notice prior to you submitting your bid response to the contracting agency. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

b. List the **three (3) Texas certified HUBs** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the company's Texas Vendor Identification (VID) Number, the date you sent notice to that company, and indicate whether it was responsive or non-responsive to your subcontracting opportunity notice.

Company Name	Texas VID (Do not enter Social Security Numbers.)	Date Notice Sent (mm/dd/yyyy)	Did the HUB Respond?
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No

c. Provide written notification of the subcontracting opportunity you listed in SECTION B-1 to two (2) or more trade organizations or development centers in Texas to assist in identifying potential HUBs by disseminating the subcontracting opportunity to their members/participants. Unless the contracting agency specified a different time period, you must provide your subcontracting opportunity notice to trade organizations or development centers at least seven (7) working days prior to submitting your bid response to the contracting agency. A list of trade organizations and development centers that have expressed an interest in receiving notices of subcontracting opportunities is available on the Statewide HUB Program's webpage at https://www.comptroller.texas.gov/purchasing/vendor/hub/resources.php.

d. List **two (2) trade organizations or development centers** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the date when you sent notice to it and indicate if it accepted or rejected your notice.

Trade Organizations or Development Centers	Date Notice Sent (mm/dd/yyyy)	Was the Notice Accepted?
		☐ - Yes ☐ - No
		☐ - Yes ☐ - No

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HUB Subcontracting Opportunity Notification Form

In accordance with Texas Gov't Code, Chapter 2161, each state agency that considers entering into a contract with an expected value of $100,000 or more shall, before the agency solicits bids, proposals, offers, or other applicable expressions of interest, determine whether subcontracting opportunities are probable under the contract. The state agency I have identified below in Section B has determined that subcontracting opportunities are probable under the requisition to which my company will be responding.

34 Texas Administrative Code, §20.285 requires all respondents (prime contractors) bidding on the contract to provide notice of each of their subcontracting opportunities to at least three (3) Texas certified HUBs (who work within the respective industry applicable to the subcontracting opportunity), and allow the HUBs at least seven (7) working days to respond to the notice prior to the respondent submitting its bid response to the contracting agency. In addition, at least seven (7) working days prior to submitting its bid response to the contracting agency, the respondent must provide notice of each of its subcontracting opportunities to two (2) or more trade organizations or development centers (in Texas) that serves members of groups (i.e., Asian Pacific American, Black American, Hispanic American, Native American, Woman, Service Disabled Veteran) identified in Texas Administrative Code §20.282(19)(C).

We respectfully request that vendors interested in bidding on the subcontracting opportunity scope of work identified in Section C, Item 2, reply no later than the date and time identified in Section C, Item 1. Submit your response to the point-of-contact referenced in Section A.

SECTION A: PRIME CONTRACTOR'S INFORMATION

Company Name: _____ State of Texas VID #: _____

Point-of-Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

SECTION B: CONTRACTING STATE AGENCY AND REQUISITION INFORMATION

Agency Name: _____

Point-of-Contact: _____ Phone #: _____

Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

SECTION C: SUBCONTRACTING OPPORTUNITY RESPONSE DUE DATE, DESCRIPTION, REQUIREMENTS AND RELATED INFORMATION

1. Potential Subcontractor's Bid Response Due Date:

If you would like for our company to consider your company's bid for the subcontracting opportunity identified below in Item 2,

we must receive your bid response no later than _____ (Central Time) on _____ (Date (mm/dd/yyyy)).

In accordance with 34 TAC §20.285, each notice of subcontracting opportunity shall be provided to at least three (3) Texas certified HUBs, and allow the HUBs at least seven (7) working days to respond to the notice prior to submitting our bid response to the contracting agency. In addition, at least seven (7) working days prior to us submitting our bid response to the contracting agency, we must provide notice of each of our subcontracting opportunities to two (2) or more trade organizations or development centers (in Texas) that serves members of groups (i.e., Asian Pacific American, Black American, Hispanic American, Native American, Woman, Service Disabled Veteran) identified in Texas Administrative Code, §20.282(19)(C).

(A working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.)

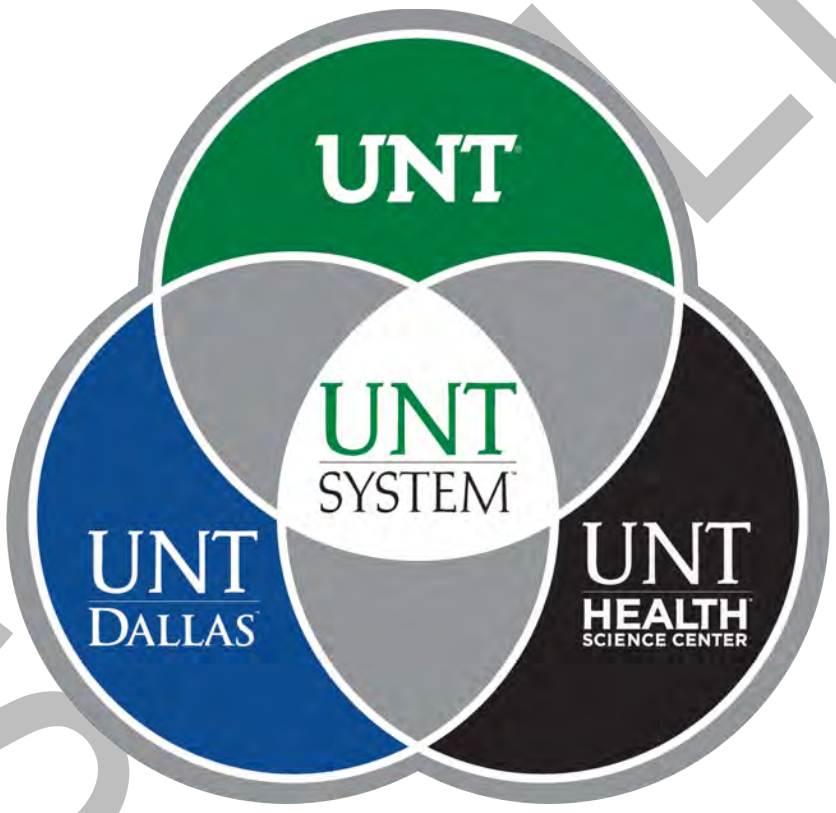
2. Subcontracting Opportunity Scope of Work:

3. Required Qualifications: ☐ - Not Applicable

4. Bonding/Insurance Requirements: ☐ - Not Applicable

5. Location to review plans/specifications: ☐ - Not Applicable

GENERAL CONSTRUCTION AGREEMENT



GENERAL CONSTRUCTION AGREEMENT
(For Use with Competitive Sealed Proposals)

This Agreement is made and entered into by and between **University of North Texas {System or Institution Name}** ("Owner"), and by **{Firm Name}** ("Contractor"), duly authorized by the laws of the State of Texas to act as contractor for construction, rehabilitation, alteration, or repair services. The capitalized term "Party" refers to either Owner or Contractor individually and the term "Parties" refers to Owner and Contractor collectively. The effective date ("Effective Date") of this Agreement shall be the date of last signature by the parties hereto.

ARTICLE 1
PROJECT

1.1 Owner does hereby engage Contractor and Contractor does hereby agree to provide all labor, materials, equipment, and services necessary to complete the Work, all of which shall be provided in full accord with the Contract Documents to construct the {Project Name} ("Project"), on the {Campus}, to be completed in accordance with the requirements herein, and generally described as follows:

{General Description of the Project}

1.2 Contractor has overall responsibility for and shall furnish all materials, equipment, tools, and labor as necessary or reasonably inferable to complete the Work, or any phase of the Work, in accordance with Owner's requirements and the terms of the Contract Documents.

ARTICLE 2
CONTRACT DOCUMENTS

2.1 Owner, through its Design Professional, shall provide all architectural and engineering design services necessary for the completion of the Work. The Drawings, Specifications, and addenda have been prepared for Owner by {Architect/Engineer} ("Design Professional").

2.2 The Contract Documents consist of:

2.2.1 This Agreement and all exhibits and attachments listed, contained or referenced in this Agreement;

2.2.2 The Uniform General Conditions for Construction and Design Contracts for the University of North Texas System ("Uniform General Conditions" or "UGC");

2.2.3 Supplementary General Conditions or Special Conditions, if any;

2.2.4 Owner's Specifications;

2.2.5 All Addenda issued prior to the Effective Date of this Agreement;

2.2.6 All Change Orders issued after the Effective Date of this Agreement;

2.2.7 The Drawings, Specifications, details and other documents developed by Design Professional to describe the Project and accepted by Owner;

2.2.8 The Drawings and Specifications developed or prepared by Owner's other consultants, if any, and accepted by Owner; and

2.2.9 The Historically Underutilized Business (HUB) subcontracting plan submitted or amended by Contractor and approved by Owner for this Project.

2.3 The Contract Documents form the entire and integrated agreement between Owner and Contractor and supersede all prior negotiations, representations or agreements, written or oral.

2.4 To the extent the terms of this Agreement conflict with the Uniform General Conditions and/or the Supplemental Conditions, the terms of this Agreement will control.

2.5 If there is an irreconcilable conflict between or among the various documents that make up the Contract Documents, the interpretation that provides for the higher quality of material and/or workmanship will prevail over all other interpretations.

ARTICLE 3
DEFINITIONS

3.1 Terms, words, and phrases used in the Contract Documents shall have the meanings given in the Uniform General Conditions.

3.2 The following terms, words, and phrases used in the Contract Documents shall have the following meanings, and if more specific than the definition given in the Uniform General Condition, the more specific given in this Agreement shall control.

3.2.1 "Baseline Schedule" means the initial time schedule prepared by Contractor for Owner's information and acceptance that conveys Contractor's and Subcontractors' activities (including coordination and review activities required in the Contract Documents to be performed by the Design Professional and Owner), durations, and sequence of work related to the entire Project to the extent required by the Contract Documents. The schedule shall clearly demonstrate the longest path of activities, critical activities durations, and necessary predecessor conditions that drive the end date of the schedule. The accepted Construction Baseline Schedule shall not change.

3.2.2 "Design Professional" means licensed professionals, or firms employing such licensed professionals, engaged by Owner as independent architects or engineers for design of all or a portion of the Project and to prepare Drawings and Specifications for the construction of the Project. More than one such professional or firm may be employed by Owner, and all such professionals or firms, regardless of number, are referred to in the singular herein.

3.2.3 "Longest Path" means the sequence of directly related activities that comprise the longest continuous chain of activities from the start of the first activity to the finish of the last activity. Each activity in the Longest Path is critical and directly related in that it prevents its successor from being scheduled earlier than it is. For this Project, "Longest Path" shall also include ten percent (10%) Total Float and Weather Days.

3.2.4 "Subcontractor" means a person or entity who has an agreement with Contractor to perform any portion of the Work. The term Subcontractor does not include the Design Professional or any person or entity hired directly by Owner.

3.2.5 "Work" means the provision of all services, labor, materials, supplies, and equipment that are required of Contractor to complete the Project in strict accordance with the requirements of the Agreement and the Construction Documents. Work includes, but is not limited to, the construction services, additional work required by Change Orders, and any other work reasonably inferable from the Construction Documents. The term "reasonably inferable" takes into consideration the understanding of the parties that some details necessary for completion of the Work may not be shown on the Drawings or included in the Specifications, but they are a requirement of the Work if they are a

usual and customary component of the Work or otherwise necessary for complete installation and operation of the Work.

ARTICLE 4
CONTRACTOR'S RESPONSIBILITIES

4.1 Contractor's responsibilities include but are not limited to supervision, furnishing labor, materials, equipment, employment of and responsibility for subcontractors, payment of taxes where applicable, patent fees, royalties, approval fees, license fees, permit fees, filing fees, registration fees, and other governmental charges.

4.2 Contractor represents that it is an independent contractor and that it is familiar with the type of Work it is undertaking. Contractor shall furnish construction administration and management services and use Contractor's diligent efforts to perform the Work in an expeditious manner consistent with the Contract Documents. Contractor will cause all persons connected with Contractor directly in charge of the Work to be duly registered and/or licensed under all applicable laws.

4.3 Neither Contractor nor any of its agents or employees shall act on behalf of or in the name of Owner except as provided in this Agreement or unless authorized in writing by Owner's Representative.

4.4 Contractor shall be responsible for the supervision and coordination of the Work, including the construction means, methods, techniques, sequences, procedures, safety provisions, precautions, and programs utilized, unless the Contract Documents give other specific instructions. In such case, Contractor shall not be liable to Owner for damages resulting from compliance with such instructions unless Contractor recognized and failed to timely report to Owner any error, inconsistency, omission, or unsafe practice that it discovered in the specified construction means, methods, techniques, sequences, procedures, safety provisions, precautions, or programs.

4.5 Contractor shall perform Work only within locations allowed by the Contract Documents, applicable laws and regulations, and applicable permits. Laws and regulations include federal, state, and local laws, ordinances, codes, rules, and regulations applicable to the Work that are enacted as of the Agreement date, with which the Constructor must comply.

4.6 Contractor shall: (a) proceed with the Work in a manner that does not hinder, delay, or interfere with the work of Owner or others or cause the work of Owner or others to become defective; (b) afford Owner or others reasonable access for introduction and storage of their materials and equipment and performance of their activities; and (c) coordinate Contractor's Work with the work of Owner and others.

4.7 Before proceeding with any portion of the Work affected by the construction or operations of Owner or others, Contractor shall give Owner written notification within forty-eight (48) hours of any defects Contractor discovers in Owner's or other's performance or work, which will prevent the proper execution of the Work. Contractor's obligations in this subsection do not create a responsibility for the performance or work of Owner or others, but are for the purpose of facilitating the Work. If Contractor does not notify Owner of defects interfering with the performance of the Work, Contractor acknowledges that the performance or work of Owner or others is not defective and is acceptable for the proper execution of the Work. Following receipt of written notice from Contractor of defects, Owner shall promptly inform Contractor what action, if any, Contractor shall take with regard to the defects.

4.8 Prior to commencing the Work, Contractor shall examine and compare the Drawings and Specifications with information furnished by Owner, relevant field measurements made by Contractor, and any visible conditions at the site affecting the Work. During the visit to the site, Contractor shall inspect the existing facilities, systems and conditions to ensure an accurate understanding of the existing conditions as required.

4.9 Should Contractor discover any discrepancies, errors, omissions, or inconsistencies in the Contract Documents, Contractor shall report them to Owner within forty-eight (48) hours of discovery. It is recognized, however, that Contractor is not acting in the capacity of a licensed design professional, and that Contractor's examination is to facilitate construction and does not create an affirmative responsibility to detect discrepancies, errors, omissions, or inconsistencies or to ascertain compliance with applicable laws and regulations, including building codes. Following receipt of written notice from Contractor of defects, Owner shall promptly inform Contractor what action, if any, Contractor shall take with regard to the defects.

4.9.1 Contractor shall have no liability for discrepancies, errors, omissions, or inconsistencies discovered under this section unless Contractor fails to promptly report a discovered or apparent discrepancy, error, omission, or inconsistency to Owner. This does not relieve Contractor of responsibility for its own discrepancies, errors, inconsistencies, or omissions.

4.10 Contractor shall provide competent supervision for the performance of the Work. Before commencing the Work, Contractor shall notify Owner in writing of the name and qualifications of its proposed superintendent(s) and project manager, so Owner may review the individual's qualifications. If, for reasonable cause, Owner refuses to approve the individual, or withdraws its approval after giving it, Contractor shall name a different superintendent or project manager for Owner's review. Any disapproved superintendent shall not perform in that capacity thereafter at the site. Contractor's superintendent(s) and project manager shall possess full authority to receive instructions from Owner and to act on those instructions. If Contractor changes its superintendent(s) or project manager or their authority, Contractor shall immediately notify Owner in writing.

4.11 Contractor shall be responsible to Owner for acts or omissions of parties or entities performing portions of the Work for or on behalf of Contractor or any of its Subcontractors.

4.12 Contractor shall permit only qualified persons to perform the Work. Contractor shall enforce safety procedures, strict discipline, and good order among persons performing the Work.

4.13 Contractor shall submit to Owner and the Design Professional all shop drawings, samples, product data, and similar submittals required by the Contract Documents for review and approval. Submittals shall be submitted in accordance with the Uniform General Conditions. Contractor shall be responsible for the accuracy and conformity of its submittals to the Contract Documents requirements.

4.14 Contractor acknowledges that it has visited, or has had the opportunity to visit, the site to visually inspect the general and local conditions of the facilities, systems and conditions to ensure an accurate understanding of the existing conditions which could affect the Work.

4.15 The Work shall be executed in accordance with the Contract Documents and Contractor agrees that (a) it will use its best efforts to perform the Work in a good and workmanlike manner and in accordance with the highest standards of Contractor’s profession or business, and (b) all the Work to be performed will be of the quality that prevails among similar businesses of superior knowledge and skill engaged in providing similar services. All materials used in the Work shall be furnished in sufficient quantities to facilitate the proper and expeditious execution of the Work.

4.16 If the Work includes installation of materials or equipment furnished by Owner or others, it shall be the responsibility of Contractor to examine the items so provided and thereupon handle, store, and install the items, unless otherwise provided in the Contract Documents, with such skill as to provide a satisfactory and proper installation. Loss or damage due to acts or omissions of Contractor shall be the responsibility of Contractor and may be deducted from any amounts due or to become due to Contractor. Any defects discovered in such materials or equipment shall be reported at once to Owner. Following receipt of written notice from Contractor of defects, Owner shall promptly inform Contractor what action, if any, Contractor shall take with regard to the defects.

4.17 Contractor shall have overall responsibility for safety precautions and programs in the performance of the Work. However, such obligation does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work or for compliance with applicable laws and regulations.

4.17.1 Contractor shall seek to avoid injury, loss, or damage to persons or property by taking reasonable steps to protect: (a) its employees and other persons at the site; (b) materials and equipment stored at onsite or offsite locations for use in the Work; and (c) property located at the site and adjacent to Work areas, whether or not the property is part of the site.

4.17.2 Contractor's site safety representative shall have a duty to prevent accidents. The safety representative shall perform their duty in accordance with the Uniform General Conditions.

4.17.3 If Owner deems any part of the Work or site unsafe, Owner, without assuming responsibility for Contractor's safety program, may require Contractor to stop performance of the Work or take corrective measures satisfactory to Owner, or both. If Contractor does not adopt corrective measures, Owner may perform them and deduct their cost from the Contract Sum. If Owner determines that a particular person does not follow safety procedures, or is unfit or unskilled for the assigned Work, Contractor shall immediately reassign the person upon receipt of Owner's written notice to do so. Contractor agrees to make no claim for damages, for an increase in the Contract Sum or for a change in the Contract Time based on Contractor's compliance with Owner's reasonable request.

4.18 If the conditions encountered at the site are: (a) subsurface or other physical conditions materially different from those indicated in the Contract Documents; or (b) unusual and unknown physical conditions materially different from conditions ordinarily encountered and generally recognized as inherent in Work provided for in the Contract Documents, then Contractor shall stop affected Work after the condition is first observed and give written notice of the condition to Owner and the Design Professional within forty-eight (48) hours.

4.19 Contractor shall regularly remove debris and waste materials at the site resulting from the Work. Prior to discontinuing Work in an area, Contractor shall clean the area and remove all rubbish and its construction equipment, tools, machinery, waste, and surplus materials. Contractor shall minimize and confine dust and debris resulting from construction activities. At the completion of the Work, Contractor shall remove from the site all construction equipment, tools, surplus materials, waste materials, and debris.

4.19.1 If Contractor fails to commence compliance with cleanup duties within two (2) business days after written notification from Owner of non-compliance, Owner may implement appropriate cleanup measures without further notice and shall deduct the reasonable costs from any amounts due or to become due Contractor in the next payment period.

4.20 Contractor shall facilitate the access of Owner, Design Professional, and others to Work in progress.

4.21 Contractor shall comply with all applicable laws and regulations at its own costs. Contractor shall be liable to Owner for all loss, cost, or expense attributable to any acts or omissions by Contractor, its employees, subcontractors, and agents for failure to comply with applicable laws and regulations, including fines, penalties, or corrective measures.

4.22 Contractor warrants that all materials and equipment shall be new unless otherwise specified, of good quality, in conformance with the Contract Documents, and free from defective workmanship and materials. Contractor shall furnish satisfactory evidence of the quality and type of materials and equipment furnished. Contractor further warrants that the Work shall be free from material

defects not intrinsic in the design or materials required in the Contract Documents. Contractor's warranty shall commence on the Date of Substantial Completion of the Work.

4.22.1 Contractor shall obtain from its Subcontractors and Material Suppliers any special or extended warranties required by the Contract Documents. Contractor's liability for such warranties shall be limited to a one-year period. After that period, Contractor shall provide reasonable assistance to Owner in enforcing the obligations of Subcontractors or Material Suppliers for such extended warranties.

4.22.2 If, prior to Substantial Completion and within one year after the date of Substantial Completion of the Work, any Work not complying with the contract requirements ("Defective Work") is found, Owner shall promptly notify Contractor in writing. Unless Owner provides written acceptance of the condition, Contractor shall promptly correct the Defective Work at its own cost and time and bear the expense of additional Work required for correction of any Defective Work for which it is responsible.

4.22.3 With respect to any portion of Work first performed after Substantial Completion, the one-year period shall be extended by the period between Substantial Completion and the actual performance of the later Work. Correction periods shall not be extended by corrective work performed by Contractor.

4.22.4 If Contractor fails to correct Defective Work within a reasonable time after receipt of written notice from Owner prior to final payment, Owner may correct it in accordance with Owner's right to carry out the Work. In such case, an appropriate Change Order shall be issued deducting the cost of correcting the Defective Work from payments then or thereafter due Contractor. If payments then or thereafter due Contractor are not sufficient to cover such amounts, Contractor shall pay the difference to Owner.

4.22.5 If Contractor's correction or removal of Defective Work causes damage to or destroys other completed or partially completed Work or existing buildings, Contractor shall be responsible for the cost of correcting the destroyed or damaged property.

ARTICLE 5
SUBCONTRACTS

5.1 With the prior written approval of Owner, Contractor may subcontract such services as Contractor deems necessary to meet its obligations under this Agreement. Subcontractors shall be qualified and experienced in the type of work they will be performing. Owner shall have the right to reject any subcontractor but such right shall not relieve the responsibility of Contractor for his work and the work of the subcontractors. Contractor expressly assumes such responsibility and liability.

5.2 Contractor shall be responsible for the management of the Subcontractors in the performance of the Work.

5.3 If this Agreement is terminated, each subcontract agreement shall be assigned by Contractor to Owner, subject to the prior rights of any surety, provided that: (a) this Agreement is terminated by Owner pursuant to Section 11.1; and (b) Owner accepts such assignment, after termination by notifying the Subcontractor and Contractor in writing, and assumes all rights and obligations of Contractor pursuant to each subcontract agreement.

5.4 Contractor agrees to bind every Subcontractor and material supplier (and require every Subcontractor to so bind its sub-subcontractors and material suppliers) to all provisions of this Agreement as they apply to the Subcontractors' or material Suppliers' portions of the Work.

5.5 Contractor shall comply with the HUB Program as defined by Tex. Gov't Code, Chapter 2161. Failure to comply with the HUB Program may constitute a material breach of this Contract as determined by Owner's sole discretion.

5.6 Contractor agrees to comply with the established HUB Subcontracting Approach and shall make no changes to the HUB Subcontracting Approach without the prior written approval of Owner. Contractor will work with the Business Support Services HUB Coordinator to develop the HUB Subcontracting Plan (HSP). Further details concerning the HSP are located within the Uniform General Conditions.

ARTICLE 6
OWNER'S RESPONSIBILITIES

6.1 Owner shall provide Contractor with reasonable access to the site to assist Contractor in its performance of all tasks reasonably necessary for the completion of Work.

6.2 Owner hereby expressly reserves the right from time to time to designate by notice to Contractor one or more representatives to act partially or wholly for Owner in connection with the performance of Owner's obligations hereunder. Contractor shall act only upon instructions from such representatives unless otherwise specifically notified to the contrary.

6.3 Owner's Designated Representative shall: (a) be fully acquainted with the Project, Work, and site; (b) agree to furnish the information and Work required of Owner in a timely manner; and (c) have the authority to bind Owner (to the extent of their authority) in all matters requiring Owner's approval or authorization. If Owner changes its representative, Owner shall promptly notify Contractor in writing.

6.4 Owner will furnish the site plan to document existing conditions to the extent requested by Contractor and as reasonably necessary for the completion of Contractor's Work.

6.5 Owner shall examine, or cause its representative(s) to examine documents submitted by Contractor and render decisions pertaining thereto promptly or within a reasonable time to avoid unreasonable delay in the progress of Contractor's Work. Review and approval of a document by Owner shall not waive the contractual responsibility or liability of Contractor.

6.6 Owner shall furnish information required as expeditiously as necessary for the orderly progress of Contractor's Work.

6.7 Except for those permits and fees related to the Work which are the responsibility of Contractor, Owner shall secure and pay for all other permits, approvals, easements, assessments, and fees required for the development, construction, use or occupancy of permanent structures or for permanent changes in existing facilities, including the building permit.

6.8 Owner may perform work at the site directly or by others. Contractor and Owner shall coordinate the activities of all forces at the site and agree upon fair and reasonable schedules and operational procedures for site activities.

ARTICLE 7
SCHEDULE, COMMENCEMENT, AND COMPLETION

7.1 Owner shall provide a Notice to Proceed in which a date for commencement of the Work to be performed shall be stated. Contractor shall achieve Substantial Completion of the work no later than {Written Number} ({#}) calendar days from the date of the Notice to Proceed, subject to extension only by approved Change Orders. Final Completion, including correction of deficiencies, shall be achieved no later than thirty (30) calendar days from the date of the Substantial Completion. Contractor understands that the Substantial Completion and Final Completion dates shall not be extended regardless of weather, strikes, or for any other reason unless Change Orders so approve.

7.1.1 Time is of the essence for this Agreement and the Contract Documents.

7.1.2 Unless instructed by Owner in writing, Contractor shall not knowingly commence the Work before the effective date of insurance to be provided by Contractor.

7.2 Schedule.

7.2.1 Contractor shall submit for review and approval a Baseline Schedule to Owner and Design Professional when submitting the response to request for competitive sealed proposal. The Baseline Schedule shall indicate the dates for starting and completing the various aspects required to complete the work and shall utilize the Longest Path method with fully editable logic. The schedule shall include mobilization, procurement, installation, testing, inspection, delivery of Close-out Documents, and acceptance of all Work. This Baseline Schedule shall become the comparison to the actual conditions throughout the Contract duration and become a part of the Work Progress Schedule (WPS).

7.2.1.1 A Baseline Schedule that does not have at least the minimum amount of Total Float at submission will result in the Contractor forfeiting all claims to WPS extensions and/or delays as a result of contract changes and/or excusable delays as described in the UGCs.

7.2.1.2 In accordance with the UGCs, the WPS shall include at least ten percent (10%) Total Float and Weather Days from the effective date of Notice to Proceed for construction services to Substantial Completion Date.

7.2.1.3 Total Float shall not be shown as a single activity, but rather the results of the relationship between the early and late finish dates or early and late start dates of each activity. The allocation of project float shall be determined by the Project Team as conditions warrant.

7.2.2 As construction proceeds, Contractor shall update and submit the WPS with the Owner, Architect, and Contractor (OAC) meeting minutes. The WPS is to indicate detailed listing for all activity sequences, durations, or milestone dates for activities of the Project, including, without limitation:

7.2.2.1 commencement, milestones, and completion dates for bidding/proposals phase, construction phase, and project stages;

7.2.2.2 times of commencement and completion, duration, and allocation of labor and materials for each Subcontractor;

7.2.2.3 other detailed schedule activities as directed by Owner including, but not limited to, Owner-managed work under separate contracts such as equipment, furniture and furnishings, telephones, project security, property protection, life-safety systems, integration with central campus monitoring systems, information and instructional technology, data-transmission systems, and computer technology systems;

7.2.2.4 a recommended schedule for Owner's purchase of materials and equipment requiring long lead-time procurement, delivery dates of products requiring long lead time procurement, and methods to expedite and coordinate delivery of long lead-time procurements including coordination of the schedule;

7.2.2.5 Owner's occupancy requirements and estimated date of Substantial Completion of the Project;

7.2.2.6 potential and actual variances between scheduled and probable completion dates;

7.2.2.7 review of schedules for Work not started or incomplete and recommendation to Owner of adjustments in the schedules to conform to the probable completion dates;

7.2.2.8 summary reports to Owner of each schedule update and documentation of all changes in construction schedules; and

7.2.2.9 evaluation of Subcontractor's personnel, equipment, and availability of supplies and materials, with respect to each Subcontractor's ability to meet the schedule and recommendation to Owner when any subcontract requirements are not met, or appear unlikely to be met.

7.2.3 During OAC meeting, Contractor shall: review progress since last meeting with the Owner and Design Professional; determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's WPS; determine how construction behind schedule will be expedited; secure commitments from parties involved to do so; discuss whether schedule revisions are required to ensure the current and subsequent activities will be completed within the Contract Time; and review WPS for next period.

7.2.4 In addition to attending regularly scheduled OAC Project progress meetings, Contractor shall schedule, direct and attend interim progress meetings (i.e., commissioning meetings, coordination meetings, pre-installation meetings) with other members of the Project Team as required to maintain Project progress. Contractor shall record and distribute the minutes of each meeting to each Project Team member. The minutes shall identify critical activities that require action and the dates by which each activity must be completed.

7.2.5 If WPS updates indicate the Longest Path contained in prior WPS will not be met, Contractor shall notify the Owner in writing within forty-eight (48) hours and make recommendations to Owner. Should the item be critical in nature, Contractor shall have a follow-up discussion with Owner.

7.2.6 Contractor, concurrently with revising the schedule, shall prepare tabulated reports showing the following:

7.2.6.1 Identification of activities that have changed

7.2.6.2 Changes in early and late start dates

7.2.6.3 Changes in early and late finish dates

7.2.6.4 Changes in activity durations in workdays

7.2.6.5 Changes in the Longest Path

7.2.6.6 Changes in Contract Time

7.2.6.7 Show relationship between activities on initial and updated schedule.

7.2.7 Contractor shall provide the necessary Longest Path schedule control with a goal to attain the Substantial Completion Date of the Project, so that Owner can occupy and utilize the entire Project facilities on such date as well as a Punch List and Final Completion date;

7.2.7.1 Punch List and Final Completion: The Longest Path schedule control shall include not more than thirty (30) days or an agreed to timeframe approved by Owner for punch list and final completion.

7.2.8 Contractor shall coordinate preparation of the Schedule of Values with preparation of WPS.

7.2.9 Contractor shall create and maintain the WPS in a format acceptable to Owner (the license and training for which shall be at Contractor's sole expense).

7.2.10 Contractor shall notify Owner within forty-eight (48) hours should a periodic update to the WPS indicates the Work is fourteen (14) or more calendar days behind the current approved WPS. Contractor shall submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the WPS and indicate changes to working hours, working days, crew sizes, and equipment required for compliance, and date by which recovery will be accomplished.

7.2.10.1 Owner's Notice Not to Accelerate to Contractor shall not be considered acceleration by Owner and Owner shall not be responsible for any increased costs incurred by Contractor.

7.2.11 Contractor shall refer to the Uniform General Conditions for schedule extension and delay processes.

7.2.12 Owner may determine the sequence in which the Work shall be performed, provided it does not unreasonably interfere with the WPS. Owner may require Contractor to make reasonable changes in the sequence at any time during the performance of the Work in order to facilitate the performance of work by Owner or others. To the extent such changes increase Contractor's costs or time, the Contract Sum and Contract Time shall be equitably adjusted.

ARTICLE 8
COMPENSATION AND PAYMENT

8.1 In full consideration of Contractor's performance of the Work and services under this Agreement, Owner shall pay to Contractor, subject to additions and deductions provided herein, the sum of {Amount} and No/100 Dollars ({#.00), in periodic progress payments as hereinafter provided.

The Contract Sum is the total of the following:

Base Bid	${Amount}
Alternate 1 -	${Amount}
Alternate 2 -	${Amount}
Alternate 3 -	${Amount}
Payments and Performance Bonds	${Amount}
TOTAL	**${Amount}**

8.1 On a monthly basis and subject to procedures set forth in the Uniform General Conditions, Contractor shall submit an Application for Payment, in accordance with Division 01 Specifications. Supporting documentation should include, without limitation: a certified statement as to the Work completed and current schedule of values; a project-to-date job cost report and a current period job cost report; a breakdown of materials and labor; supporting subcontractor invoices and sworn statements and waivers of lien for all amounts paid to Contractor for materials, labor, equipment,

and other costs; and copies of third-party invoices, receipts, and other third-party supporting documentation.

8.2 Based on the Application for Payment, Owner shall make a periodic progress payment to Contractor for the cost of labor, materials, and equipment incurred by Contractor in relation to the Work during the previous month, except that the percentage of the total amount paid shall not exceed the percentage amount of the Work that has been completed as determined in the reasonable judgment of Owner. Upon verification of costs incurred and percentage of Work completed, Owner will make payment to Contractor within thirty (30) working days or will notify Contractor of any objection to the invoiced amount.

8.3 Owner shall have the right to withhold from payments due Contractor such sums as are necessary to protect Owner against any loss or damage which may result from negligence by Contractor or failure of Contractor to perform Contractor's obligations under this Agreement and as set forth in the Uniform General Conditions.

8.4 The final request for payment shall not be made until Contractor delivers to Owner a complete release of all liens arising out of this Agreement and an affidavit that so far as Contractor has knowledge or information, the release includes and covers all materials and Work over which Contractor has control for which a lien could be filed, but Contractor may, if any agent or consultant refuses to furnish a release in full, furnish a bond satisfactory to Owner to indemnify Owner against any lien. If any lien remains unsatisfied after all payments are made, Contractor shall refund to Owner all moneys Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees, and Owner shall have all remedies at law and in equity.

8.5 In addition to the procedures contained in the Uniform General Conditions, Owner shall have no obligation to make Final Payment until a final accounting of the Work has been submitted by Contractor and has been verified by Owner or Owner’s representatives. The aggregate total of payments to Contractor shall not exceed the total of the actual Work as verified by Owner or Owner’s representative from Contractor’s final accounting, as certified for payment in accordance with the Agreement. If payments made to Contractor exceed that which is due and owing pursuant to this Article, then Contractor shall promptly refund such excess to Owner.

8.6 Nothing contained herein shall require Owner to pay Contractor an aggregate amount exceeding the Contract Sum or to make payment if in Owner’s belief the cost to complete the Work would exceed the Contract Sum less previous payments to Contractor. Any provision to the contrary notwithstanding, Owner shall not be obligated to make any payment (whether a periodic progress payment or Final Payment) to Contractor hereunder if any one or more of the following conditions precedent exist:

8.6.1 Contractor is in breach or default under this Agreement;

8.6.2 Any part of such payment is attributable to services which are not performed in accordance with this Agreement; provided, however, such payment shall be made as to the part thereof attributable to services which were performed in accordance with this Agreement;

8.6.3 Contractor has failed to make payments promptly to consultants or other third parties used in connection with the services for which Owner has made payment to Contractor;

8.6.4 If Owner, in its good faith judgment, determines that the portion of the compensation then remaining unpaid will not be sufficient to complete the services in accordance with this Agreement, no additional payments will be due Contractor hereunder unless and until Contractor, at Contractor's sole cost, performs a sufficient portion of the remaining services so that such portion of the compensation then remaining unpaid is determined by Owner to be sufficient to so complete the then remaining services; or

8.6.5 To the extent Liquidated Damages or actual damages are imposed by Owner for failure of Contractor to complete the Work within the Contract Time.

8.7 No partial payment made hereunder shall be, or shall be construed to be, final acceptance or approval of that part of the services to which such partial payment relates, or a release of Contractor of any Contractor's obligations hereunder or liabilities with respect to such services.

8.8 Contractor shall promptly pay all bills validly due and owing for labor and material performed and furnished by others in connection with the performance of the construction of the Work.

8.9 The acceptance by Contractor or Contractor's successors of Final Payment under this Agreement, shall constitute a full and complete release of Owner from any and all claims, demands, and causes of action whatsoever which Contractor or Contractor's successors have or may have against Owner under the provisions of this Agreement except those previously made in writing and identified by Contractor as unsettled at the time of the final request for payment.

ARTICLE 9
BONDS

9.1 Prior to commencing work, Contractor shall provide performance and payment bonds in accordance with the requirements set forth in the Uniform General Conditions. The penal sum of the payment and performance bonds shall be for 100% of the Contract Sum. Any increase in the Contract Sum shall require a rider to the Bonds increasing penal sums accordingly. Contractor shall endeavor to keep its surety advised of changes potentially impacting the Contract Time and Contract Sum. Owner will pay Contractor the bonding costs as a pass through amount not to exceed {Amount} (${#}.00) with proper documentation provided along with an Application for Payment. No retainage is to be withheld with respect to the cost of the required bonds.

9.2 Contractor shall not cause or allow any of its bonds to be canceled nor permit any lapse during the term of this Agreement.

ARTICLE 10
INDEMNITY AND INSURANCE

10.1 **Contractor covenants and agrees to FULLY INDEMNIFY and HOLD HARMLESS Owner and its component institutions, the UNTS Board of Regents, elected and appointed officials, directors, officers, employees, agents, representatives, and volunteers, individually or collectively, from and against any and all costs, claims, liens, damages, losses, expenses, fees, fines, penalties, proceedings, actions, demands, causes of action, liability, and suits of any kind and nature, including but not limited to, personal or bodily injury, death, or property damage, made upon Owner directly or indirectly arising out of, resulting from, or related to Contractor's activities under the Contract, including any acts or omissions of Contractor, or any director, officer, employee, agent, representative, consultant, or Subcontractor of Contractor, and their respective directors, officers, employees, agents, and representatives while in the exercise of performance of the rights or duties under the Contract. The indemnity provided for in this paragraph does not apply to any liability resulting from the negligence of Owner or separate contractors in instances where such negligence causes personal injury, death, or property damage. IN THE EVENT CONTRACTOR AND OWNER ARE FOUND JOINTLY LIABLE BY A COURT OF COMPETENT JURISDICTION, LIABILITY WILL BE APPORTIONED COMPARATIVELY IN ACCORDANCE WITH THE LAWS OF THE STATE OF TEXAS, WITHOUT WAIVING ANY GOVERNMENTAL IMMUNITY AVAILABLE TO THE STATE UNDER TEXAS LAW AND WITHOUT WAIVING ANY DEFENSES OF THE PARTIES UNDER TEXAS LAW.**

10.1.1 The provisions of this indemnification are solely for the benefit of the parties hereto and not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

10.1.2 Contractor shall promptly advise Owner in writing of any claim or demand against Owner or against Contractor known to Contractor related to or arising out of Contractor's activities under this Contract.

10.2 Insurance.

10.2.1 Contractor shall not commence work under the Agreement until it has obtained all insurance required in accordance with this Agreement and the Uniform General Conditions and until such insurance has been reviewed and approved in writing by Owner. Approval of the insurance by Owner shall not relieve nor decrease the liability of Contractor hereunder. Prior to commencing of the Work Contractor shall provide evidence as required by this Article that demonstrates coverage for Employer's Liability, Workers' Compensation, Commercial General Liability, and Automobile Liability as set forth in the Uniform General Conditions are in full force and effect. Prior to commencing any construction work, Builder's Risk as set forth in the Uniform General Conditions shall be in full force and effect and shall be increased as necessary for each separate bid package, phase, or stage of construction prior to the commencement of construction for that package, phase, or stage. No retainage is to be withheld with respect to the cost of the required insurance.

Owner shall obtain builder's risk insurance coverage for the Project. In the event of an insured loss caused by the action or inaction of Contractor, or by any subcontractor or sub-subcontractor, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, Contractor shall be responsible for, and reimburse to Owner, any applicable deductible under the builder's risk insurance policy, which may be up to $25,000. Any costs associated with Contractor's responsibility for the applicable deductible shall not be considered cost of Work.

10.2.2 Contractor shall include Owner, {Campus if different from Owner} and the Board of Regents of the University of North Texas System as loss payees and Additional Insured's on General Liability and Business Automobile Liability. The Commercial General Liability, Business Automobile Liability, and Worker's Compensation policies shall include a waiver of subrogation in favor of Owner.

10.2.3 Insurance policies required under this Article shall contain a provision that the insurance company must give Owner written notice transmitted in writing: (a) thirty (30) calendar days before coverage is non-renewed by the insurance company and (b) within ten (10) business days after cancellation of coverage by the insurance company. Prior to start of Services and upon renewal or replacement of the insurance policies, Contractor shall furnish Owner with certificates of insurance until one year after acceptance of the Services. If any insurance policy required under this Article is not to be immediately replaced without lapse in coverage when it expires, exhausts it limits, or is to be cancelled, Contractor will give Owner written notice within forty-eight (48) hours upon actual or constructive knowledge of such condition.

10.2.4 Owner reserves the right to review the insurance requirements set forth in this Article during the effective period of the Agreement and to make reasonable adjustments to the insurance coverage and their limits when deemed necessary and prudent by Owner based upon changes in statutory law, court decisions, or the claims history of the industry as well as Contractor.

10.2.5 Owner shall be entitled, upon request, and without expense, to receive copies of the policies, all endorsements thereto and documentation to support costs and may make

any reasonable requests for deletion, or revision or modification of particular policy terms, conditions, limitations, exclusions and costs, except where policy provisions are established by law or regulation binding upon either of the Parties or the underwriter of any of such polices. Any price credits determined in the insurance review will be refundable to Owner. Actual losses not covered by insurance as required by this Article shall be paid by the Contractor.

10.2.6 Contractor shall not cause or allow any of its insurance to be canceled nor permit any lapse during the term of the Agreement or as required in the Agreement.

ARTICLE 11
TERMINATION AND SUSPENSION

11.1 With or without cause, Owner reserves and has the right to terminate this Agreement or to cancel, suspend or abandon execution of all or any Work in connection with this Agreement at any time upon written notice to Contractor. Contractor may terminate this Agreement upon seven (7) days written notice to Owner only if Owner substantially fails to perform its obligations under Article 6 of this Agreement or fails to timely pay Contractor as required under Article 8, and after adequate written notice is delivered to Owner and Owner has failed to take action within thirty (30) days in order to begin to correct the problem.

11.1.1 In the event of termination, cancellation, suspension, or abandonment that is not the fault of Contractor, Owner shall pay to Contractor as full payment for all services performed and all expenses incurred under this Agreement, the appropriate portion of Contract Sum due under Article 8 as shall have become payable for Work actually rendered hereunder by Contractor.

11.1.2 In ascertaining the services actually rendered hereunder up to the date of termination, cancellation, suspension, or abandonment of this Agreement, consideration shall be given to both completed work and work in progress, to complete and incomplete Drawings, and to other related documents, whether delivered to Owner or in possession of Contractor.

11.1.3 For any said sum paid under this Article, Contractor agrees to accept same in full settlement of all claims for services rendered under this Agreement.

11.2 If, upon payment of the amount required to be paid under this Article following the termination of this Agreement, Owner thereafter should determine to complete the original project or, substantially, the same project without major change in scope; Owner, for such purposes, shall have the right of utilization of any and all original tracings, Drawings, calculations, design analysis, Specifications, estimates, related data, and other documents including Construction Documents, prepared under this Agreement by Contractor who shall make them available to Owner upon request, with compensation to Contractor limited to actual reproduction costs. Owner agrees to credit Contractor with such authorship as may be due but is not required to renew this Agreement.

11.3 Upon request at the termination, cancellation, suspension, or abandonment of this Agreement, Contractor agrees to furnish to Owner copies of the latest documents prepared by Contractor for the Project.

11.4 A termination, cancellation, suspension, or abandonment under this Article shall not relieve Contractor or any of its employees of liability for violations of this Agreement, or any willful, negligent or accidental act or omission of Contractor. In the event of a termination under this Article, Contractor hereby consents to employment by Owner of a substitute contractor to complete the services under this Agreement, with the substitute contractor having all rights and privileges of the original contractor of the Project.

ARTICLE 12
MISCELLANEOUS

12.1 Assignment. The terms and conditions of this Agreement shall be binding upon the Parties, their partners, successors, permitted assigns, and legal representatives. This Agreement is a service contract for the services of Contractor, and Contractor's interest in this Agreement, duties hereunder and/or fees due hereunder may not be assigned or delegated to a third party. The benefits and burdens of this Agreement are, however, assignable by Owner to a component or affiliate of Owner or a branch or agency of the State of Texas.

12.2 Death or Incapacity. If Contractor transacts business as an individual, his death or incapacity shall automatically terminate this Agreement as of the date of such event, and neither he nor his estate shall have any further right to perform hereunder; and Owner shall pay him or his estate the compensation payable under the Agreement for any services rendered prior to such termination. If Contractor is a firm comprised of more than one principal and any one of the members thereof dies or becomes incapacitated and the other members continue to render the services covered herein, Owner will make payments to those continuing as though there had been no such death or incapacity, and Owner will not be obliged to take any account of the person who died or became incapacitated or to make any payment to such person or his estate. This provision shall apply in the event of progressive or simultaneous occasions of death or incapacity among any group of persons named as Contractor; and if death or incapacity befalls the last one of such group before this Agreement is fully performed, then the rights shall be as if there had been only one Contractor. In any event, notice of the death or incapacity of any principal shall be given to Owner by any surviving principal within a reasonable time.

12.3 Irreparable Injury. It is acknowledged and agreed that Contractor's services to Owner are unique, which gives a peculiar value to Owner and for the loss of which Owner cannot be reasonably or adequately compensated in damages; accordingly, Contractor acknowledges and agrees that a breach by Contractor of the provisions hereof will cause Owner irreparable injury and damage. Contractor, therefore, expressly agrees that Owner shall be entitled to injunctive and/or other equitable relief in any court of competent jurisdiction to prevent or otherwise restrain a breach of this Agreement, but only if Owner is not in breach of this Agreement.

12.4 Certifications.

12.4.1 Pursuant to Texas Family Code, Section 231.006, Contractor certifies that it is not ineligible to receive the award of or payments under this Agreement and acknowledges that this Agreement may be terminated and payment may be withheld if this certification is inaccurate.

12.4.2 Pursuant to Texas Government Code, Section 2155.004, Contractor certifies that the business entity named in this Agreement is not ineligible to receive the award of or payments under this Agreement and acknowledges that this Agreement may be terminated and payment withheld if this certification is inaccurate.

12.4.3 If a corporate or limited liability company, Contractor certifies that it is not currently delinquent in the payment of any Franchise Taxes due under Texas Tax Code, Chapter 171, or that the corporation or limited liability company is exempt from the payment of such taxes, or that the corporation or limited liability company is an out-of-state corporation or limited liability company that is not subject to the Texas Franchise Tax, whichever is applicable.

12.4.4 Pursuant to Texas Government Code Sections 2107.008 and 2252.903, Contractor agrees that any payments owing to Contractor under this Agreement may be applied directly toward any debt or delinquency that Contractor owes the State of Texas or any

agency of the State of Texas regardless of when it arises, until such debt or delinquency is paid in full.

12.4.5 Pursuant to Texas Government Code Chapter 2252, Subchapter F, Contractor certifies that it is not engaged in business with Iran, Sudan, or a foreign terrorist organization. Contractor acknowledges this Agreement may be terminated if this certification is inaccurate.

12.4.6 Pursuant to Texas Government Code Sections 2252.201-2252.205, Contractor certifies that it is in compliance with the requirement that any iron or steel product produced through a manufacturing process and used in the Project is produced in the United States.

12.4.7 If the Agreement is subject to Texas Gov't Code Section 2271.002, Contractor hereby represents, verifies, and warrants that it does not boycott Israel and will not boycott Israel during the term of the Agreement. If the Agreement is subject to Texas Gov't Code Section 2274.002, Contractor hereby represents, verifies, and warrants that it does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association and will not discriminate against a firearm entity or firearm trade association during the term of the Agreement. If the Agreement is subject to Texas Gov't Code Section 2274.002, Contractor hereby represents, verifies, and warrants that it does not boycott energy companies and will not boycott energy companies during the term of the Agreement.

12.4.8 Contractor certifies that no member of the Board of Regents of the University of North Texas System, or executive officers, including component institutions, has a financial interest, directly or indirectly, in the transaction that is the subject of this Agreement.

12.5 Illegal Dumping. Contractor shall ensure that it and all of its subcontractors and assigns prevent illegal dumping of litter in accordance with Title 5, Texas Health and Safety Code, Chapter 365.

12.6 Asbestos Containing Materials.

12.6.1 Contractor shall provide a notarized certification to Owner that all equipment and materials used in fulfillment of its Contract responsibilities are non-Asbestos Containing Building Materials (ACBM) no later than Contractor's application for Final Payment as required by the Uniform General Conditions.

12.6.2 All materials used in this Project shall be certified as non-ACBM. Contractor shall take whatever measures it deems necessary to insure that all employees, suppliers, fabricators, material men, subcontractors, or their assigns, comply with the following acts:

12.6.2.1 Asbestos Hazard Emergency Response Act (AHERA—40 CFR 763, Subpart E)

12.6.2.2 National Emission Standards for Hazardous Air Pollutants (NESHAP—EPA 40 CFR 61, Subpart M, National Emission Standard for Asbestos)

12.6.2.3 Texas Asbestos Health Protection Rules (TAHRP—Tex. Admin. Code Title 25, Part 1, Ch. 295, Subchapter C, Asbestos Health Protection)

12.7 State Auditor's Right to Audit. Pursuant to Section 2262.154 of the Texas Government Code, the state auditor may conduct an audit or investigation of any entity receiving funds from the state directly under any contract or indirectly through a subcontract under the contract. The acceptance of funds by Contractor or any other entity or person directly under the Agreement or indirectly through a subcontract under the Agreement acts as acceptance of the authority of the state auditor,

under the direction of the legislative audit committee, to conduct an audit or investigation in connection with those funds. Under the direction of the legislative audit committee, the Contractor or other entity that is the subject of an audit or investigation by the state auditor must provide the state auditor with access to any information the state auditor considers relevant to the investigation or audit. Contractor shall ensure that this paragraph concerning the authority to audit funds received indirectly by Subcontractors through the contract and the requirement to cooperate is included in any subcontract awards.

12.8 Records and Right to Audit. Owner shall have the right to verify and audit the details set forth in Contractor's billings, certificates, accountings, cost data, and statements, either before or after payment therefore, by: (a) inspecting the books and records of Contractor during normal business hours; (b) examining any reports with respect to this Project; (c) interviewing Contractor's business employees; (d) visiting the Project site; and (e) other reasonable action. Records of Contractor's costs, reimbursable expenses pertaining to the Project and payments shall be kept on a generally recognized accounting basis and shall be made available to Owner or its authorized representative during business hours for audit or other purposes as determined by Owner and in accordance with the requirements in the Uniform General Conditions.

12.9 Notices. All notices, consents, approvals, demands, requests or other communications provided for or permitted to be given under any of the provisions of this Agreement shall be in writing and shall be deemed to have been duly given or served when delivered by hand delivery or when deposited in the U.S. Mail by registered or certified mail, return receipt requested, postage prepaid, and addressed as follows:

If to Owner:
{Name}
{Title}
University of North Texas {System or Institution Name}
1155 Union Circle #311040
Denton, Texas 76203-5017

If to Contractor:
{Contact Name}
{Firm Name}
{Street Address}
{City, State Zip}

or to such other person or address as may be given in writing by either party to the other in accordance with the aforesaid.

12.10 Independent Contractor. Contractor recognizes that it is engaged as an independent contractor and acknowledges that Owner will have no responsibility to provide transportation, insurance or other fringe benefits normally associated with employee status. Contractor, in accordance with its status as an independent contractor, covenants and agrees that it shall conduct itself consistent with such status, that it will neither hold itself out as nor claim to be an officer, partner, employee or agent of Owner by reason hereof, and that it will not by reason hereof make any claim, demand or application to or for any right or privilege applicable to an officer, partner, employee or agent of Owner, including, but not limited to, unemployment insurance benefits, social security coverage or retirement benefits. Contractor hereby agrees to make its own arrangements for any of such benefits as it may desire and agrees that it is responsible for all income taxes required by applicable law.

12.11 Loss of Funding. Performance by Owner under the Agreement may be dependent upon the appropriation and allotment of funds by the Texas State Legislature (the "Legislature") and/or allocation of funds by the Board of Regents of The University of North Texas System (the "Board"). If the Legislature fails to appropriate or allot the necessary funds, or the Board fails to allocate the necessary funds, then Owner shall issue written notice to Contractor and Owner may terminate the Agreement. Contractor acknowledges that appropriation, allotment, and allocation of funds are beyond the control of Owner.

12.12 Confidentiality. All information owned, possessed or used by Owner which is communicated to, learned, developed or otherwise acquired by Contractor in the performance of services for Owner, which is not generally known to the public, shall be confidential and Contractor shall not, beginning on the date of first association or communication between Owner and Contractor and continuing through the term of this Agreement and any time thereafter, disclose, communicate or divulge, or permit disclosure, communication or divulgence, to another or use for Contractor's own benefit or the benefit of another, any such confidential information, unless required by law. Except when defined as part of the Work, Contractor shall not make any press releases, public statements, or advertisement referring to the Project or the engagement of Contractor as an independent contractor of Owner in connection with the Project, or release any information relative to the Project for publications, advertisement or any other purpose without the prior written approval of Owner. Contractor shall obtain assurances similar to those contained in this subparagraph from persons, and subcontractors retained by Contractor. Contractor acknowledges and agrees that a breach by Contractor of the provisions hereof will cause Owner irreparable injury and damage. Contractor, therefore, expressly agrees that Owner shall be entitled to injunctive and/or other equitable relief in any court of competent jurisdiction to prevent or otherwise restrain a breach of this Agreement.

12.13 Open Records. Owner shall release information to the extent required by the Texas Public Information Act and other applicable law. If required, Contractor shall make public information available to Owner in an electronic format. The requirements of Subchapter J, Chapter 552, Government Code, may apply to this Agreement and Contractor agrees that the Agreement can be terminated if Contractor knowingly or intentionally fails to comply with a requirement of that subchapter.

12.14 Governing Law and Venue. This Agreement and all of the rights and obligations of the parties hereto and all of the terms and conditions hereof shall be construed, interpreted and applied in accordance with and governed by and enforced under the laws of the State of Texas and venue shall be as provided in Texas Education Code Section 105.151 for any legal proceeding pertaining to this Agreement.

12.15 Waivers. No delay or omission by either of the parties hereto in exercising any right or power accruing upon the non-compliance or failure of performance by the other party hereto of any of the provisions of this Agreement shall impair any such right or power or be construed to be a waiver thereof. A waiver by either of the parties hereto of any of the covenants, conditions or agreements hereof to be performed by the other party hereto shall not be construed to be a waiver of any subsequent breach thereof or of any other covenant, condition or agreement herein contained.

12.16 Severability. Should any term or provision of this Agreement be held invalid or unenforceable in any respect, the remaining terms and provisions shall not be affected and this Agreement shall be construed as if the invalid or unenforceable term or provision had never been included.

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

OWNER:
UNIVERSITY OF NORTH TEXAS
{SYSTEM OR INSTITUTION NAME}

By: _____
(signature)

[Authorized Signatory Name]
[Authorized Signatory Title]

Date: _____

CONTRACTOR:

{FIRM NAME}

By: _____
(signature)

_____
(typed name and title)

Date: _____

_____
Street/PO Box

_____
City, State, ZIP

_____
Telephone

_____
State of TX Vendor ID Number

EXHIBIT A

SPECIFICATIONS, DRAWINGS, AND ADDENDA

SPECIFICATIONS

As listed in project manual titled [Title], prepared by [Professional], issued for construction on [Date].

.

DRAWINGS

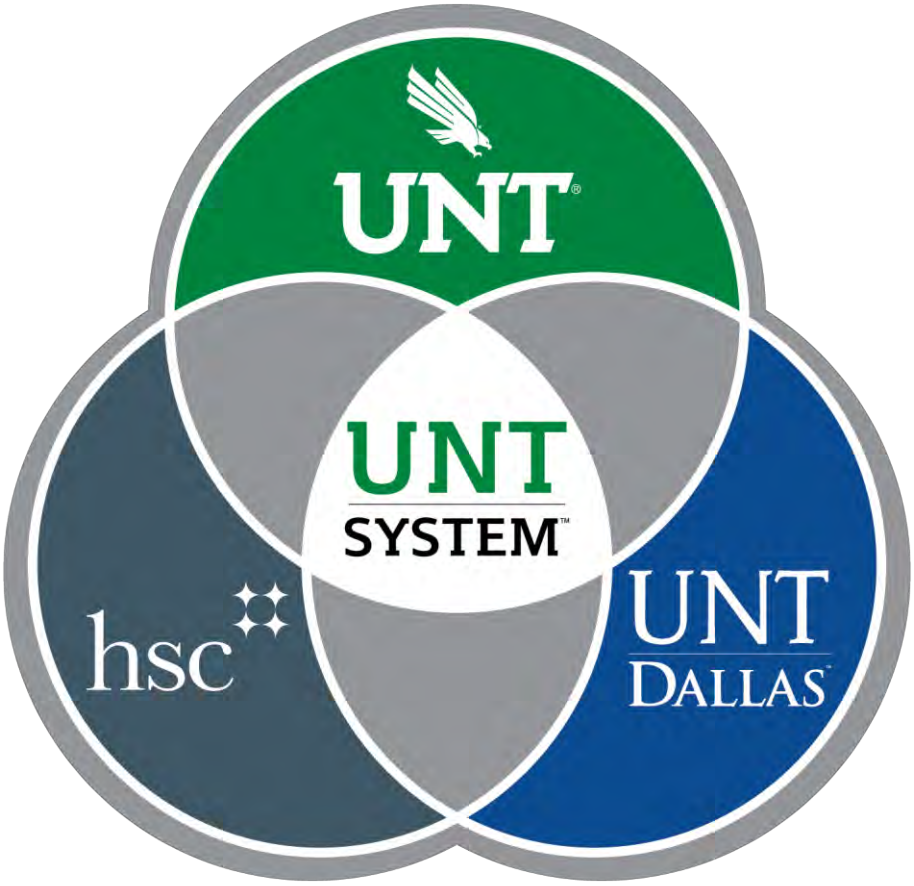
Entitled [Title], as prepared by [Professional], issued for construction on [Date], consisting of the following pages:

Sheet Number	Title

ADDENDA

Number	Title

UNIFORM GENERAL CONDITIONS
FOR CONSTRUCTION AND DESIGN CONTRACTS
2022



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UNIFORM GENERAL CONDITIONS FOR CONSTRUCTION AND DESIGN CONTRACTS 2022

ARTICLE 1. DEFINITIONS

Unless the context clearly requires another meaning, the following terms have the meaning assigned herein.

1.1 "Addendum/Addenda" means formally issued written or graphic modification and/or interpretations of the Construction Documents that may add to, delete from, clarify or correct the description and/or scope of the Work. Addenda are issued during the bidding phase of the project.

1.2 "Application for Final Payment" means Contractor's final invoice for payment that includes any portion of the Work that has been completed for which an invoice has not been submitted, amounts owing to adjustments to the final Contract Sum resulting from approved change orders, and release of remaining Contractor's retainage.

1.3 "Application for Payment" means Contractor's monthly partial invoice for payment that includes any portion of the Work that has been completed and performed in accordance with the requirements of the Contract Documents for which an invoice has not been submitted. The Application for Payment must accurately reflect the progress of the Work, be itemized based on the Schedule of Values, bear the notarized signature of Contractor, and not include subcontracted items for which Contractor does not intend to pay.

1.4 "Authority Having Jurisdiction" means a federal, state, local or other regional department, or an individual such as a fire marshal, building official, electrical inspector, utility provider or other individual having statutory authority.

1.5 "Baseline Schedule" means the initial time schedule prepared by Contractor for Owner's information and acceptance that conveys Contractor's and Subcontractors' activities (including coordination and review activities required in the Contract Documents to be performed by Design Professional and Owner), durations, and sequence of work related to the entire Project to the extent required by the Contract Documents. The schedule clearly demonstrates the Longest Path of activities, durations, and necessary predecessor conditions that drive the end date of the schedule. The Baseline Schedule shall not exceed the time limit current under the Contract Documents.

1.6 "Certificate of Final Completion" means the certificate issued by Design Professional that documents, to the best of Design Professional's knowledge and understanding, Contractor's completion of all Contractor's Punch list items and pre-final Punch list items, final cleanup, and Contractor's provision of Record Documents, operations and maintenance manuals, and all other closeout documents required by the Contract Documents.

1.7 "Certificate of Substantial Completion" means the certificate executed by the Design Professional, Owner, and Contractor that documents to the best of the Design Professional's and Owner's knowledge and understanding, Contractor's sufficient completion of the Work in accordance with the Contract, so as to be operational and fit for the use intended.

1.8 "Change Order" means a written modification of the Contract between Owner and Contractor, agreed to and signed by Owner, Contractor, and Design Professional.

1.9 "Change Order Request (COR)" means a Contractor generated document which describes a change in the scope of Work, including a detailed description, Drawings and Specifications, and a request for changes to costs or time, as necessary, to inform Owner of the nature of the requested change to the Contract.

1.10 "Close-Out Documents" mean the product brochures, submittals, product/equipment maintenance and operations instructions, manuals, and other documents/warranties, record documents, affidavits of payment, releases of liens and claims, and other documents as may be further defined, identified, and required by the Contract Documents.

1.11 "Construction Cost Limitation (CCL)" means the maximum funding authorized by and available to Owner to pay for the construction of the Project, exclusive of: (I) furniture, fixtures and other equipment (FFE) not in the Contract; (ii) Owner's Contingency; and (iii) any design and/or commissioning fees.

1.12 "Contract" means the agreement, including all attachments thereto, and all of the Contract Documents between Owner and Contractor.

1.13 "Contract Date" is the date when the agreement between Owner and Contractor becomes effective.

1.14 "Contract Documents" mean those documents identified as a component of the Contract between Owner and Contractor. These may include, but are not limited to: Drawings; Specifications; Uniform General Conditions; Owner's Special Conditions; Owner's Design Criteria Package for Design-Build Projects; Guaranteed Maximum Price Proposal executed by Owner and Contractor; all Change Orders; all pre-bid and/or pre-proposal addenda; Owner's Request for Proposal and/or Request for Qualifications; and Contractor's response to Owner's Request for Proposal and/or Request for Qualifications.

1.15 "Contract Duration" means the period between the Effective Date of the Contract and the end of the Warranty Period.

1.16 "Contract Sum" means the total compensation payable to Contractor for completion of the Work in accordance with the terms of the Contract.

1.17 "Contract Time" means the period between the start date identified in the Notice to Proceed with construction and the date to achieve Substantial Completion identified in the Notice to Proceed or as subsequently amended by a Change Order.

1.18 "Contractor" means the individual, corporation, limited liability company, partnership, joint venture, firm, or other entity contracted to perform the Work, regardless of the type of construction contract used, so that the term as used herein includes a Construction Manager-at-Risk or a Design-Build firm as well as a general or prime Contractor. The Contract Documents refer to Contractor as if singular in number but shall be interpreted to include the plural. The term "Contractor" shall also be inclusive of and apply to Design Professional in these Uniform General Conditions when the context does not indicate otherwise.

1.19 "Construction Change Directive" means an approved change in the Work issued by the Owner without the complete agreement of Contractor as to cost and/or time.

1.20 "Construction Documents" mean the Drawings, Specifications, and other documents issued to build the Project. Construction Documents become part of the Contract Documents when listed in the Contract or any Change Order.

1.21 "Construction Manager-at-Risk", in accordance with Tex. Education Code §51.782, means a sole proprietorship, partnership, corporation, or other legal entity that assumes the risk for construction, rehabilitation, alteration, or repair of a facility at the contracted price as a general contractor and provides consultation to Owner regarding construction during and after the design of the facility.

1.22 "Coordination Documents" means an ongoing process performed by the Contractor that documents, in a format approved by the Owner, the review of plans and specifications developed by the Design Professional demonstrating the Contractor understands the scope of the project and reviews complex interrelationships among project components.

1.23 "Date of Commencement" means the date designated in the Notice to Proceed for Contractor to commence the Work.

1.24 "Day" means a calendar day unless otherwise specifically stipulated.

1.25 "Design-Build" means a project delivery method in which the detailed design and subsequent construction is provided through a single contract with a Design-Build Firm. The Design-Build Project delivery shall be implemented in accordance with Tex. Education Code § 51.780.

1.26 "Design-Build Firm", in accordance with Texas Education Code § 51.780, means a partnership, corporation, or other legal entity or team that includes an engineer or architect and builder qualified to engage in building construction in Texas.

1.27 "Design Professional" means a person registered as an architect pursuant to Tex. Occ. Code Ann., Chapter 1051, as a landscape architect pursuant to Tex. Occ. Code Ann., Chapter 1052, a person licensed as a professional engineer pursuant Tex. Occ. Code Ann., Chapter 1001, and/or a firm employed by Owner or Design-Build Firm to provide professional architectural or engineering services and to exercise overall responsibility for the design of a Project or a significant portion thereof, and to perform the contract administration responsibilities set forth in the Contract.

1.28 "Drawings" mean that product and set of documents of Design Professional which graphically depicts the Work.

1.29 "Final Completion" means the date determined and certified by Design Professional and Owner on which the Work is fully and satisfactorily complete in accordance with the Contract.

1.30 "Final Payment" means the last and final monetary compensation made to Contractor for any portion of the Work that has been completed and accepted for which payment has not been made including adjustments to the final Contract Sum resulting from approved change orders and release of Contractor's retainage.

1.31 "Float" means the period of time a task can be delayed without delaying Substantial Completion Date.

1.32 "Historically Underutilized Business (HUB)" pursuant to Tex. Gov't Code, Chapter 2161, means a business that is at least 51% owned by an Asian Pacific American, a Black American, a Hispanic American, a Native American and/or an American Woman; is an entity with its principal place of business in Texas; and has an owner residing in Texas with proportionate interest that actively participates in the control, operations, and management of the entity's affairs.

1.33 "Longest Path" means the sequence of directly related activities that comprise the longest continuous chain of activities from the start of the first activity to the finish of the last activity. The activities represent critical path plus Float plus historical Weather Days. Each activity in the Longest Path is critical and directly related in that it prevents its successor from being scheduled earlier than it is.

1.34 "Notice to Proceed" means written document furnished by the Owner informing Contractor of the date to commence the Work and the date anticipated for Substantial Completion.

1.35 "Open Item List" means a list of work activities, Punch list items, changes, or other issues not expected by Owner, Design Professional, and Contractor to be complete prior to Substantial Completion.

1.36 "Owner" means the University of North Texas System and/or its component institutions, as a higher education university system and agency of the State of Texas.

1.37 "Owner's Construction Manager (OCM)" means the individual assigned by the Owner to act on its behalf and to undertake certain activities as specifically outlined in the Contract. The OCM does not have the authority to bind the Owner or direct changes to the scope, cost, or time of the Contract.

1.38 "Owner's Designated Representative (ODR)" means the individual assigned by Owner to act on its behalf and to undertake certain activities as specifically outlined in the Contract. The ODR is the only party authorized to direct changes to the scope, cost, or time of the Contract.

1.39 "Progress Assessment Report (PAR)" means the monthly compliance report to Owner verifying compliance with the HUB subcontracting plan (HSP).

1.40 "Project" means all activities necessary for realization and completion of Owner's desired building or other structure including all ancillary and related work. This includes design, contract award(s), execution of the Work itself, fulfillment of all Contract and warranty obligations, and work by Owner's forces or other contractors.

1.41 "Project Costs" means all costs necessary for the realization and completion of Owner's desired building or other structure including all ancillary and related work. This includes design, contract award(s), execution of the Work itself, fulfillment of all Contract and warranty obligations, and work by Owner's forces or other contractors.

1.42 "Proposal Request (PR)" means a document that informs Contractor, Owner, and Design Professional of a proposed change in the Work and appropriately describes or otherwise documents such change including Contractor's pricing for the proposed change.

1.43 "Punch List" means a list of items of Work to be completed or corrected by Contractor before Final Completion, and indicates items to be finished, remaining Work to be performed, or Work that does not meet quality or quantity requirements as required in the Contract Documents.

1.44 "Reasonably Inferable" means a fair, proper, and moderate conclusion reached by considering all of the facts and deducing a logical conclusion from them.

1.45 "Record Documents" mean the Drawings, Specifications, and other materials maintained by Contractor during construction and as corrected by Design Professional, that documents all addenda, Architect's Supplemental Instructions, Change Orders, and postings and markings that record the as-built conditions of the Work and all changes made during construction.

1.46 "Request for Information (RFI)" means a written request by Contractor directed to Design Professional and Owner for a clarification of the information provided in the Contract Documents or for direction concerning information necessary to perform the Work.

1.47 "Samples" mean representative physical examples of materials, equipment, or workmanship used to confirm compliance with requirements and/or to establish standards for use in execution of the Work.

1.48 "Schedule of Values" means the detailed breakdown of the cost of the materials, labor, and equipment necessary to accomplish the Work, submitted by Contractor for approval by Owner and Design Professional.

1.49 "Shop Drawings" mean the drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data prepared by Contractor or its agents which detail a portion of the Work.

1.50 "Site" means the geographical area of the location of the Work.

1.51 "Special Conditions" mean the documents containing terms and conditions which may be unique to the Work or Project.

1.52 "Specifications" mean the written product of Design Professional that establishes the quality and/or performance of products utilized in the Work and processes to be used, including testing and verification for producing the Work.

1.53 "Subcontractor" means an individual or entity that enters into an agreement with Contractor to perform part of the Work or to provide services, materials, or equipment for use in the Work.

1.54 "Submittal Register" means a list provided by Contractor of all items to be furnished for review and approval by Design Professional and Owner and as identified in the Contract Documents including anticipated sequence and submittal dates.

1.55 "Substantial Completion" means the date determined and certified by Contractor, Design Professional, and Owner when the Work, or a designated portion thereof, is sufficiently complete, in accordance with the Contract, so as to be operational and fit for the use intended.

1.56 "Substantial Completion Date" means the required date for substantial completion of the project. The Substantial Completion Date can only be changed by a written change order.

1.57 "Total Float" means the total number of days an activity on the longest path can be delayed without delaying the Substantial Completion Date.

1.58 "Unit Price Work" means the Work or a portion of the Work, paid for based on incremental units of measurement.

1.59 "Work" means the administration, procurement, materials, equipment, construction, and all services necessary for Contractor, and/or its agents, to fulfill Contractor's obligations under the Contract.

1.60 "Work Progress Schedule" means the continually updated time schedule prepared and monitored by Contractor that coordinates and integrates activities of the Project, including Contractor's services, Design Professional's services, the work of other consultants, suppliers, and Owner's activities with the anticipated construction schedules for other contractors. The Work Progress Schedule accurately indicates all necessary and appropriate revisions, including a Longest Path impact analysis, as required by the conditions of the Work and the Project while maintaining a concise comparison to the Baseline Schedule.

ARTICLE 2.
WAGE RATES AND OTHER LAWS GOVERNING CONSTRUCTION

2.1 Environmental Regulations. Contractor shall conduct activities in compliance with applicable laws and regulations and other requirements of the Contract relating to the environment and its protection at all times. Unless otherwise specifically determined, Contractor is responsible for obtaining and maintaining permits related to storm water run-off. Contractor shall conduct operations consistent with storm water run-off permit conditions. Contractor is responsible for all items it brings to the Site, including hazardous materials, and all such items brought to the Site by

its Subcontractors and suppliers, or by other entities subject to direction of Contractor. Contractor shall not incorporate hazardous materials into the Work without prior approval of Owner, and shall provide an affidavit attesting to such in association with request for Substantial Completion inspection.

2.2 Wage Rates. Contractor shall, and shall cause subcontractors to, comply with the Texas Prevailing Wage law. Contractor shall pay not less than the wage scale of the various classes of labor as shown on the prevailing wage schedule as established by the United States Department of Labor in accordance with the Davis-Bacon Act, as amended. The specified wage rates are minimum rates only. Owner is not bound to pay any claims for additional compensation made by Contractor because Contractor pays wages in excess of the applicable minimum rate contained in the Contract. The prevailing wage schedule is not a representation that qualified labor adequate to perform the Work is available locally at the prevailing wage rates. When requested, Contractor shall furnish competent evidence of compliance with the Texas Prevailing Wage Law and the addresses of all workers.

2.2.1 Notification to Workers. Contractor shall post the prevailing wage schedule in a place conspicuous to all workers on the Project Site and shall notify each worker, in writing, of the following as they commence Work on the Contract: the worker's job classification, the established minimum wage rate requirement for that classification, as well as the worker's actual wage. The notice must be delivered to and signed in acknowledgement of receipt by the worker and must list both the wages and fringe benefits to be paid or furnished for each classification in which the worker is assigned duties.

2.2.1.1 Contractor shall submit a copy of each worker's wage-rate notification to *Owner* with the application for progress payment for the period during which the worker was engaged in activities on behalf of the Project.

2.2.1.2 Pursuant to Tex. Gov't Code § 2258.024, Contractor shall keep, on site, true and accurate records showing the name and occupation of each worker employed by the Contractor or subcontractors and the actual per diem wages paid to each worker. The record shall be open to inspection by the ODR and their agents at all reasonable hours for the duration of the contract.

2.2.1.3 With each application for progress payment, Contractor shall make available upon request certified payroll records, including from subcontractors of any tier level, on Form WH-347 as promulgated by the U.S. Department of Labor, as may be revised from time to time and in unlocked and unprotected Excel format, along with copies of any and all Contract Documents between Contractor and any Subcontractor. Pursuant to Tex. Penal Code § 37.02 and 37.10, Employees of Contractor and subcontractors, including all tier levels, shall be subject to prosecution for submitting certified payroll records that contain materially false information.

2.2.1.4 The prevailing wage schedule is determined by Owner in compliance with Tex. Gov't Code, Chapter 2258. Should Contractor at any time become aware that a particular skill or trade not reflected on Owner's prevailing wage schedule will be or is being employed in the Work, whether by Contractor or by Subcontractor, Contractor shall promptly inform *Owner* of the proposed wage to be paid for the skill along with a justification for same and *Owner* shall promptly concur with or reject the proposed wage and classification.

2.2.1.5 Contractor is responsible for determining the most appropriate wage for a particular skill in relation to similar skills or trades identified on the prevailing wage schedule. In no case, shall any worker be paid less than the wage indicated for laborers.

2.2.1.6 Pursuant to Tex. Labor Code § 214.008, Misclassification of Workers; Penalty, Owner requires Contractor and all subcontractors properly classify individuals as employees or independent contractors.

2.2.2 Penalty for Violation. Contractor, and any Subcontractor, will pay to the State a penalty of sixty dollars ($60) for each worker employed for each day, or portion thereof, that the worker is paid less than the wage rates stipulated in the prevailing wage schedule.

2.2.3 Complaints of Violations.

2.2.3.1 Owner's Determination of Good Cause. Upon receipt of information concerning a violation, Owner will conduct an investigation in accordance with Tex. Gov't Code, Chapter 2258, and make an initial determination as to whether good cause exists that a violation occurred. Upon making a good cause finding, Owner will retain the full amounts claimed by the claimant or claimants as the difference between wages paid and wages due under the prevailing wage schedule and any supplements thereto, together with the applicable penalties, such amounts being subtracted from successive progress payments pending a final decision on the violation.

2.2.3.2 No Extension of Time. If Owner's determination proves valid that good cause existed to believe a violation had occurred, Contractor is not entitled to an extension of time for any delay arising directly or indirectly from the arbitration procedures.

2.2.3.3 Cooperation with Owner's Investigation. Contractor shall cooperate with Owner during any investigation hereunder. Such cooperation shall include, but not necessarily be limited to, timely providing the information and/or documentation requested by Owner, which may include certified payroll records on Form WH-347 as promulgated by the U.S Department of Labor, as may be revised from time to time and in unlocked and unprotected Excel

format; and copies of any and all Contract Documents between Contractor and any Subcontractors.

2.2.3.4 Notification to Owner. In the event Contractor or Subcontractor elect to appeal an initial determination made pursuant to Paragraph 2.2.3.1, the Contractor and/or Subcontractor, as applicable, shall deliver notice thereof to Owner.

2.3 Licensing of Trades. Contractor shall comply with all applicable provisions of State law related to license requirements for skilled tradesmen, contractors, suppliers, and laborers, as necessary to accomplish the Work. In the event Contractor, or one of its Subcontractors, loses its license during the term of performance of the Contract, Contractor shall promptly hire or contract with a licensed provider of the service at no additional cost to Owner.

2.4 Royalties, Patents, and Copyrights. Contractor shall pay all royalties and license fees, defend suits or claims for infringement of copyrights and patent rights, and shall hold Owner harmless from loss on account thereof. Provided, however, if Contractor is a Construction Manager-at-Risk, Contractor shall not be responsible for such defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by Owner or Design Professional; unless Contractor has reason to believe that the required design, process, or product is an infringement of a copyright or a patent then Contractor shall be responsible for such loss unless notice of such information is promptly furnished to Design Professional.

2.5 State Sales and Use Taxes. Owner qualifies for exemption from certain State and local sales and use taxes pursuant to the provisions of Tex. Tax Code, Chapter 151. Upon request from Contractor, Owner shall furnish evidence of tax-exempt status. Contractor may claim exemption from payment of certain applicable State taxes by complying with such procedures as prescribed by the State Comptroller of Public Accounts. Owner acknowledges not all items qualify for exemption. Owner is not obligated to reimburse Contractor for taxes paid on items that qualify for tax exemption.

2.6 Antiquities. Contractor shall take precaution to avoid disturbing primitive records and antiquities of archaeological, paleontological, or historical significance. No objects of this nature shall be disturbed without written permission of Owner and the Texas Historical Commission. When such objects are uncovered unexpectedly, the Contractor shall stop all Work in close proximity and notify the OCM and the Texas Historical Commission of their presence and shall not disturb them until written permission and permit to do so is granted. All primitive rights and antiquities, as defined in Chapter 191, Texas Natural Resource Code, discovered on the Owner's property shall remain property of State of Texas. If it is determined by Owner, in consultation with the Texas Historical Commission that exploration or excavation of primitive records or antiquities on the Project Site is necessary to avoid loss, Contractor shall cooperate in salvage work attendant to preservation. If the Work stoppage or salvage work causes an increase in the Contractor's cost of, or time required for, performance of the Work, Contractor may notify the Owner in accordance with Article 14.

2.7 Franchise Tax Status. Upon request, the Contractor agrees to execute and provide to the Owner a Certification of Franchise Tax Payment, on a form approved by the Owner.

ARTICLE 3.
GENERAL RESPONSIBILITIES OF OWNER

3.1 Preconstruction Conference. Prior to, or concurrent with, the issuance of Notice to Proceed, a conference will be convened for attendance by Owner, Contractor, Design Professional and appropriate Subcontractors. The purpose of the conference is to establish a working understanding among the parties as to the Work, the operational conditions at the Project Site, and general administration of the Project. Topics include communications, schedules, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, maintaining required records and all other matters of importance to the administration of the Project and effective communications between the Project team members.

3.2 Owner's Construction Manager (OCM). Prior to the start of construction, Owner will identify its OCM, who has the express authority to act on behalf of the Owner to the extent and for the purposes described in the Contract, including responsibilities for general administration of the Contract.

3.2.1 Point of Contact. Unless otherwise specifically defined elsewhere in the Contract Documents, OCM is the single point of contact between Owner and Contractor. Notice to OCM, unless otherwise noted, constitutes notice to Owner under the Contract.

3.2.2 Directives. All directives on behalf of Owner will be conveyed to Contractor and Design Professional by OCM in writing.

3.3 Owner Supplied Materials and Information.

3.3.1 Surveys. Owner will furnish to Contractor those surveys Owner possesses describing the physical characteristics, legal description, limitations of the Site, Site utility locations, and other information used in the preparation of the Contract Documents.

3.3.2 Drawings and Specifications. Owner will furnish or cause to be furnished, free of charge, the number of complete sets, paper or electronic, of the Drawings, Specifications, and addenda as provided in the Contract.

3.3.3 Other Information. Owner will provide information, equipment, or services under Owner's control to Contractor with reasonable promptness.

3.4 Availability of Lands. Owner will furnish, as indicated in the Contract, all required rights to use the lands upon which the Work occurs. This includes rights-of-way and easements for access and such other lands that are designated for use by Contractor. Contractor shall comply with all Owner identified encumbrances or restrictions specifically related to use of lands so furnished. Owner

will obtain and pay for easements for permanent structures or permanent changes in existing facilities, unless otherwise required in the Contract Documents.

3.5 Limitation on Owner's Duties.

3.5.1 No Control. Owner will not supervise, direct, control or have authority over, or be responsible for Contractor's means, methods, technologies, sequences, or procedures of construction or the safety precautions and programs incident thereto. Owner is not responsible for any failure of Contractor to comply with laws and regulations applicable to the Work. Owner is not responsible for the failure of Contractor to perform or furnish the Work in accordance with the Contract Documents. Except as provided herein, Owner is not responsible for the acts or omissions of Contractor, or any of its Subcontractors, suppliers, or of any other person or organization performing or furnishing any of the Work on behalf of Contractor.

3.5.2 No Contravention of Design Professional. Owner will not take any action in contravention of a design decision made by Design Professional in preparation of the Contract Documents, when such actions are in conflict with statutes under which Design Professional is licensed for the protection of the public health and safety.

ARTICLE 4.
GENERAL RESPONSIBILITIES OF DESIGN PROFESSIONAL

4.1 Role of Design Professional. Unless specified otherwise in the Contract between Owner and Contractor, in addition to design services Design Professional shall provide general administration services for Owner during the construction phase of the project. Written correspondence, RFIs, and Shop Drawings/submittals shall be directed to Design Professional for determination and action. Design Professional has the authority to act on behalf of Owner to the extent provided in the Contract Documents, unless otherwise modified by written instrument, which will be furnished to Contractor by OCM, upon request.

4.2 Site Visits. Design Professional will make visits to the Site at intervals as provided in the Design Professional's Contract with Owner, to observe the progress and the quality of the various aspects of Contractor's executed Work and report findings to OCM.

4.3 Inspections. Design Professional has the authority to interpret Contract Documents and inspect the Work for compliance and conformance with the Contract. Except as referenced in Paragraph 3.1.5.2, Owner retains the sole authority to accept or reject Work and issue direction for correction, removal, or replacement of Work.

4.4 Clarifications and Interpretations. It may be determined that clarifications or interpretations of the Contract Documents are necessary. Such clarifications or interpretations will be provided by Design Professional consistent with the intent of the Contract Documents. Design Professional will issue these clarifications with reasonable promptness to Contractor as Design Professional's supplemental instruction ("ASI") or similar instrument. If Contractor believes that such

clarification or interpretation justifies an adjustment in the Contract Sum or the Contract Time, Contractor shall so notify Owner in accordance with the provisions of Article 14.

4.5 Limitations on Design Professional Authority. Design Professional is not responsible for:

- Contractor's means, methods, techniques, sequences, procedures, safety, or programs incident to the Work, nor will Design Professional supervise, direct, control, or have authority over the same;
- The failure of Contractor to comply with laws and regulations applicable to the furnishing or performing the Work;
- Contractor's failure to perform or furnish the Work in accordance with the Contract Documents; or
- Acts or omissions of Contractor, or of any other person or organization performing or furnishing any of the Work.

ARTICLE 5.
GENERAL RESPONSIBILITIES OF CONTRACTOR

5.1 Contractor's General Responsibilities. Contractor is solely responsible for implementing the Work in full compliance with all applicable laws and the Contract Documents and shall supervise and direct the Work using the best skill and attention to assure that each element of the Work conforms to the Contract requirements. Contractor is solely responsible for all construction means, methods, techniques, safety, sequences, coordination, procedures and protection of the installed work as part of the contract until Substantial Completion of the project. Contractor remains responsible for the care and protection of materials and Work in the areas where Punch list items are completed until Final Completion.

5.1.1 Site Visit. Contractor shall visit the Site before commencing the Work and become familiar with local conditions such as the location, accessibility and general character of the Site and/or building. Contractor shall evaluate and plan for all construction related activities that will potentially impact the safety of students, staff, and visitors. A site-specific safety plan must be provided to the OCM prior to the commencement of any construction activities. The site-specific safety plan must include, at the minimum, project site controls and safety, building locations, delivery logistics, project offices, materials staging and parking.

5.2 Project Administration. Contractor shall provide Project administration for all Subcontractors, vendors, suppliers, and others involved in implementing the Work and shall coordinate administration efforts with those of Design Professional and OCM in accordance with these Uniform General Conditions and other provisions of the Contract, and as outlined in the pre-construction conference. Contractor's Project Administration includes periodic daily reporting on weather, work progress, labor, materials, equipment, obstruction to prosecution of the work, accidents and injuries in accordance with the Contract and transmitted no less frequently than on a weekly basis.

5.2.1 Contractor's Management Personnel. Contractor shall employ a competent person or persons who will be present at the Project Site during the progress of the Work to supervise or oversee the Work. Contractor's management personnel are subject to the approval of OCM, and shall be removed and replaced at the request of OCM. Contractor shall not change approved staff during the course of the Project without the written approval of OCM unless the staff member leaves the employment of Contractor in which case Contractor shall notify OCM and appoint an approved replacement as soon as reasonably possible. Contractor shall provide additional quality control, safety, and other staff as may be stated in the Contract Documents or as may be necessary or advisable for completion of the Work.

5.2.2 Labor. Contractor shall provide competent, suitably qualified personnel to survey, lay-out, and construct the Work as required by the Contract Documents and maintain good discipline and order at the Site at all times.

5.2.3 Services, Materials, and Equipment. Unless otherwise specified, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities, incidentals, and services necessary for the construction, performance, testing, start-up, inspection, and completion of the Work. The Contractor shall provide, without extra charge, all incidental items required as a part of the Work, even if not particularly specified or indicated in the Contract Documents.

5.2.4 No Substitutions without Approval. Contractor may make substitutions only with the consent of the Owner, after evaluation and recommendation by the Design Professional and in accordance with a Change Order.

5.3 Owner Equipment or Material. For Owner furnished equipment or material that will be in the care, custody, and control of Contractor, Contractor will be responsible for any damage or loss.

5.4 Non-Compliant Work. Should Design Professional and/or OCM identify Work as noncompliant with the Contract Documents, Design Professional and/or OCM shall communicate the finding to Contractor, and Contractor shall correct such Work at no additional cost to the Owner. The approval of Work by either Design Professional or OCM does not relieve Contractor from the obligation to comply with all requirements of the Contract Documents.

5.5 Subcontractors. Contractor shall not employ any Subcontractor, supplier, or other person or organization, whether initially or as a substitute, against whom Owner shall have reasonable objection. Owner will communicate such objections in writing within ten (10) days of receipt of Contractor's intent to use such Subcontractor, supplier, or other person or organization. Contractor is not required to employ any Subcontractor, supplier, or other person or organization to furnish any of the work to whom Contractor has reasonable objection. Contractor shall not substitute Subcontractors without the acceptance of Owner.

5.5.1 Contract Documents. All Subcontracts and supply contracts shall be consistent with and bind the Subcontractors and suppliers to the terms and conditions of the Contract Documents including provisions of the Contract between Contractor and Owner.

5.5.2 Scheduling. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, suppliers, and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract or subcontract with Contractor. Contractor shall require all Subcontractors, suppliers, and such other persons and organizations performing or furnishing any of the Work to communicate with Owner only through Contractor. Contractor shall furnish to Owner a copy, at Owner's request, of each first-tier subcontract promptly after its execution. Contractor agrees that Owner has no obligation to review or approve the content of such contracts and that providing Owner such copies in no way relieves Contractor of any of the terms and conditions of the Contract, including, without limitation, any provisions of the Contract which require the Subcontractor to be bound to Contractor in the same manner in which Contractor is bound to Owner.

5.6 Continuing the Work. Contractor shall carry on the Work and adhere to the progress schedule during all disputes, disagreements, or alternative resolution processes with Owner. Contractor shall not delay or postpone any Work because of pending unresolved disputes, disagreements, or alternative resolution processes, except as Owner and Contractor may agree in writing.

5.7 Cleaning. Contractor shall at all times, keep the Site and the Work clean and free from accumulation of waste materials or rubbish caused by the construction activities under the Contract. Contractor shall ensure that the entire Project is thoroughly cleaned prior to requesting Substantial Completion inspection and, again, upon completion of the Project prior to the final inspection.

5.8 Acts and Omissions of Contractor, its Subcontractors, and Employees. Contractor shall be responsible for acts and omissions of its employees and its Subcontractors and their agents and employees. Owner may, in writing, require Contractor to remove from the Project any of Contractor's or its Subcontractor's employees or agents whom OCM finds to be careless, incompetent, unsafe, uncooperative, disruptive, or otherwise objectionable.

5.9 Ancillary Areas. Contractor shall operate and maintain operations and associated storage areas at the site of the Work in accordance with the following:

- All Contractor operations, including storage of materials and employee parking upon the Site of Work, shall be confined to areas designated by OCM.
- Contractor may erect, at its own expense, temporary buildings that will remain its property. Contractor will remove such buildings and associated utility service lines upon completion of the Work, unless Contractor requests and Owner provides written consent that it may abandon such buildings and utilities in place.
- Contractor will use only established roadways or construct and use such temporary roadways as may be authorized by OCM. Contractor will not allow load limits of

vehicles to exceed the limits prescribed by appropriate regulations or law. Contractor will provide protection to road surfaces, curbs, sidewalks, trees, shrubbery, sprinkler systems, drainage structures, and other like existing improvements to prevent damage and will repair any damage thereto at the expense of Contractor.

- Owner may restrict Contractor's entry to the Site to specifically assigned entrances and routes.

5.10 Off-Site Storage. With prior approval by Owner and in the event, Contractor elects to store materials at an off-site location, Contractor must abide by the following conditions, unless otherwise agreed to in writing by Owner:

- Store materials in a commercial warehouse meeting the criteria stated below.
- Provide insurance coverage adequate not only to cover materials while in storage, but also in transit from the off-site storage areas to the Project Site. Copies of duly authenticated certificates of insurance must be filed with Owner's representative.
- Inspection by Owner's representative is allowed at any time. OCM must be satisfied with the security, control, maintenance, and preservation measures.
- Materials for this Project must be physically separated and marked for the Project in a sectioned-off area. Only materials which have been approved through the submittal process are to be considered for payment.
- Owner reserves the right to reject materials at any time prior to final acceptance of the complete Contract if they do not meet Contract requirements regardless of any previous progress payment made.
- With each monthly payment estimate, Contractor must submit a report to OCM and Design Professional listing the quantities of materials already paid for and still stored in the off-site location.
- Contractor must make warehouse records, receipts, and invoices available to Owner's representatives, upon request, to verify the quantities and their disposition.
- In the event of Contract termination or default by Contractor, the items in storage off-site, upon which payment has been made, will be promptly turned over to Owner or Owner's agents in place or at a location near the jobsite as directed by OCM. The full provisions of performance and payment bonds on this Project cover the materials off-site in every respect as though they were stored on the Project Site.

5.11 Separate Contracts. Owner reserves the right to award other contracts in connection with the Project or other portions of the Project under the same or substantially similar contract conditions, including those portions related to insurance and waiver of subrogation. Owner reserves the right to perform operations related to the Project with Owner's own forces.

5.11.1 Continuation of Contract. Under a system of separate contracts, the conditions described herein continue to apply except as may be amended by Amendment or Change Order.

5.11.2 Cooperation. Contractor shall cooperate with other contractors or forces employed on the Project by Owner, including providing access to Site, integration of activities within Contractor's Work Progress Schedule and Project information as requested.

5.11.3 Reimbursement. Owner shall be reimbursed by Contractor for costs incurred by Owner which are payable to a separate contractor because of delays, improperly timed activities, or defective construction by Contractor. Owner will equitably adjust the Contract by Change Order for costs incurred by Contractor because of delays, improperly timed activities, damage to the Work, or defective construction by a separate contractor.

ARTICLE 6.
HISTORICALLY UNDERUTILIZED BUSINESS (HUB) SUBCONTRACTING PLAN

6.1 General Description. The purpose of the Historically Underutilized Business (HUB) program is to promote equal business opportunities for economically disadvantaged persons (as defined by Tex. Gov't Code, Chapter 2161) to contract with the State of Texas in accordance with the goals specified in the State of Texas Disparity Study. The HUB program annual procurement utilization goals are defined in 34 T.A.C. § 20.284.

6.1.1 Good Faith Effort.

6.1.1.1 State agencies are required by statute to make a good faith effort to assist HUBs in participating in contract awards issued by the State. 34 T.A.C., Chapter 20, Subchapter D, Division 1 outlines the State's policy to encourage the utilization of HUBs in State contracting opportunities through race, ethnic, and gender-neutral means.

6.1.1.2 A Contractor who contracts with the State in an amount of $100,000 or greater is required to make a good faith effort to award subcontracts to HUBs in accordance with 34 T.A.C. § 20.285 by submitting a HUB subcontracting plan within twenty-four (24) hours after the bid or response is due and complying with the HUB subcontracting plan after it is accepted by Owner and during the term of the Contract.

6.2 Compliance with Approved HUB Subcontracting Plan. Contractor, having been awarded this Contract in part by complying with the HUB program statute and rules, hereby covenants to continue to comply with the HUB program as follows:

- Prior to adding or substituting a Subcontractor, promptly notify Owner in the event a change is required for any reason to the accepted HUB subcontracting plan.
- Conduct the good-faith effort activities required, and provide Owner with necessary documentation to justify approval of a change to the approved HUB subcontracting plan.
- Cooperate in the execution of a Change Order or such other approval of the change in the HUB subcontracting plans as Contractor and Owner may agree to.

- Maintain and make available to Owner upon request business records documenting compliance with the accepted HUB subcontracting plan.
- Upon receipt of payment for performance of Work, submit to Owner a compliance report, in the format required by Owner that demonstrates Contractor's performance of the HUB subcontracting plan.
- Submit monthly Progress Assessment Reports (PAR) to Owner, verifying compliance with the HUB subcontracting plan, including the use/expenditures made made/to Subcontractors. (The PAR is available at the following link: http://www.window.state.tx.us/procurement/prog/hub/hub-forms/.)
- Promptly and accurately explain and provide supplemental information to Owner to assist in Owner's investigation of Contractor's good-faith effort to fulfill the HUB subcontracting plan and the requirements under 34 T.A.C. § 20.285.

6.3 Failure to Demonstrate Good-Faith Effort. Upon a determination by Owner that Contractor has failed to demonstrate a good-faith effort to fulfill the HUB subcontracting plan or any Contract covenant detailed above, Owner may, in addition to all other remedies available to it, report the failure to perform to the Comptroller of Public Accounts, Texas Procurement and Support Services Division, Historically Underutilized Business Program and may bar Contractor from future contracting opportunities with Owner.

ARTICLE 7.
BONDS

7.1 Construction Bonds. Contractor is required to tender to Owner, prior to commencing the Work, performance and payment bonds, as required by Tex. Gov't Code, Chapter 2253.

7.2 Bond Requirements. Each bond shall be executed by a corporate surety or sureties authorized to do business in the State of Texas, acceptable to Owner, and in compliance with the relevant provisions of the Texas Insurance Code. If any bond is for more than ten percent (10%) of the surety's capital and surplus, Owner may require certification that the company has reinsured the excess portion with one or more reinsurers authorized to do business in the State. A reinsurer may not reinsure for more than ten percent (10%) of its capital and surplus. If a surety upon a bond loses its authority to do business in the State, Contractor shall, within thirty (30) days after such loss, furnish a replacement bond at no added cost to Owner.

7.2.1 Performance Bonds. A Performance bond is required if the Contract Sum is in excess of $100,000. The performance bond is solely for the protection of Owner. The performance bond is to be for the Contract Sum to guarantee the faithful performance of the Work in accordance with the Contract Documents. For Design-Build Projects the performance bond is to be for the full amount of both the construction and design services in accordance with the Contract Documents. The form of the bond shall be approved by Owner. The performance bond shall be effective through Contractor's warranty period.

7.2.2 Payment Bonds. A Payment bond is required if the Contract Sum is in excess of $25,000. The payment bond is to be for the Contract Sum and is payable to Owner solely for the protection and use of payment bond beneficiaries. For Design-Build Projects the payment bond is to be for the full amount of both the construction and design services in accordance with the Contract Documents. The form of the bond shall be approved by Owner.

7.2.3 When Bonds Are Due. Payment and performance bonds are due before Contractor commences any Work.

7.2.4 Power of Attorney. Each bond shall be accompanied by a valid power of attorney (issued by the surety company and attached, signed and sealed with the corporate embossed seal, to the bond) authorizing the attorney-in-fact who signs the bond to commit the company to the terms of the bond, and stating any limit in the amount for which the attorney can issue a single bond.

7.3 Bond Indemnification. The process of requiring and accepting bonds and making claims thereunder shall be conducted in compliance with Tex. Gov't Code, Chapter 2253. IF FOR ANY REASON A STATUTORY PAYMENT OR PERFORMANCE BOND IS NOT HONORED BY THE SURETY, CONTRACTOR SHALL FULLY INDEMNIFY AND HOLD HARMLESS OWNER, AND ITS COMPONENT INSTITUTIONS, REGENTS, ELECTED AND APPOINTED OFFICIALS, DIRECTORS, OFFICERS, EMPLOYEES, AGENTS, REPRESENTATIVES, AND VOLUNTEERS, FROM AND AGAINST ANY COSTS, LOSSES, OBLIGATIONS, OR LIABILITIES IT INCURS AS A RESULT.

7.3.1 Furnishing Bond Information. Owner shall furnish certified copies of the payment bond and the related Contract to any qualified person seeking copies who complies with Tex. Gov't Code § 2253.026.

7.3.2 Claims on Payment Bonds. Claims on payment bonds must be sent directly to Contractor and his surety in accordance with Tex. Gov't Code § 2253.041. All payment bond claimants are cautioned that no lien exists on the funds unpaid to Contractor on such Contract, and that reliance on notices sent to Owner may result in loss of their rights against Contractor and/or his surety. Owner is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no such responsibility because of any representation by any agent or employee.

7.4 Payment of Claims when Payment Bond is Not Required. The rights of Subcontractors regarding payment are governed by Tex. Prop. Code § 53.231 – 53.239 when the value of the Contract between Owner and Contractor is less than $25,000.00. These provisions set out the requirements for filing a valid lien on funds unpaid to Contractor as of the time of filing the claim, and actions necessary to release the lien and satisfaction of such claim.

7.5 Sureties. A surety shall be listed on the US Department of the Treasury's Listing of Approved Sureties maintained by the Bureau of Financial Management Service (FMS), https://fiscal.treasury.gov/surety-bonds/list-certified-companies.html, stating companies holding

Certificates of Authority as acceptable sureties on federal bonds and acceptable reinsuring companies (FMS Circular 570). The Owner will consider acceptable any corporate surety which is qualified under this paragraph and which has a rating of at least B in Best's Insurance Reports – Property – Casualty.

7.6 Bond Costs. The costs of bonds are a pass-through amount to the Owner. No markup amounts are to be included and documentation of bond costs are required in requests for payment. Any costs associated with subcontractor bonds or SubGuard-related items are not paid by the Owner in General Conditions or Cost of Work.

ARTICLE 8.
INDEMNITY AND INSURANCE

8.1 Indemnification of Owner. Contractor covenants and agrees to FULLY INDEMNIFY and HOLD HARMLESS Owner, and its component institutions, Regents, elected and appointed officials, directors, officers, employees, agents, representatives, and volunteers, individually or collectively, from and against any and all costs, claims, liens, damages, losses, expenses, fees, fines, penalties, proceedings, actions, demands, causes of action, liability, and suits of any kind and nature, including but not limited to, personal or bodily injury, death, or property damage, made upon Owner directly or indirectly arising out of, resulting from, or related to Contractor's activities under the Contract, including any acts or omissions of Contractor, or any director, officer, employee, agent, representative, consultant, or Subcontractor of Contractor, and their respective directors, officers, employees, agents, and representatives while in the exercise of performance of the rights or duties under the Contract. The indemnity provided for in this paragraph does not apply to any liability resulting from the negligence of Owner or separate contractors in instances where such negligence causes personal injury, death, or property damage. IN THE EVENT CONTRACTOR AND OWNER ARE FOUND JOINTLY LIABLE BY A COURT OF COMPETENT JURISDICTION, LIABILITY WILL BE APPORTIONED COMPARATIVELY IN ACCORDANCE WITH THE LAWS OF THE STATE OF TEXAS, WITHOUT WAIVING ANY GOVERNMENTAL IMMUNITY AVAILABLE TO THE STATE UNDER TEXAS LAW AND WITHOUT WAIVING ANY DEFENSES OF THE PARTIES UNDER TEXAS LAW.

8.1.1 **No Third-Party Beneficiaries. The provisions of this indemnification are solely for the benefit of the parties hereto and not intended to create or grant any rights, contractual or otherwise, to any other person or entity.**

8.1.2 **Notice. Contractor shall promptly advise Owner in writing of any claim or demand against Owner or against Contractor known to Contractor related to or arising out of Contractor's activities under this Contract.**

8.1.3 The indemnity provisions shall survive the termination of the Contract regardless of the reason for termination.

8.2 Insurance Requirements. Design Professional shall carry insurance in the types and amounts indicated in the Contract for the duration of the Contract. Unless otherwise provide for in the Contract, Contractor shall carry insurance in the types and amounts indicated in these Uniform General Conditions for the duration of the Contract. The insurance shall be evidenced by delivery to Owner of certificates of insurance executed by the insurer or its authorized agent stating coverage, limits, expiration dates, and compliance with all applicable required provisions. Upon request, Owner and its agents shall be entitled to receive, without expense, copies of the policies and all endorsements. Contractor shall update all expired policies prior to submission for monthly payment. Failure to update policies shall be reason for withholding of payment until renewal is provided to Owner.

8.2.1 Period of Coverage. Contractor, consistent with its status as an independent contractor, shall provide and maintain all insurance coverages with the minimum amounts described below until the end of the warranty period unless expressly agreed otherwise. Failure to maintain insurance coverage, as required, is grounds for suspension of Work for cause pursuant to Article 17.

8.2.2 Certificates. Contractor shall deliver to Owner true and complete copies of certificates and corresponding policy endorsements prior to the issuance of any Notice to Proceed.

8.2.3 Failure to Provide Certificates. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

8.2.4 Contractor's Liability. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

8.2.5 Insurance Limits. The insurance coverage and limits established herein shall not be interpreted as any representation or warranty that the insurance coverage and limits necessarily will be adequate to protect Contractor.

8.2.6 Insurers. Coverage shall be written on an occurrence basis by companies authorized and admitted to do business in the State of Texas and rated A-, VII or better by A.M. Best Company or similar rating company or otherwise acceptable to Owner.

8.3 Insurance Coverage Required.

8.3.1 Workers' Compensation Insurance. Coverage with limits as required by the Texas Workers' Compensation Act, with the policy endorsed to provide a waiver of subrogation as to Owner, and Employer's Liability Insurance with limits of not less than:

- $1,000,000 each accident;
- $1,000,000 disease each employee; and
- $1,000,000 disease policy limit.

- Workers' compensation insurance coverage must meet the statutory requirements of Tex. Lab. Code § 401.011(44), and requirements specific to construction projects for public entities as required by Tex. Lab. Code § 406.096.
- Policies must include (a) Other States Endorsement to include TEXAS if business is domiciled outside the State of Texas, and (b) a waiver of all rights of subrogation in favor of Owner.

8.3.2 Commercial General Liability Insurance. Coverage including premises, operations, independent contractor's liability, products, and completed operations and contractual liability, covering, but not limited to, the liability assumed under the indemnification provisions of this Contract, fully insuring Contractor's (or Subcontractor's) liability for bodily injury (including death) and property damage with a minimum limit of:

- $1,000,000 per occurrence;
- $2,000,000 general aggregate;
- $5,000 Medical Expense each person;
- $1,000,000 Personal Injury and Advertising Liability;
- $2,000,000 products and completed operations aggregate;
- $50,000 Damage to Premises Rented by You; and
- Coverage shall be on an "occurrence" basis.
- The policy shall include coverage extended to apply to completed operations and explosion, collapse, and underground hazards. The policy shall include endorsement CG2503 Amendment of Aggregate Limits of Insurance (per Project) or its equivalent.
- If the Work involves any activities within fifty (50) feet of any railroad, railroad protective insurance as may be required by the affected railroad, written for not less than the limits required by such railroad.

8.3.3 Asbestos Abatement Liability Insurance. Coverage including coverage for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos containing materials. This requirement applies if the Work or the Project includes asbestos containing materials.

- The combined single limit for bodily injury and property damage will be a minimum of $1,000,000 per occurrence.
- Specific requirement for claims-made form: Required period of coverage will be determined by the following formula: continuous coverage for life of the Contract, plus one (1) year (to provide coverage for the warranty period), and an extended discovery period for a minimum of five (5) years which shall begin at the end of the warranty period.
- Employer's liability limits for asbestos abatement will be:
- $1,000,000 each accident;
- $1,000,000 disease each employee; and
- $1,000,000 disease policy limit.

8.3.4 Comprehensive Automobile Liability Insurance. Coverage covering owned, hired, and non-owned vehicles, with a minimum combined single limit for bodily injury (including death) and property damage of $1,000,000 per occurrence. No aggregate shall be permitted for this type of coverage.

- Such insurance is to include coverage for loading and unloading hazards.
- Contractor, or any subcontractor of Contractor, responsible for transporting asbestos or other hazardous materials defined as asbestos shall provide pollution coverage for any vehicle hauling asbestos containing cargo. The policy must include an MCS 90 endorsement with a $5,000,000 limit and the CA 9948 Pollution Endorsement, or its equivalent.

8.3.5 All-Risk Builder's Risk Insurance. Coverage shall be all-risk (or all-risk installation floater for instances in which the project involves solely the installation of material and/or equipment), including, but not limited to, fire, extended coverage, vandalism and malicious mischief, theft and, if applicable, flood, earth movement and named storm. Builder's risk and installation floater limits shall be equal to 100 percent of the Contract Sum plus, if any, existing property and Owner-furnished equipment specified by Owner. The policy shall be written jointly in the names of Owner and Contractor. Subcontractors shall be named as additional insureds. The policy shall have endorsements as follows:

- This insurance shall be specific as to coverage and not contributing insurance with any permanent insurance maintained on the property.
- This insurance shall not contain an occupancy clause suspending or reducing coverage should Owner partially occupy the Site and before the parties have determined Substantial Completion.
- Loss, if any, shall be adjusted with and made payable to Owner as trustee for the insureds as their interests may appear. Owner shall be named as loss payee.
- For renovation projects or projects that involve portions of Work contained within an existing structure, refer to Supplementary or Special Conditions for possible additional builder's risk insurance requirements.
- For Owner furnished equipment or materials that will be in care, custody or control of Contractor, Contractor will be responsible for damage and loss.
- For those properties located within a Tier 1 or 2 windstorm area, named storm coverage must be provided with limits specified by Owner.
- For those properties located in flood prone areas, flood insurance coverage must be provided with limits specified by Owner.
- Builder's risk insurance policy shall remain in effect until Substantial Completion.
- If this Contract is for asbestos abatement only, the foregoing All-Risk Builder's Risk or All-Risk Installation Floater is not required.

8.3.6 "Umbrella" Liability Insurance. Coverage during the Contract term, insuring Contractor (or Subcontractor) that provides coverage at least as broad as and applies in excess and follows form of the primary liability coverage required above. The policy shall provide

"drop down" coverage where underlying primary insurance coverage limits are insufficient or exhausted.

- "Umbrella" Liability Insurance coverage shall be for the following Contract amounts in the corresponding coverage amounts:

Contract Amount	Occurrence	Annual Aggregate
< $1,000,000	No Umbrella	
$1,000,000 up to < $3,000,000	$1,000,000	$2,000,000
$3,000,000 up to < $5,000,000	$5,000,000	$5,000,000
$5,000,000 or greater	$10,000,000	$10,000,000

8.4 Policy Requirements. Policies must include the following clauses, as applicable:

- This insurance shall not be suspended, voided, canceled, materially changed, or non-renewed except after thirty (30) days, or ten (10) days for non-payment of premium, written notice has been given to Owner.
- It is agreed that Contractor's insurance shall be deemed primary with respect to any insurance or self-insurance carried by Owner for liability arising out of operations under the Contract with Owner.
- Owner, its officials, directors, employees, representatives, and volunteers are added as additional insureds with respect to operations and activities of, or on behalf of the named insured performed under the Contract with Owner. The additional insured status must cover completed operations as well. This is not applicable to workers' compensation policies.
- A waiver of subrogation in favor of Owner shall be provided in all policies.
- If Owner is damaged by the failure of Contractor (or Subcontractor) to maintain insurance as required herein and/or as further described in Owner's Special Conditions, then Contractor shall bear all reasonable costs properly attributable to that failure.

8.5 Subcontractor Insurance Coverage**. WITHOUT LIMITING ANY OF THE OTHER OBLIGATIONS OR LIABILITIES OF CONTRACTOR, CONTRACTOR SHALL REQUIRE EACH SUBCONTRACTOR PERFORMING WORK UNDER THE CONTRACT TO MAINTAIN DURING THE TERM OF THE CONTRACT, THE SAME STIPULATED MINIMUM INSURANCE INCLUDING THE REQUIRED PROVISIONS AND ADDITIONAL POLICY CONDITIONS AS SHOWN ABOVE, AS AN ALTERNATIVE, CONTRACTOR MAY INCLUDE ITS SUBCONTRACTORS AS ADDITIONAL INSUREDS ON ITS OWN COVERAGE AS PRESCRIBED UNDER THESE REQUIREMENTS. CONTRACTOR'S CERTIFICATE OF INSURANCE SHALL NOTE IN SUCH EVENT THAT SUBCONTRACTORS ARE INCLUDED AS ADDITIONAL INSUREDS AND THAT CONTRACTOR AGREES TO PROVIDE WORKERS' COMPENSATION FOR SUBCONTRACTORS AND THEIR EMPLOYEES. CONTRACTOR SHALL OBTAIN AND MONITOR THE CERTIFICATES OF**

INSURANNCE FROM EACH SUBCONTRACTOR IN ORDER TO ASSURE COMPLIANCE WITH THE INSURANCE REQUIREMENTS. CONTRACTOR MUST RETAIN THE CERTIFICATES OF INSURANCE FOR THE DURATION OF THE CONTRACT PLUS SEVEN (7) YEARS AND SHALL HAVE THE RESPONSIBILITY OF ENFORCING THESE INSURANCE REQUIREMENTS ITS SUBCONTRACTORS. OWNER SHALL BE ENTITLED, UPON REQUEST AND WITHOUT EXPENSE, TO RECEIVE COPIES OF THESE CERTIFICATES. CONTRUCTION DOCUMENTS, COORDINATION DOCUMENTS, AND RECORD DOCUMENTS.

ARTICLE 9.

CONSTRUCTION DOCUMENTS, COORDINATION DOCUMENTS, AND RECORD DOCUMENTS

9.1 Drawings and Specifications.

9.1.1 Copies Furnished. Design Professional will furnish, free of charge, the number of complete sets of Drawings, Specifications, and addenda as provided in the Contract. Contractor will be furnished, free of charge, the number of complete sets of Drawings, Specifications, and addenda as provided in the Contract. Additional complete sets of Drawings and Specifications, if requested, will be furnished at reproduction cost to the one requesting such additional sets. Electronic copies of such documents will be provided to Contractor without charge.

9.1.2 Ownership of Drawings and Specifications. All Drawings, Specifications and copies thereof furnished by Design Professional shall be property of the Owner. These documents are not to be used by the Design Professional on any other project. Owner may use the Contract record set and electronic versions as needed for warranty operations or future renovations or additions without written approval of the Design Professional. All additional or confirmatory land survey field notes, sketches and related data, and additional or confirmatory soils engineering or investigations, samples, calculations, test results, and reports, for which Owner has paid for such direct services, shall be the sole property of Owner.

9.2 Interrelation of Documents. The Contract Documents as referenced in the Contract between Owner and Contractor are complimentary, and what is required by one shall be as binding as if required by all.

9.3 Resolution of Conflicts in Documents. Where conflicts may exist within the Contract Documents, the documents shall govern in the following order: (a) Change Orders or other written, signed amendments or addenda; (b) the Contract; (c) Uniform General Conditions; (d) Drawings; (e) Specifications (but Specifications shall control over Drawings as to quality of materials); and (f) other Contract Documents. Among other categories of documents having the same order of precedence, the term or provision that includes the latest date shall control. Contractor shall notify Design Professional and Owner for resolution of the issue prior to executing the Work in question.

9.4 Contractor's Duty to Review Contract Documents. In order to facilitate Contractor's responsibilities for completion of the Work in accordance with and as reasonably inferable from the Contract Documents, Contractor shall, prior to commencing the Work, examine and compare the Contract Documents, information furnished by Owner, relevant field measurements made by Contractor, and any visible or reasonably anticipated conditions at the Site affecting the Work. This duty extends throughout the design phase and construction phase prior to commencing each particular work activity and/or system installation. Updated Coordination Documents shall be provided to the Owner and Design Professional monthly.

9.5 Discrepancies and Omissions in Drawings and Specifications. Contractor shall immediately report to OCM and to Design Professional the discovery of any discrepancy, error, omission, or inconsistency in the Contract Documents prior to execution of the Work. When performing as a Construction Manager-at-Risk, Contractor has a shared responsibility with Design Professional for discovery and resolution of discrepancies, errors, omissions, and inconsistencies in the Contract Documents. In such case, Contractor's responsibility pertains to review, coordination, and recommendation of resolution strategies within budget constraints.

9.5.1 Design-Build Firm. It is recognized that Contractor is not acting in the capacity of a licensed design professional, unless it is performing as a Design-Build firm. When performing as a Design-Build firm, Contractor has sole responsibility for discrepancies, errors, and omissions in the Drawings and Specifications.

9.5.2 Construction Manager-at-Risk Examination and Reporting. When performing as a Construction Manager-at-Risk, Contractor has no liability for discrepancies, errors, omissions, or inconsistencies unless Contractor fails to immediately report in writing a discovered or apparent discrepancy, error, omission, or inconsistency to OCM and Design Professional. Should Contractor fail to perform the examination and reporting obligations of these provisions, Contractor is responsible for avoidable costs and direct and/or consequential damages.

9.5.3 Other Limitations. Unless Contractor is performing as a Design-Build Firm or a Construction Manager-at-Risk, Contractor's examination of Contract Documents is to facilitate construction and does not create an affirmative responsibility to detect discrepancies, errors, omissions, or inconsistencies or to ascertain compliance with applicable laws, building codes, or regulations.

9.6 No Warranty or Representation by Owner. Owner makes no representations, express or implied, about the adequacy or accuracy of the Drawings, Specifications, or other Construction Documents provided or their suitability for their intended use. Owner expressly disclaims any implied warranty that the Construction Documents are adequate, accurate, or suitable for their intended use.

9.7 Requirements for Record Documents.

9.7.1 Contractor shall:

9.7.1.1 Maintain at the Site one copy of all Drawings, Specifications, addenda, approved submittals, Contract modifications, Change Orders, and all Project correspondence and one record copy of approved Shop Drawings, Samples, and similar required submittals.

9.7.1.2 Keep current and maintain Drawings and Specifications in good order with postings and markings to record actual conditions of Work, and show and reference all changes made during construction. Provide Owner and Design Professional access to these documents.

9.7.1.3 Keep current and maintain the record set of Drawings and Specifications which reflect the actual field conditions and representations of the Work performed, whether it be directed by addendum, Change Order, or otherwise. Make available all records prescribed herein for reference and examination by Owner and Design Professional, and their representatives and agents.

9.7.1.4 Be responsible for marking the Record Documents for all Contractor initiated documents and changes to the Contract Documents due to coordination and actual field conditions, including RFIs. During construction, update the Record Documents, including all related RFI's, ASI's CCD's, and CO's, at least monthly prior to submission of periodic partial pay estimates. Failure to maintain current Record Documents constitutes cause for denial of a progress payment otherwise due.

9.7.1.5 Within thirty (30) days of Substantial Completion, Contractor shall furnish the Design Professional a copy of its marked-up Record Documents and a preliminary copy of each instructional manual, maintenance and operating manual, parts catalog, wiring diagrams, spare parts, specified written warranties and like publications, or parts for all installed equipment, systems, and like items, and as described in the Contract Documents. A complete set must be provided to the Design Professional within seven (7) days of Final Completion.

9.7.2 Design Professional shall:

9.7.2.1 In coordination with Contractor, shall update Record Documents to accurately depict progress of the Work and "as-built" condition of the Project.

9.7.2.2 Be responsible for updating the Record Documents for any addenda, Change Orders, Design Professional supplemental instructions, and any other alterations to the Contract Documents generated by Design Professional or Owner. Design Professional shall provide Owner with an electronic copy of the Auto-CADD files, BIM files, and Record Documents in both native format and a reproducible format within thirty (30) days following Final Completion.

9.7.2.3 Upon final completion and as a condition of final payment, once Record Documents are determined acceptable by OCM and with input from the Contractor, provide one (1) reproducible copy and one (1) electronic media copy of all Record Documents incorporating all of the above requirements, unless required otherwise.

ARTICLE 10.
CONSTRUCTION SAFETY

10.1 General. It is the duty and responsibility of Contractor and all of its Subcontractors to be familiar with, enforce, and comply with all requirements of Public Law No. 91-596, 29 U.S.C. § 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto. Contractor shall prepare a site-specific safety plan specific to the Project and submit it to OCM and Design Professional prior to commencing Work. In addition, Contractor and all of its Subcontractors shall comply with all applicable laws and regulations of any public body having jurisdiction for safety of persons or property to protect them from damage, injury, or loss and erect and maintain all necessary safeguards for such safety and protection.

10.1.1 Site Visits. The OCM/ODR may perform random visits to Project Sites to address adherence to the site-specific safety plans and any Contractor safety requirements. Any violations that are discovered will be reported to Contractor for prompt remediation and correction. Poor performance in regards to safety, as determined by the OCM/ODR, is grounds for contract termination and/or immediate removal. The OCM/ODR may also require meetings with contractors regarding safety on the Project. The OCM/ODR may request to review safety policies of Contractor, Contractor's safety inspection forms, and the most current site-specific safety plan, as required.

10.2 Notices. Contractor shall provide notices as follows:

10.2.1 Utilities and Adjacent Properties. Notify owners of adjacent property, including those that own or operate utilities, utility services, and/or underground facilities, when prosecution of the Work may affect them or their facilities, and cooperate with them in the protection, removal, relocation and replacement, and access to their facilities and/or utilities.

10.2.2 Safety Data Sheets. Coordinate the exchange of safety data sheets (SDSs) or other hazard communication information required to be made available to or exchanged between or among employers at the site in connection with laws and regulations. Maintain a complete file of SDSs for all materials in use on site throughout the construction phase and make such file available to Owner and its agents as requested.

10.3 Emergencies. In any emergency affecting the safety of persons or property, Contractor shall act to minimize, mitigate, and prevent threatened damage, injury, or loss. Contractor shall:

10.3.1 On Call Response. Have authorized agents of Contractor respond immediately upon call at any time of day or night when circumstances warrant the presence of Contractor to

protect the Work or adjacent property from damage or to take such action pertaining to the Work as may be necessary to provide for the safety of the public.

10.3.2 Notice.

10.3.2.1 To OCM and Design Professional: Give OCM and Design Professional prompt notice of all such events.

10.3.2.2 Changes or Variations to Work: If Contractor believes that any changes in the Work or variations from Contract Documents have been caused by its emergency response, promptly notify Owner within twenty-four (24) hours of the emergency response event.

10.3.3 Owner Remedy. Should Contractor fail to respond, Owner is authorized to direct other forces to take action as necessary and Owner may deduct any cost of remedial action from funds otherwise due Contractor.

10.4 Injuries. In the event of an incident or accident involving outside medical care for an individual on or near the Work, Contractor shall notify OCM and other parties as may be directed promptly, but no later than twenty-four (24) hours after Contractor learns that an event required medical care. Contractor shall:

10.4.1 Documentation. Record the location of the event and the circumstances surrounding it, by using photography or other means, and gather witness statements and other documentation which describes the event.

10.4.2 Incident Report. Supply OCM and Design Professional with an incident report no later than thirty-six (36) hours after the occurrence of the event. In the event of a catastrophic incident (one (1) fatality or three (3) workers hospitalized), barricade and leave intact the scene of the incident until all investigations are complete. A full set of incident investigation documents, including facts, finding of cause, and remedial plans shall be provided within one (1) week after occurrence, unless otherwise directed by legal counsel. Contractor shall provide OCM with written notification within one (1) week of such catastrophic event if legal counsel delays submission of full report.

10.5 Environmental Safety. Upon encountering any previously unknown potentially hazardous material, or other materials potentially contaminated by hazardous material, Contractor shall immediately stop work activities impacted by the discovery, secure the affected area, and notify OCM immediately.

10.5.1 Subcontractors. Contractor shall bind all Subcontractors to the same duty.

10.5.2 Owner. Upon receiving such notice, OCM will promptly engage qualified experts to make such investigations and conduct such tests as may be reasonably necessary to determine the existence or extent of any environmental hazard. Upon completion of this investigation, OCM will issue a written report to Contractor identifying the material(s)

found and indicate any necessary steps to be taken to treat, handle, transport or dispose of the material.

10.5.2.1 Owner may hire third-party Contractors to perform any or all such steps.

10.5.2.2 Should compliance with OCM's instructions result in an increase in Contractor's cost of performance or delay the Work, upon Contractor's submission of substantiated costs or an updated Work Progress Schedule and substantiated critical path analysis, Owner will make an equitable adjustment to the Contract Sum and/or the time of completion, and issue a Change Order accordingly.

10.6 Trenching Plan. When the project requires excavation which either exceeds a depth of four (4) feet, or results in any worker's upper body being positioned below grade level, Contractor is required to submit a trenching plan to OCM prior to commencing trenching operations unless an engineered plan is part of the Contract Documents. The plan is required to be prepared and sealed by a professional engineer registered in the State of Texas and hired or employed by Contractor or Subcontractor to perform the work. Said engineer cannot be anyone who is otherwise either directly or indirectly engaged on this project.

10.6.1 OSHA Regulations: All trench excavations shall be performed in full compliance with OSHA Regulations. The regulation identified as 29 CFR Subpart P – Excavations, consisting of sections 1926.650 through 1926.652 with Appendices A through F, of the OSHA Health and Safety Regulations, as amended or modified, shall apply to Contractor's trench excavations. Contractor shall meet and comply with this regulation and all other applicable safety standards that have been adopted by government agencies that have jurisdiction over this Project. It is the Contractor's responsibility to comply with any additional requirements resulting from any pre-construction conference relating to coordination of geotechnical investigation subjects.

10.6.2 Texas State Law: Texas State Law (Underground Facility Damage Prevention and Safety Act: Tex. Util. Code, Chapter 251) requires Contractors submit all required notifications to the authorities having jurisdiction two working days prior to commencement of all excavation site work. It is the Contractor's responsibility to inform Texas Excavation Safety System (1-800-DIG-TESS or 811) about all planned excavations and provide adequate notice. Contractor is required to coordinate identification of underground facilities with the Design Professional and ODR, and site mark approximate locations prior to planned excavation.

10.6.3 Contractor Responsibility: It is the sole duty and responsibility of the Contractor to determine the specific applicability of the designed trench safety systems to each field condition and to make inspections of the trench safety systems. Contractor shall maintain a permanent record of inspections, readily available to the ODR at any time.

10.7 Crane Safety. Any and all construction associated activities with crane operations must be coordinated and reviewed with OCM/ODR prior to commencement of such activities. Prior to the operation of any crane on Site, a suitable location needs to be determined and consulted with the OCM/ODR. Such location must be included on the site-specific safety plan. Consideration should be made to the capacity and type of crane in safe relationship to the physical site location limitations, as well as any existing or future underground/overhead conditions and utilities. Contractor is required to coordinate identification of underground/overhead facilities with Design Professional and ODR and site mark approximate locations prior to initial planned setup and activities. Any critical lift plans must be reviewed by OCM/ODR prior to activity occurring. If possible, avoiding critical lifts is preferred. All crane operators must be certified by the National Commission for Certification of Crane Operators (NCCCO). All signal persons & riggers at a minimum need to be qualified in accordance with OSHA standard. Contractor should have certified riggers & signal persons working on campus and Owner reserves the right to request such certification depending on the scope of work being performed. Contractor shall develop a lift plan for any crane activities being performed. The lift plan must be submitted to OCM/ODR prior to any lifting or hoisting activities occurring, with any additional documentation, including but not limited to, equipment manuals, inspections, certifications and licenses to be provided to the owner upon request.

10.8 Unmanned Aircraft System (UAS) Usage. Any UAS operation on Owner's property must follow Federal Aviation Administration (FAA) regulations, state law, and Owner's policies and procedures. Any images or video obtained from a pre-authorized and compliant UAS flight on Owner's property must be approved for use by the Owner prior to usage of any such images or video obtained. Any violations will result in an ODR directed no-fly restriction for UAS operations on Owner's property.

10.9 Fire Protection Procedures. Contractor shall maintain compliance with all Life/Safety Code requirements throughout the duration of the Contract and take precautions to prevent potential fire hazards at the jobsite. Contractor shall adhere to the preventative fire protection procedures of the University of North Texas System Fire Marshal and instruct all associated subcontractors, skilled tradesmen, contractors, material men, suppliers and/or laborers of the procedures for preventative fire measures. Construction sites and structures are required to have proper site access and egress, active and certified extinguishing devices or systems at all times, and all fire and egress systems clearly marked and identified. Fire department access (fire lanes) shall be kept clear of vehicles, equipment and materials at all times. Occupied buildings which require any fire protection systems to be non-active, require two weeks advance notice and life safety protection method of procedures must be reviewed by University of North Texas System Fire Marshal, prior to system deactivation.

10.10 Smoke and Tobacco Free Campus. All campuses within the University of North Texas System are designated 'Smoke and Tobacco Free' environments. Due to State health, sanitation and safety regulations, tobacco products are not permitted to be consumed by construction personnel in any Owner's property, occupied or unoccupied, including mechanical and other service spaces. Contractor shall be responsible for enforcing this policy on the construction site, at all times.

ARTICLE 11.
QUALITY CONTROL

11.1 Materials & Workmanship. Contractor shall execute Work in a good and workmanlike matter in accordance with the Contract Documents. Contractor shall develop and provide a quality control plan specific to this Project and acceptable to Owner. Where Contract Documents do not specify quality standards, complete and construct all Work in compliance with generally accepted construction industry standards. Unless otherwise specified, incorporate all new materials and equipment into the Work under the Contract.

11.2 Testing.

11.2.1 Owner. Owner is responsible for coordinating and paying for routine and special tests required to confirm compliance with quality and performance requirements, except as stated below or otherwise required by the Contract Documents.

11.2.2 Contractor. Contractor shall provide the following testing:

11.2.2.1 Any test of basic material or fabricated equipment included as part of a submittal for a required item in order to establish compliance with the Contract Documents.

11.2.2.2 Any test of basic material or fabricated equipment offered as a substitute for a specified item on which a test may be required in order to establish compliance with the Contract Documents.

11.2.2.3 Preliminary, start-up, pre-functional, and operational testing of building equipment and systems as necessary to confirm operational compliance with requirements of the Contract Documents.

11.2.2.4 All subsequent tests on original or replaced materials conducted as a result of prior testing failure.

11.2.3 Standards. All testing shall be performed in accordance with standard test procedures by an accredited laboratory, or special consultant as appropriate, acceptable to Owner. Results of all tests shall be provided promptly to OCM, Design Professional, and Contractor.

11.2.4 Non-Compliance (Test Results). Should any of the tests indicate that a material and/or system does not comply with the Contract requirements, the burden of proof remains with Contractor, subject to:

11.2.4.1 Contractor selection and submission of the laboratory for Owner acceptance.

11.2.4.2 Acceptance by Owner of the quality and nature of tests.

11.2.4.3 All tests taken in the presence of Design Professional and/or OCM, or their representatives.

11.2.4.4 If tests confirm that the material/systems comply with Contract Documents, Owner will pay the cost of the test.

11.2.4.5 If tests reveal noncompliance, Contractor will pay those laboratory fees and costs of that particular test and all future tests, of that failing Work, necessary to eventually confirm compliance with Contract Documents.

11.2.4.6 Proof of noncompliance with the Contract Documents will make Contractor liable for any corrective action which OCM determines appropriate, including complete removal and replacement of noncompliant work or material.

11.2.5 Notice of Testing. Contractor shall give OCM and Design Professional timely notice of its readiness and the date arranged so OCM and Design Professional may observe such inspection, testing, or approval.

11.2.6 Test Samples. Contractor is responsible for providing Samples of sufficient size for test purposes and for coordinating such tests with the Work Progress Schedule to avoid delay.

11.2.7 Covering Up Work. If Contractor covers up any Work without providing Owner an opportunity to inspect, Contractor shall, if requested by OCM, uncover and recover the work at Contractor's expense.

11.3 Submittals.

11.3.1 Contractor's Submittals. Contractor shall submit with reasonable promptness consistent with the Project schedule and in orderly sequence all Shop Drawings, Samples, or other information required by the Contract Documents, or subsequently required by Change Order. Prior to submitting, Contractor shall review each submittal for general compliance with Contract Documents and approve submittals for review by Design Professional and Owner by an approval stamp affixed to each copy. Submittal data presented without Contractor's stamp will be returned without review or comment, and any delay resulting from failure is Contractor's responsibility.

11.3.1.1 Contractor shall within twenty-one (21) days of the effective date of the Notice to Proceed with construction, submit to OCM and Design Professional, a submittal schedule/register, organized by specification section, listing all items to be furnished for review and approval by Design Professional and Owner. The list shall include Shop Drawings, manufacturer literature, certificates of compliance, materials Samples, materials colors, guarantees, and all other items identified throughout the Specifications.

11.3.1.2 Contractor shall indicate the type of item, Contract requirements reference, and Contractor's scheduled dates for submitting the item along with the

requested dates for approval answers from Design Professional and Owner. The Submittal Register shall indicate the projected dates for procurement of all included items and shall be updated at least monthly with actual approval and procurement dates. Contractor's Submittal Register must be reasonable in terms of the review time for complex submittals. Contractor's submittal schedule must be consistent with the Work Progress Schedule and identify critical submittals. Show and allow a minimum of fifteen (15) days duration after receipt by Design Professional and OCM for review and approval. If re-submittal required, allow a minimum of an additional *seven (7)* days for review. Submit the updated Submittal Register with each request for progress payment. Owner may establish routine review procedures and schedules for submittals at the preconstruction conference and/or elsewhere in the Contract Documents. If Contractor fails to update and provide the Submittal Register as required, Owner may, after seven (7) days notice to Contractor withhold a reasonable sum of money that would otherwise be due Contractor.

11.3.1.3 Contractor shall coordinate the Submittal Register with the Work Progress Schedule. Do not schedule Work requiring a submittal to begin prior to scheduling review and approval of the related submittal. Revise and/or update both schedules monthly to ensure consistency and current project data. Provide to OCM the updated Submittal Register and schedule with each application for progress payment. Refer to requirements for the Work Progress Schedule for inclusion of procurement activities therein. Regardless, the Submittal Register shall identify dates submitted and returned and shall be used to confirm status and disposition of particular items submitted, including approval or other action taken and other information not conveniently tracked through the Work Progress Schedule.

11.3.1.4 By submitting Shop Drawings, Samples or other required information, Contractor represents that it has determined and verified all applicable field measurements, field construction criteria, materials, catalog numbers and similar data; and has checked and coordinated each Shop Drawing and Sample with the requirements of the Work and the Contract Documents.

11.3.2 Review of Submittals. Design Professional and OCM review is only for conformance with the design concept and the information provided in the Contract Documents. Responses to submittals will be in writing. The approval of a separate item does not indicate approval of an assembly in which the item functions. The approval of a submittal does not relieve Contractor of responsibility for any deviation from the requirements of the Contract unless Contractor informs Design Professional and OCM of such deviation in a clear, conspicuous, and written manner on the submittal transmittal and at the time of submission, and obtains Owner's written specific approval of the particular deviation.

11.3.3 Correction and Resubmission. Contractor shall make any corrections required to a submittal and resubmit the required number of corrected copies promptly so as to avoid

delay, until submittal approval. Direct attention in writing to Design Professional and OCM, when applicable, to any new revisions other than the corrections requested on previous submissions.

11.3.4 Limits on Shop Drawing Review. Contractor shall not commence any Work requiring a submittal until review of the submittal under Subsection 11.3.2. Contractor shall construct all such work in accordance with reviewed submittals. Comments incorporated as part of the review in Subsection 11.3.2 of Shop Drawings and Samples is not authorization to Contractor to perform extra work or changed work unless authorized through a Change Order. Design Professional's and OCM*'s* review does not relieve Contractor from responsibility for defects in the Work resulting from errors or omissions of any kind on the submittal, regardless of any approval action.

11.3.5 No Substitutions without Approval. OCM and Design Professional may receive and consider Contractor's request for substitution when Contractor agrees to reimburse Owner for review costs and satisfies the requirements of this section. If Contractor does not satisfy these conditions, OCM and Design Professional will return the request without action except to record noncompliance with these requirements. Owner will not consider the request if Contractor cannot provide the product or method because of failure to pursue the Work promptly or coordinate activities properly. Contractor's request for a substitution may be considered by OCM and Design Professional when:

11.3.5.1 The Contract Documents do not require extensive revisions; and

11.3.5.2 Proposed changes are in keeping with the general intent of the Contract Documents and the design intent of Design Professional and do not result in an increase in cost to Owner; and

11.3.5.3 The request is timely, fully documented, properly submitted and one or more of the following apply:

- Contractor cannot provide the specified product, assembly or method of construction within the Contract Time;
- The request directly relates to an "or-equal" clause or similar language in the Contract Documents;
- The request directly relates to a "product design standard" or "performance standard" clause in the Contract Documents;
- The requested substitution offers Owner a substantial advantage in cost, time, energy conservation or other considerations, after deducting additional responsibilities Owner must assume;
- The specified product or method of construction cannot receive necessary approval by an authority having jurisdiction, and OCM can approve the requested substitution;
- Contractor cannot provide the specified product, assembly or method of construction in a manner that is compatible with other materials and

where Contractor certifies that the substitution will overcome the incompatibility;

- Contractor cannot coordinate the specified product, assembly or method of construction with other materials and where Contractor certifies they can coordinate the proposed substitution; or
- The specified product, assembly or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.
- The manufacture of the specified product has been removed from production due to cancellation or obsolescence.

11.3.6 Unauthorized Substitutions at Contractor's Risk. Contractor is financially responsible for any additional costs or delays resulting from unauthorized substitution of materials, equipment or fixtures other than those specified. Contractor shall reimburse Owner for any increased design or contract administration costs resulting from such unauthorized substitutions.

11.4 Field Mock-up. Mock-ups shall be constructed prior to commencement of a specified scope of work to confirm acceptable workmanship.

11.4.1 Minimum. As a minimum, field mock-ups shall be constructed for roofing systems, exterior veneer / finish systems, glazing systems, and any other Work requiring a mock-up as identified throughout the Contract Documents. Mock-ups for systems not part of the Project scope shall not be required.

11.4.2 No Incorporation Unless Approved. Mock-ups may be incorporated into the Work if allowed by the Contract Documents and if acceptable to OCM. If mock-ups are freestanding, they shall remain in place until otherwise directed by Owner.

11.4.3 Schedule. Contractor shall include field mock-ups in their Work Progress Schedule and shall notify OCM and Design Professional of readiness for review sufficiently in advance to coordinate review without delay.

11.5 Inspection During Construction. Contractor shall provide sufficient, safe, and proper facilities, including equipment as necessary for safe access, at all reasonable times for observation and/or inspection of the Work by Owner or Design Professional and their agents. Contractor shall not cover up any Work with finishing materials or other building components prior to providing Owner and Design Professional and their agents an opportunity to perform an inspection of the Work.

11.5.1 Corrected Work. Should corrections of the Work be required for approval, Contractor shall not cover up corrected Work until Owner indicates approval.

11.5.2 Owner's Self Help. Should Contractor be unable to perform corrective work without impacting the overall WPS, Owner reserves the right to hire a separate Contractor to

complete the correction. The cost of the correction performed by separate Contractor will be charged back to Contractor.

11.5.3 Notice. Contractor shall provide notification of at least five (5) working days or otherwise as mutually agreed, to OCM of the anticipated need for an inspection so that Contractor may proceed with cover-up of Work. Should OCM fail to make the necessary inspection within the agreed period, Contractor may proceed with cover-up Work, but is not relieved of responsibility for Work to comply with requirements of the Contract Documents.

ARTICLE 12.
CONSTRUCTION SCHEDULES

12.1 Contract Time. **TIME IS AN ESSENTIAL ELEMENT OF THE CONTRACT**. The Contract Time is the time between the dates indicated in the Notice to Proceed for commencement of the Work and for achieving Substantial Completion. The Contract Time can be modified only by Change Order. Failure to achieve Substantial Completion within the Contract Time will cause damage to Owner and may subject Contractor to liquidated damages as provided in the Contract Documents. If Contractor fails to achieve Final Completion within thirty (30) days after Substantial Completion, Contractor shall be responsible for Owner's additional inspection, project management, and maintenance cost to the extent caused by Contractor's failure to achieve Final Completion.

12.2 Notice to Proceed. Owner will issue a Notice to Proceed which shall state the dates for commencing Work and for achieving Substantial Completion of the Work.

12.3 Work Progress Schedule. Refer to Division 1 of the Specifications for additional schedule requirements. Contractor shall submit for review and approval a Construction Baseline Schedule to Owner and Design Professional no later than twenty-one (21) days after the effective date of the Notice to Proceed with construction. The Construction Baseline Schedule shall indicate the dates for starting and completing the various aspects required to complete the work and shall utilize the Longest Path Method with fully editable logic. The schedule shall include mobilization, procurement, installation, testing, inspection, delivery of Close-out Documents, and acceptance of all Work. This Baseline Schedule shall become the comparison to the actual conditions throughout the Contract duration and become a part of the Work Progress Schedule (WPS). Contractor shall coordinate and integrate the Work Progress Schedule with the services and activities of Owner, Contractor, Design Professional, other consultants/suppliers, subcontractors and the requirements of governmental entities.

This section applies to construction phase Work Progress Schedules. Requirements for design phase scheduling for Construction Manager-at-Risk and Design Build contracts are outlined in the specific agreements.

12.3.1 Work Progress Schedule Updates.

12.3.1.1 Contractor shall update the Work Progress Schedule and the Submittal Register weekly during the Owner/Architect/Contractor (OAC) meetings, at a minimum, to reflect progress to date and current plans for completing the Work, while maintaining the Baseline Schedule, and shall submit electronic and paper copies of the update to Design Professional and OCM as directed but at a minimum with each request for payment. Owner has no duty to make progress payments unless accompanied by the updated Work Progress Schedule.

12.3.1.2 Contractor should revise the Work Progress Schedule as necessary or appropriate for the management of the Work. All updated Work Progress Schedules must show the anticipated date of completion and reflect all extensions of time granted through Change Order as of the date of the update.

12.3.1.3 Contractor shall identify all proposed changes to schedule logic to Owner and to Design Professional via an executive summary accompanying the updated Work Progress Schedule for review and approval prior to implementation of any revisions to the Work Progress Schedule. Schedule changes that materially impact Owner's operations shall be communicated within forty-eight (48) hours to OCM.

12.3.1.4 The Work Progress Schedule constitutes Contractor's representation to Owner of the accurate depiction of all progress to date and that Contractor will follow the schedule as submitted in performing the Work.

12.3.2 Use of Work Progress Schedules. The Work Progress Schedule is for Contractor's use in managing the Work and submittal of the Work Progress Schedule, and successive updates or revisions, is for the information of Owner and to demonstrate that Contractor has complied with requirements for planning and completing the Work.

12.3.2.1 Owner will coordinate its own activities with Contractor's activities as shown on the Work Progress Schedule.

12.3.2.2 Owner's review of the Work Progress Schedule, or update or revision, does not indicate any approval of Contractor's proposed sequences and duration.

12.3.2.3 Owner's review of a Work Progress Schedule update or revision indicating early or late completion does not constitute Owner's consent, alter the terms of the Contract, or waive either Contractor's responsibility for timely completion or Owner's right to damages for Contractor's failure to so do.

12.3.2.4 Contractor's scheduled dates for completion of any activity or the entire Work do not constitute a change in terms of the Contract. Change Orders are the only method of modifying the Substantial Completion Date(s) and Contract Time.

12.4 Ownership of Float. Unless indicated otherwise in the Contract Documents, Contractor shall develop its schedule, pricing, and execution plan to provide a minimum of ten percent (10%) total Float at acceptance of the Baseline Schedule. Float time contained in the Work Progress Schedule is not for the exclusive benefit of Contractor or Owner, but belongs to the Project and may be consumed by either party. Before Contractor uses any portion of the Float, Contractor must submit a written request to Owner and receive Owner's written authorization to use the portion of Float. Owner's approval will not unreasonably be withheld.

12.5 Completion of Work. Contractor is responsible and accountable for completing the Work within the Contract Time stated in the Contract, or as otherwise amended by Change Order.

12.5.1 Owner's Self Help. Should Contractor be unable to complete portion of Work, Owner may hire separate Contractor to complete these items. The cost to complete this Work will be charged back to Contractor.

12.5.2 Requirement to Regain Schedule. If, in the judgment of Owner, the Work is behind schedule and the rate of placement of Work is inadequate to regain scheduled progress to insure timely completion of the entire Work or a separable portion thereof, Contractor, when so informed by Owner, shall immediately take action to increase the rate of Work placement by:

12.5.2.1 An increase in working forces.

12.5.2.2 An increase in equipment or tools.

12.5.2.3 An increase in hours of work or number of shifts.

12.5.2.4 Expedited delivery of materials.

12.5.2.5 Other action proposed if acceptable to Owner.

12.5.3 Recovery Schedule. Within ten (10) days after such notice, Contractor shall notify OCM in writing of the specific measures taken and/or plan to increase the rate of progress. Contractor shall include an estimate as to the date of scheduled progress recovery and an updated Work Progress Schedule illustrating Contractor's plan for achieving timely completion of the Work. Should Owner deem the plan of action inadequate, Contractor shall take additional steps or make adjustments as necessary to its plan of action until it meets with Owner's approval.

12.5.4 Owner's Notice Not Acceleration. Owner's notice to Contractor shall not be considered acceleration by Owner and Owner shall not be responsible for any increased costs incurred by Contractor.

12.6 Modification of the Contract Time. Delays and extensions of Contract Time are valid only if properly noticed and documented by Change Order.

12.6.1 Extension Request. When a delay is an Excusable Delay, as defined below, and such delay prevents Contractor from completing the Work within the Contract Time, Contractor may be granted an extension of Contract Time. Owner will extend Contract Time by the number of days lost due to Excusable Delay, as measured by a substantiated critical path analysis of the Work Progress Schedule; provided, however, in no event will an extension of Contract Time be granted for delays that merely extend the duration of non-critical activities, or concurrent delay or which only consume Float. All extensions of Contract Time will be granted in calendar days.

12.6.2 Weather Days. "Weather Days" means days contained in the Baseline Schedule that are reasonably foreseeable adverse weather conditions and will not constitute an Excusable Delay. "Seasonably foreseeable adverse weather conditions" means weather conditions in keeping with the historical average listed by the National Oceanic and Atmospheric Administration on its website, www.noaa. When a Weather Day prevents critical path activities at the site from proceeding, Contractor shall: (a) immediately notify OCM for confirmation of the conditions and provide a detailed list of critical path activities impacted; and (b) at the end of each calendar month, submit to OCM and Design Professional a list of Weather Days occurring in that month along with documentation of the impact on critical path activities. Based on substantiated critical path analysis to the Work Progress Schedule, Owner will issue a Weather Day confirmation for any Contract Time extension to be documented by Change Order.

12.6.3 Excusable Delay. An "Excusable Delay" is a delay to Contractor's current schedule caused by circumstances listed below that prevents Contractor from completing the Work within the Contract Time. Based on substantiated critical path analysis to the Work Progress Schedule, any Contract Time extension will be issued by Change Order. Excusable Delay may be caused by the following:

12.6.3.1 Discrepancies, errors, omissions, and inconsistencies in design, which Design Professional corrects by means of changes in the Drawings and Specifications; provided, however, that this does not apply if (a) Contractor is a Design-Build Firm, or (b) Contractor is a Construction Manager-at-Risk and failed to promptly report a discovered or apparent discrepancy, error, omission, or inconsistency during the pre-construction phase.

12.6.3.2 Unanticipated physical conditions at the Site, which Design Professional corrects by means of changes to the Drawings and Specifications or for which ODR directs changes in the Work identified in the Contract Documents.

12.6.3.3 Changes in the Work that delay activities identified in Contractor's Work Progress Schedule as "critical" to completion of the entire Work, if such changes are directed by ODR or recommended by Design Professional and directed by ODR.

12.6.3.4 Suspension of Work for unexpected natural events, civil unrest, strikes or other events which are not within the reasonable control of Contractor.

12.6.3.5 Suspension of Work for convenience of Owner, which prevents Contractor from completing the Work within the Contract Time.

12.7 No Damages for Weather Days. An extension of Contract Time shall be the sole remedy of Contractor for delays in performance of the Work due to Weather Days, and Contractor shall not be entitled to any compensation or recovery of any direct or indirect costs or damages.

12.8 Costs for Excusable Delay. In the event that Contractor incurs additional direct costs because of an Excusable Delay (other than described in Subsection 12.6.3.4) within the reasonable control of Owner, in addition to an extension of Contract Time the Contract Sum will be equitably adjusted by Owner pursuant to the provisions of Article 14.

12.9 No Damages for Other Delay. Except for direct costs for Excusable Delay as provided above, Contractor has no claim for monetary damages for delay or hindrances to the Work from any cause, whether or not such delays are foreseeable, except for delays caused solely by acts of Owner that constitute intentional interference with Contractor's performance of the Work and then only to the extent such acts continue after Contractor notifies Owner in writing of such interference. For delays caused by any act other than the sole intentional interference of Owner that continues after notice, Contractor shall not be entitled to any compensation or recovery of any damages including, without limitation, direct and indirect costs, consequential damages, lost opportunity costs, impact damages, loss of productivity, or other similar damages. Owner's exercise of any of its rights or remedies under the Contract including, without limitation, ordering changes in the Work or directing suspension, rescheduling, or correction of the Work, shall not be construed as intentional interference with Contractor's performance of the Work regardless of the extent or frequency of Owner's exercise of such rights or remedies.

12.10 Concurrent Delay. Notwithstanding anything herein to the contrary, when the completion of the Work is simultaneously delayed by a Weather Day or an Excusable Delay and a delay arising from a cause not designated as excusable, Contractor will not be entitled to an extension of Contract Time for the period of concurrent delay.

12.11 Time Extension Requests for Changes to the Work or Excusable Delay. Extensions to Contract Time requested in association with changes to the Work directed or requested by Owner shall be included with Contractor's proposed costs for such change. If Contractor believes that the completion of the Work is delayed by Excusable Delay, Contractor shall give OCM written notice, stating the nature of the delay and the activities potentially affected, within five (5) days after the onset of the event or circumstance giving rise to the Excusable Delay. Contractor shall provide sufficient written evidence to document the Excusable Delay. In the case of a continuing cause of delay, only one claim is necessary. Claims for extensions of time should be made in numbers of whole or half days.

12.11.1 Content of Request. Within ten (10) days after the cessation of the Excusable Delay, Contractor shall formalize in writing its request for extension of Contract Time to include substantiation of the excusable nature of the delay and a complete analysis of impact to critical path activities. Based on substantiated critical path analysis to the Work Progress Schedule, any Contract Time extension granted will be issued by Change Order.

12.11.2 No Release. No extension of time releases Contractor or the Surety furnishing a performance or payment bond from any obligations under the Contract or such a bond. Those obligations remain in full force until the discharge of the Contract.

12.11.3 Longest Path Analysis. Contractor shall provide with each time extension request a quantitative demonstration of the impact of the delay on completion of the Work and Contract Time, based on the Work Progress Schedule. Contractor shall include with time extension requests a reasonably detailed narrative setting forth:

12.11.3.1 The nature of the delay and its cause due to a change in the Work or an Excusable Delay and the basis of Contractor's claim of entitlement to an extension of Contract Time.

12.11.3.2 Documentation of the actual impacts of the claimed delay on the Longest Path in Contractor's Work Progress Schedule, and any concurrent delays.

12.11.3.3 Description and documentation of steps taken by Contractor to mitigate the effect of the claimed delay, including, when appropriate, the modification of the Work Progress Schedule.

12.11.4 Owner Response. Owner will respond to the time extension request by providing to Contractor written notice of the number of days granted, if any, and giving its reason if this number differs from the number of days requested by Contractor.

12.11.4.1 Owner will not grant time extensions for delays that do not affect the Contract Substantial Completion date.

12.11.4.2 Owner will respond to each properly submitted Time Extension Request within a reasonable time following receipt. If Owner does not have enough information to make a determination or cannot reasonably make a determination within forty-five (45) days, Owner will notify Contractor in writing.

12.12 Failure to Complete Work in the Contract Time. **TIME IS AN ESSENTIAL ELEMENT OF THE CONTRACT.** Contractor's failure to achieve substantial completion by the Contract Time or to achieve Substantial Completion as required will cause damage to Owner. These damages shall be liquidated by agreement of Contractor and Owner, in the amount per day as set forth in Section 12.13 below or elsewhere in the Contract Documents.

12.13 Liquidated Damages. Unless otherwise stated in the Contract, for each consecutive calendar day beyond the Contract Time that Substantial Completion of the Work is not achieved, Contractor shall pay Owner, within ten (10) days following written demand, an amount determined by the following schedule:

Project Cost		Liquidated Damages
From	To	Per Day
	< $ 1,000,000	$ 250
$ 1,000,000	< $ 25,000,000	$ 1,000
$ 25,000,000	< $ 50,000,000	$ 2,500
$ 50,000,000	< $ 75,000,000	$ 5,000
$ 75,000,000	< $ 100,000,000	$ 7,500
> $ 100,000,000		$ 10,000

12.13.1 Reasonable Estimate. Such amount is not a penalty but liquidated damages representing the parties' estimate at the time of Contract execution of the damages that Owner will sustain for late Substantial Completion of Work. The parties stipulate and agree that the actual damages sustained by Owner for late Substantial Completion of the Work will be uncertain and difficult to ascertain, that calculating Owner's actual damages would be impractical, unduly burdensome, and cause unnecessary delay, and that the amount of daily liquidated damages set forth above is a reasonable estimate.

12.13.2 Offset. Owner may also recover the liquidated damages from any money due or that becomes due Contractor. The amount of liquidated damages may be adjusted by the terms of the Contract.

12.13.3 No Waiver. Payment or offset of the liquidated damages does not preclude recovery under the Contract, except for claims related to delays in Substantial Completion or Final Completion. Owner's right to receive liquidated damages shall not affect Owner's right to terminate the Contract as provided in these Uniform General Conditions or elsewhere in the Contract Documents, nor shall termination of the Contract release Contractor from the obligation to pay liquidated damages.

ARTICLE 13.
PAYMENTS

13.1 Job Order Contracts. Contractor shall submit to OCM pricing based on the **regional** RS Means or Gordian Group pricing. The Job Order may be a fixed price, lump-sum contract based on unit pricing applied to estimated quantities or unit price order based on the quantities and line items delivered and the coefficient applied to the work items.

13.2 Schedule of Values (utilized in Construction-Manager-at-Risk and General Construction Agreement). Contractor shall submit to OCM and Design Professional for acceptance a Schedule of Values accurately itemizing material and labor for the various classifications of the Work based on the organization of the specification sections and of sufficient detail acceptable to OCM. The accepted Schedule of Values will be the basis for the progress payments under the Contract.

13.2.1 Requirements.

13.2.1.1 No progress payments will be made prior to receipt and acceptance of the Schedule of Values, provided in such detail as required by OCM, and submitted not less than twenty-one (21) days after the effective date of the Notice to Proceed. The Schedule of Values shall follow the order of trade divisions of the Specifications and include itemized costs for General Conditions, costs for preparing Close-Out Documents, fees, contingencies, and Owner cash allowances, if applicable, so that the sum of the items will equal the Contract Sum. As appropriate, assign each item labor and/or material values, the subtotal thereof equaling the value of the Work in place when complete.

13.2.1.2 Owner requires that the Work items be inclusive of the cost of the Work items only. Any contract markups for overhead and profit, General Conditions, etc., shall be contained within separate line items for those specific purposes which shall be divided into at least two (2) lines, one (1) for labor and one (1) for materials.

13.2.1.3 Contractor shall retain a copy of all worksheets used in preparation of its bid or proposal, supported by a notarized statement that the worksheets are true and complete copies of the documents used to prepare the bid or proposal, and shall make the worksheets available to Owner at the time of Contract execution. Thereafter, Contractor shall grant Owner during normal business hours access to said copy of worksheets at any time during the period commencing upon execution of the Contract and ending one (1) year after final payment.

13.3 Progress Payments. Contractor will receive periodic progress payments for Work performed, materials in place, suitably stored on Site, or as otherwise agreed to by Owner and Contractor. Payment is not due until receipt by Owner or its designee of a correct and complete Pay Application in electronic and/or hard copy format as required by the Contract Documents, and certified by Design Professional. Progress payments are made provisionally and do not constitute acceptance of Work not in accordance with the Contract Documents. Owner will not process progress payment applications for Change Order Work until all parties execute the Change Order.

13.3.1 Preliminary Pay Worksheet. Once each month that a progress payment is to be requested, the Contractor shall submit to Design Professional and OCM a complete, clean copy of a preliminary pay worksheet or preliminary pay application, to include the following:

13.3.1.1 Contractor's estimate of the amount of Work performed, labor furnished, and materials incorporated into the Work, using the established Schedule of Values;

13.3.1.2 An updated Work Progress Schedule reflecting progress of Work, including the executive summary and all required schedule reports. The progress of Work shall be the same progress as payment request;

13.3.1.3 HUB subcontracting plan Progress Assessment Report (PAR); The PAR should document compliance with the HUB Plan.

13.3.1.4 Reimbursable Expenses: Reimbursable expenses incurred solely and directly in support of the Project within one of the following categories:

- Travel expenditures at State of Texas reimbursement rates, provided that reimbursement will not be granted for travel 1) within the Denton-Dallas-Fort Worth area or 2) involving less than 150 miles round-trip; or
- Reproductions, printing, printing supplies, plotting, photographs, renderings, postage, binding, collating, delivery and handling of reports; Drawings and Specifications or other project-related work product other than that used solely in-house by Contractor at actual expense incurred; or
- Fees and associated reimbursable expenses paid to consultants hired in accordance with prior written approval from Owner.
- Expenses excluded from reimbursement include telephone charges, FAX services, alcoholic beverages, laundry service, valet service, entertainment expenses and any non-Project related items.
- Reimbursement of tips shall not exceed fifteen percent (15%).

13.3.1.5 Such additional documentation as Owner may require in the Contract Documents; and

13.3.1.6 Construction payment affidavit.

13.3.2 Contractor's Application for Payment. As soon as practicable, but in no event later than seven (7) days after receipt of the preliminary pay worksheet, Design Professional and OCM will meet with Contractor to review the preliminary pay worksheet and to observe the condition of the Work. Based on this review, OCM and Design Professional may require modifications to the preliminary pay worksheet prior to the submittal of an Application for Payment, and will promptly notify Contractor of revisions necessary for approval. As soon as practicable, Contractor shall submit its Application for Payment on the appropriate and completed form, reflecting the required modifications to the Schedule of Values required by Design Professional and/or OCM, and must attach all additional

documentation required by OCM and/or Design Professional, as well as an affidavit affirming that all payrolls, bills for labor, materials, equipment, subcontracted work, and other indebtedness connected with Contractor's Application for Payment are paid or will be paid within the time specified in Tex. Gov't Code, Chapter 2251. No Application for Payment is complete unless it fully reflects all required modifications, and attaches all required documentation including Contractor's affidavit.

13.3.3 Certification by Design Professional. Within five (5) days or earlier following Design Professional's receipt of Contractor's formal Application for Payment, Design Professional will review the Application for Payment for completeness, and forward it to OCM. Design Professional will certify that the application is complete and payable, or that it is incomplete, stating in particular what is missing. If the Application for Payment is incomplete, Contractor shall make the required corrections and resubmit the Application for Payment for processing.

13.4 Owner's Duty to Pay. Owner has no duty to pay the Contractor except on receipt by OCM of: (a) a complete Application for Payment certified by Design Professional; and (b) Contractor's updated Work Progress Schedule.

13.4.1 Stored Materials. Payment for stored materials and/or equipment confirmed by Owner and Design Professional to be on-site or otherwise properly stored is limited to eighty-five percent (85%) of the invoice price or eighty-five percent (85%) of the scheduled value for the materials or equipment, whichever is less.

13.4.2 Retainage. Owner will withhold from each progress payment, as retainage, whichever is more of the following three options: (a) five percent (5%) of the total earned amount; (b) the amount authorized by law; or (c) as otherwise set forth in the Contract Documents. Retainage will be managed in conformance with Tex. Gov't Code, Chapter 2252, Subchapter B.

13.4.2.1 Contractor shall provide written consent of its surety and concurrence of Design Professional for any request for reduction or release of retainage.

13.4.2.2 At least sixty-five percent (65%) of the Contract, or such other discrete Work phase as set forth in Subsection 15.1.6 or Work package delineated in the Contract Documents, must be completed before Owner can consider a retainage reduction or release, and only if permissible by law.

13.4.2.3 Contractor shall not withhold retainage from its Subcontractors and suppliers in amounts that are any percentage greater than that withheld in its Contract with Owner under this subsection, unless otherwise acceptable to Owner.

13.4.3 Price Reduction to Cover Loss. Owner may reduce any Application for Payment, prior to payment to the extent necessary to protect Owner from loss on account of actions of Contractor including, but not limited to, the following:

13.4.3.1 Defective or incomplete Work not remedied;

13.4.3.2 Damage to Work of a separate Contractor;

13.4.3.3 Failure to maintain scheduled progress;

13.4.3.4 Reasonable evidence provided with Work Progress Schedule that the Work will not be completed within the Contract Time;

13.4.3.5 Persistent failure to carry out the Work in accordance with the Contract Documents;

13.4.3.6 Reasonable evidence that the Work cannot be completed for the unpaid portion of the Contract Sum;

13.4.3.7 Assessment of fines for violations of prevailing wage rate law; or

13.4.3.8 Failure to include the appropriate amount of retainage for that periodic progress payment.

13.4.4 Title.

13.4.4.1 Title to all material and Work covered by progress payments transfers to Owner upon payment.

13.4.4.2 Transfer of title to Owner does not: (a) relieve Contractor and its Subcontractors of the sole responsibility for the care and protection of materials and Work upon which payments have been made until final acceptance; (b) diminish the responsibility of Contractor and its Subcontractors to restore any damaged Work; or (c) waive the right of Owner to require the fulfillment of all the terms of the Contract.

13.4.5 Contracts with No Payment Bond. For a Contract in any amount less than $25,000.00, payment will be made in one lump sum at the Final Completion of the Work, including Punch list items and change orders.

13.4.6 No Release. Progress payments to Contractor do not release Contractor or its surety from any obligations under the Contract.

13.4.7 Documentation.

13.4.7.1 Upon Owner's request, Contractor shall furnish manifest proof of the status of Subcontractor's accounts in a form acceptable to Owner.

13.4.7.2 Pay estimate certificates must be signed by a corporate officer or a representative duly authorized by Contractor.

13.4.7.3 Provide copies of bills of lading, invoices, delivery receipts, or other evidence of the location and value of such materials in requesting payment for materials. For purposes of Tex. Gov't Code § 2251.021(a)(2), the date the performance of service is complete is the date when ODR approves the Application for Payment.

13.5 Time for Payment by Contractor: Pursuant to Tex. Gov't Code § 2251.023, upon Contractor's receipt of payment from Owner, Contractor shall pay Subcontractor the appropriate share of the payment not later than the tenth (10th) day after the date the Contractor receives the payment. The appropriate share is overdue on the eleventh (11th) day after the date Contactor receives the payment.

ARTICLE 14.
CHANGES

14.1 Change Orders. A Change Order issued after execution of the Contract is a written order to Contractor, signed by ODR, Contractor, and Design Professional, authorizing a change in the Work or an adjustment in the Contract Sum or the Contract Time. The Contract Sum and the Contract Time can only be changed by Change Order. A Change Order signed by Contractor indicates his agreement therewith, including the adjustment in the Contract Sum and/or the Contract Time. ODR may issue a written authorization for Contractor to proceed with Work of a Change Order in advance of final execution by all parties in accordance with the provisions herein or other Contract provisions.

Whenever Change Orders Requests to adjust the contract price become necessary, the Owner will have the right to select the method of pricing to be used by the Contractor among the following options: 1) lump sum Change Order; 2) unit price Change Order, or 3) cost plus fee Change Order.

14.1.1 Owner Ordered Changes. Owner, without invalidating the Contract and without approval of Contractor's Surety, may order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, and the Contract Sum and the Contract Time will be adjusted accordingly. All such changes in the Work shall be authorized by Change Order or Construction Change Directive, and shall be performed under the applicable conditions of the Contract Documents. If such changes cause an increase or decrease in Contractor's cost of, or time required for, performance of the Work, an adjustment to Contract Sum or Contract Time shall be made and authorized by a Change Order.

14.1.2 Corrections. It is recognized by the parties hereto and agreed by them that the Drawings and Specifications may not be complete or free from discrepancies, errors, omissions, or inconsistencies, or that they may require changes or additions in order for the Work to be completed to the satisfaction of Owner. Accordingly, it is the express intention of the parties, notwithstanding any other provisions in the Contract, that any discrepancies, errors, omissions, or inconsistencies in such Drawings and Specifications, or any changes in or additions to Drawings and Specifications or to the Work ordered by Owner and any

resulting delays in the Work or increases in Contractor's costs and expenses arising out of such discrepancies, errors, omissions, or inconsistencies shall not constitute or give rise to any claim, demand, or cause of action of any nature whatsoever in favor of Contractor, whether for breach of Contract, or otherwise. However, Contractor will be entitled to the time or sum stated to be due Contractor in any Change Order approved and signed by all parties, which shall constitute full compensation to Contractor for all costs, expenses, and damages to Contractor.

14.2 Lump Sum Change Order Request. Contractor will submit a properly itemized Lump Sum Change Order Request covering the additional work and/or the work to be deleted. This Request will be itemized for the various components of work and segregated by labor, material and equipment in a detailed format satisfactory to Owner. Owner will require itemized Change Orders on all Change Order Requests from Contractor, subcontractors and sub-subcontractors regardless of tier. Details to be submitted include detailed line item estimates showing detailed materials quantity take-offs, material prices by item, and related labor hour pricing information and extensions (by line item or by drawing as applicable).

14.2.1 Self-Performed Labor. Estimated labor costs to be included for self-performed work shall be based on the actual cost per hour paid by any Contractor (regardless of tier) for those workers or crews of workers who the Contractor reasonably anticipates will perform the Change Order work. Estimated labor hours shall include hours only for the worker and working foreman directly involved in performing the change order work. Supervision above the level of working foreman (such as general foreman, superintendent, project manager, etc.) is considered to be included in the markup percentages as outlined in the Contract. Note: No separate allowances for warranty or safety expenses will be allowed as a direct cost of a Change Order. Costs attributed to warranty expenses and safety expense will be considered to be covered by the markup percentage as outlined in the Contract.

14.2.2 Overhead and Profit. Overhead shall be considered to include insurance beyond the scope of Article 8, field and office supervisors and assistants, including safety and scheduling personnel, use of small tools, incidental job burdens, and general home office expenses. No separate allowance will be made.

14.2.3 Labor Burden. Labor burden allowable in Change Orders shall be defined as Contractor's net actual cost of payroll taxes (FICA, Medicare, SUTA, FUTA), net actual cost for Contractor's cost of union benefits (or other usual and customary fringe benefits if the employees are not union employees), and net actual cost to Contractor for worker's compensation insurance taking into consideration adjustments for experience modifiers, premium discounts, dividends, rebates, expense constants, assigned risk pool costs, net cost reductions due to policies with deductibles for self-insured losses, assigned risks rebates, etc. Contractor shall reduce their standard payroll tax percentages to properly reflect the effective cost reduction due to the estimated impact of the annual maximum wages subject to payroll taxes. (An estimated percentage for labor burden may be used for pricing change orders. However, the percentage used for labor burden to price change orders will be

examined at the conclusion of the project and an adjustment to the approved change orders will be processed if it is determined that the actual labor burden percentage should have been more or less than the estimated percentage used.)

14.2.3.1 Non-Reimbursable Labor Burden. Employee Stock Ownership Plan (ESOP) related to fringe benefit costs are specifically considered non-reimbursable labor burden and any ESOP costs are considered covered by the allowable change order markups to cover overhead and profit.

14.2.4 Material. Estimated material change order costs shall reflect Contractor's reasonably anticipated net actual cost for the purchase of the material needed for the change order work. Estimated material costs shall reflect cost reductions available to Contractor due to "non-cash" discounts, trade discounts, free material credits, and/or volume rebates. "Cash" discounts (i.e. prompt payment discounts of 1.5% or less) available on material purchased for change order work shall be credited to Owner if Contractor has provided Owner funds in time for Contractor to take advantage of any such "cash" discounts. Price quotations from material suppliers must be itemized with unit prices for each specific item to be purchased. "Lot pricing" quotations will not be considered sufficient substantiating detail.

14.2.5 Equipment. Allowable change order estimated costs may include appropriate amounts for rental of major equipment specifically needed to perform the change order work (defined as tools and equipment with an individual purchase order cost of more than $750). For Contractor owned equipment, the "bare" equipment rental rates allowed to be used for pricing change order proposals shall be 75% of the monthly rate listed in the most current publication of The AED Green Book divided by 173.3 to arrive at a maximum hourly rate to be applied to the hours the equipment is used performing the change order work. Further, for Contractor owned equipment the aggregate equipment rent charges for any signed piece of equipment used in all change order work shall be limited to 50% of the fair market value of the piece of equipment when the first change order is priced involving usage of the piece of equipment. Fuel necessary to operate the equipment will be considered a separate direct cost associated with the change order work.

14.2.6 Maximum Markup Percentage Allowable on Self-Performed Work. With respect to pricing change orders, the maximum markup percentage fee to be paid to any Contractor (regardless of tier) on self-performed work shall be a single markup percentage not-to-exceed fifteen percent (15%) of the net direct cost of 1) direct labor and allowable labor burden costs applicable to the change order or extra work 2) the net cost of material and installation equipment incorporated into the change or extra work, and 3) net rental cost of major equipment and related fuel costs necessary to complete the change in the work.

14.2.7 Maximum Markup Percentages Allowable on Work Performed by Subcontractors. With respect to pricing the portion of change order proposals involving work performed by Subcontractors, the maximum markup percentage fee allowable to the Contractor supervising the Subcontractor's work shall not exceed five percent (5%) of the net of all

approved change order work performed by all subcontractors combined for any particular Change Order Request.

14.2.8 GMP Limitation. For Contracts based on a GMP, the Construction Manager-at-Risk or Design Builder shall NOT be entitled to a percentage mark-up or additional fee on any Change Order Work unless the Change Order increases the GMP or if contingency funds are utilized. If the GMP increases or contingency funds are utilized, the Construction-Manager-at-Risk or Design Builder will be allowed additional fees at the rate specified in the Contract.

14.2.9 No Markup on Bonds and Liability Insurance Costs. Change Order cost adjustments due increases or decreases in bond or insurance costs (if applicable) shall not be subject to any markup percentage fee.

14.2.10 Direct and Indirect Costs Covered by Markup Percentages. As a further clarification, the agreed upon markup percentage fee is intended to cover the Contractor's profit and all indirect costs associated with the Change Order Work. Items intended to be covered by the markup percentage fee include, but are not limited to: home office expenses, branch office and field office overhead expense of any kind; project management; superintendents, general foremen; non-working foremen; estimating; engineering; coordinating; expediting; purchasing; detailing; legal; accounting; data processing or other administrative expenses; shop drawings; permits; auto insurance and umbrella insurance; pick-up truck costs; ESOP related costs; and warranty expense costs. The cost for the use of small tools is also to be considered covered by the markup percentage fee. Small tools shall be defined as tools and equipment (power or non-power) with an individual purchase cost of less than $750.

14.2.11 Deduct Change Orders and Net Deduct Changes. The application of the markup percentage referenced in the Contract will apply to both additive and deductive change orders. In the case of a deductive change order, the credit will be computed by applying the sliding scale percentages as outlined above so that a deductive change order would be computed in the same manner as an additive change order. In those instances where a change order involves but additive and deductive work, the additions and deductions will be netted and the markup percentage adjustments will be applied to the net amount.

14.2.12 Contingency. In no event will any lump sum or percentage amounts for "contingency" be allowed to be added as a separate line item in change order estimates. Unknowns attributed to labor hours will be accounted for when estimating labor hours anticipated to perform the work. Unknowns attributable to material scrap and waste will be estimated as part of the material costs.

14.3 Unit Price Change Order Requests. As an alternative to Lump Sum Change Order Request, the Owner or the Contractor acting with the approval of the Owner may choose the option to use Contract unit prices. Agreed upon Contract unit prices shall be the same for added quantities and deductive quantities. Unit prices are not required to be used for pricing change orders where other methods of pricing change order work are more equitable.

14.3 Cost Plus Change Order Requests. As an alternative to either Lump Sum Change Order Requests or Unit Price Change Order Requests, the Owner may elect to have any extra work performed on a cost plus markup percentage fee basis. Upon written notification, the Contractor shall perform such authorized extra work at actual cost for direct labor (working foreman, journeymen, apprentices, helpers, etc.), actual cost of labor burden, actual cost of material used to perform the extra work, and actual cost of rental of major equipment (without any charge for administration, clerical expense, general supervision or superintendent of any nature whatsoever, including general foremen, or the cost or rental of small tools, minor equipment, or plant) plus the approved markup percentage fee. The intent of this clause is to define allowable cost plus chargeable costs to be the same as those allowable when pricing Lump Sum Change Requests as outlined above. Owner and Contractor may agree in advance in writing on a maximum price for this work and Owner shall not be liable for any charge in excess of the maximum. Daily time sheets with names of all Contractor's employees working on the project will be required to be submitted to the Owner for both labor and equipment used by the Contractor for the time periods during which extra work is performed on a cost plus fee basis. Daily time sheets will break down the paid hours worked by the Contractor's employees showing both base contract work as well as extra work performed by each employee.

14.4 Job Order Unit Prices. Job Order unit prices as stated in the contract document or Change Order Request shall be based upon a regional RS Means Book or Gordian Group pricing.

14.5 Claims for Additional Costs.

14.5.1 Claim with no Requested Change. If Contractor wishes to make a claim for an increase in the Contract Sum not related to a requested change, Contractor shall give Owner and Design Professional written notice thereof within twenty-one (21) days after the occurrence of the event giving rise to such claim, but, in any case before proceeding to execute the Work considered to be additional cost or time, except in an emergency endangering life or property in which case Contractor shall act in accordance with Section 10.3. No such claim shall be valid unless so made. If Owner and Contractor cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined as set forth under Article 18. Any change in the Contract Sum resulting from such claim must be authorized by a Change Order.

14.5.2 Miscellaneous Claims. If Contractor claims that additional cost is involved because of, but not limited to: (1) any written interpretation of the Contract Documents; (2) any order by Owner to stop the Work pursuant to Article 17 where Contractor was not at fault; or (3) any written order for a minor change in the Work issued pursuant to Section 14.6, Contractor shall make such claim as provided in Section 14.5.1.

14.5.3 Failure to Notify. Should Contractor fail to call to the attention of Owner and Design Professional to discrepancies, errors, omissions, or inconsistencies in the Contract Documents, but claim additional costs for corrective Work after Contract award or after Owner's acceptance of Contractor's Construction Manager-at-Risk guaranteed maximum price, Owner may assume intent to circumvent competitive bidding for the necessary

corrective Work. In such case, Owner may choose to let a separate Contract for the corrective Work, or issue a CCD to require performance by Contractor. Claims for time extensions or for extra cost resulting from delayed notice of patent Contract Document discrepancies, errors, omissions, or inconsistencies will not be considered by Owner.

14.6 Minor Changes. Design Professional, with concurrence of OCM, will have authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time. Such changes shall be affected by written order which Contractor shall carry out promptly and record on as-built Record Documents.

14.7 Concealed Site Conditions. Contractor is responsible for visiting the Site and being familiar with local conditions such as the location, accessibility, and general character of the Site and/or building. If, in the performance of the Contract, subsurface, latent, or concealed conditions at the Site are found to be materially different from the information included in the Contract Documents, or if unknown conditions of an unusual nature are disclosed differing materially from the conditions usually inherent in Work of the character shown and specified, OCM and Design Professional shall be notified in writing of such conditions before they are disturbed. Upon such notice, or upon its own observation of such conditions, Design Professional, with the approval of ODR, will promptly make such changes in the Drawings and Specifications as deemed necessary to conform to the different conditions. Any increase or decrease in the cost of the Work, or in the time within which the Work is to be completed, resulting from such changes will be adjusted by Change Order.

14.8 Extension of Time. All changes to the Contract Time made as a consequence of requests as required in the UGC's, must be documented by Change Order.

14.9 Administration of Change Order Requests. All changes in the Contract shall be administered in accordance with procedures approved by Owner, and when required, make use of such electronic information management system(s) as Owner may employ.

14.9.1 Procedures.

14.9.1.1 Procedures for administration of Change Orders shall be established by Owner and stated in the Contract Documents.

14.9.1.2 No oral order, oral statement, or oral direction of Owner or his duly appointed representative shall be treated as a change under this article or entitle Contractor to an adjustment.

14.9.2 Routine Changes. Routine changes shall be formally initiated by Design Professional or Owner by means of a Proposal Request form detailing requirements of the proposed change for pricing by Contractor, or may be initiated by Contractor by means of a Change Order Request form detailing proposed work, pricing, and time. This action may be preceded by communications between Contractor, Design Professional, and OCM concerning the need and nature of the change, but such communications shall not constitute a basis for beginning the proposed Work by Contractor. Except for emergency conditions described

below, approval of Contractor's cost proposal by Design Professional and ODR will be required for authorization to proceed with the Work being changed. Owner will not be responsible for the cost of Work changed without prior approval and Contractor may be required to remove Work so installed.

14.9.3 Documentation. All proposed costs or time for Change Order Work must be supported by itemized accounting of material, equipment, and associated itemized installation costs in sufficient detail following the outline and organization of the established Schedule of Values, and be supported by documented impact to critical path activities, to permit analysis by Design Professional and ODR using current estimating guides and/or practices. Photocopies of Subcontractor and vendor proposals shall be furnished unless specifically waived by ODR. Contractor shall provide written response to a change request within twenty-one (21) days of receipt.

14.9.4 Emergencies. Emergency changes to save life or property may be initiated by Contractor alone with the claimed cost and/or time of such work to be fully documented as to necessity and detail of the reported costs and/or time.

14.9.5 Coordination with Schedule of Values. The method of incorporating approved Change Orders into the parameters of the accepted Schedule of Values must be coordinated and administered in a manner acceptable to Owner.

14.10 Construction Change Directive (CCD). Owner may issue a written CCD directing a change in the Work prior to reaching agreement with Contractor on the adjustment, if any, in the Contract Sum and/or the Contract Time. Owner retains sole discretion whether or not to issue any CCD. Owner's issuance of a CCD does not require Owner to issue subsequent Change Orders. Owner and Contractor shall negotiate for appropriate adjustments, as applicable, to the Contract Sum or the Contract Time arising out of a CCD. Contractor shall not submit its costs for CCD Work with its Application for Payment until a Change Order has been issued. The Parties reserve their rights as to the disputed amount, subject to Article 18.

14.11 Audit of Changes. All Change Orders are subject to audit by Owner or its representative at any time and Change Order amounts may be adjusted lower as a result of such audit.

ARTICLE 15.
PROJECT COMPLETION AND ACCEPTANCE

15.1 Closing Inspections.

15.1.1 Purpose of Inspection. Inspection is for determining the completion of the Work, and does not relieve Contractor of its overall responsibility for completing the Work in a good and competent fashion, in compliance with the Contract. Work accepted with incomplete Punch list items, or the failure of Owner or other parties to identify Work that does not comply with the Contract Documents or is defective in operation or workmanship, does

not constitute a waiver of Owner's rights under the Contract or relieve Contractor of its responsibility for performance or warranties.

15.1.2 Annotation. Any Certificate issued under this Article may be annotated to indicate that it is not applicable to specified portions of the Work, or that it is subject to any limitation as determined by Owner.

15.1.3 Substantial Completion Inspection. When Contractor considers the entire Work or part thereof Substantially Complete, it shall notify OCM in writing that the Work will be ready for Substantial Completion inspection on a specific date. Contractor shall include with this notice Contractor's Punch list to indicate that it has previously inspected all the Work associated with the request for inspection, noting items it has corrected and included all remaining work items with date scheduled for completion or correction prior to final inspection. The failure to include any items on this list does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents. If any of the items on this list prevents the Project from being used as intended, Contractor shall not request a Substantial Completion inspection. Owner and its representatives will review the list of items and schedule the requested inspection, or inform Contractor in writing that such an inspection is premature because the Work is not sufficiently advanced or conditions are not as represented on Contractor's list.

15.1.3.1 Prior to the Substantial Completion inspection, Contractor shall furnish a copy of its marked-up Record Documents and a preliminary copy of each instructional manual, maintenance and operating manual, parts catalog, wiring diagrams, spare parts, specified written warranties, and like publications or parts for all installed equipment, systems, and like items as described in the Contract Documents. Delivery of these items is a prerequisite for requesting the Substantial Completion inspection.

15.1.3.2 On the date requested by Contractor, or as mutually agreed upon pending the status of the Open Items List, Design Professional, OCM, Contractor, and other Owner representatives as determined by Owner will jointly attend the Substantial Completion inspection, which shall be conducted by OCM or Owner's representative. If Owner and Design Professional determines that the Work is Substantially Complete, Design Professional will issue a Certificate of Substantial Completion to be signed by Design Professional, Owner, and Contractor establishing the date of Substantial Completion and identifying responsibilities for security and maintenance. Design Professional will provide with this certificate a list of Punch list items (the pre-final Punch list) for completion prior to final inspection. This list may include items in addition to those on Contractor's Punch list, which the inspection team deems necessary to correct or complete prior to final inspection. If Owner occupies the Project upon determination of Substantial Completion, Contractor shall complete all corrective Work at the convenience of Owner, without disruption to Owner's use of the Project for its intended purposes.

15.1.4 Final Inspection. Contractor shall correct or complete all items on the final Punch list before requesting a Final Completion inspection and Final Payment. Unless otherwise agreed to in writing by the parties, Contractor shall complete this work within thirty (30) days of receiving the final Punch list. Upon completion of the final Punch list, Contractor shall notify Design Professional and OCM in writing stating the disposition of each final Punch list item. Design Professional, Owner, and Contractor shall promptly inspect the completed items. When the final Punch list is complete, and the Contract is fully satisfied according to the Contract Documents Design Professional will issue a certificate establishing the date of Final Completion. Completion of all Work is a condition precedent to Contractor's right to receive Final Payment.

15.1.5 Additional Inspections.

15.1.5.1 If Owner's inspection team determines that the Work is not Substantially Complete at the Substantial Completion inspection, Owner or Design Professional will give Contractor written notice listing cause(s) of the rejection. Contractor will set a time for completion of incomplete or defective work acceptable to Owner. Contractor shall complete or correct all work so designated prior to requesting a second Substantial Completion inspection. Owner's or Design Professional's failure to include items as causes of rejection does not constitute a waiver of Owner's right under the Contract or relieve Contractor of its responsibility for performance.

15.1.5.2 If Owner's inspection team determines that the Work is not complete at the Final Completion inspection, Owner or Design Professional will give Contractor written notice listing the cause(s) of the rejection. Contractor will set a time for completion of incomplete or defective work acceptable to Owner. Contractor shall complete or correct all Work so designated prior to again requesting a final inspection. Owner's or Design Professional's failure to include items as causes of rejection does not constitute a waiver of Owner's right under the Contract or relieve Contractor of its responsibility for performance.

15.1.5.3 The Contract contemplates three (3) comprehensive inspections: the Substantial Completion inspection, the Final Completion inspection, and the inspection of completed final Punch list items. The cost to Owner of additional inspections resulting from the Work not being ready for one or more of these inspections is the responsibility of Contractor. Owner may issue a CO deducting these costs from Final Payment. Upon Contractor's written request, Owner will furnish documentation of any costs so deducted. Work added to the Contract by Change Order after Substantial Completion inspection is not corrective Work for purposes of determining timely completion, or assessing the cost of additional inspections.

15.1.6 Phased Completion. The Contract may provide, or Project conditions may warrant, as determined by ODR, that designated elements or parts of the Work be completed in phases. Where phased completion is required or specifically agreed to by the parties, the provisions of the Contract related to closing inspections, occupancy, and acceptance apply independently to each designated element or part of the Work. For all other purposes, unless otherwise agreed by the parties in writing, Substantial Completion of the Work as a whole is the date on which the last element or part of the Work completed receives a Substantial Completion certificate. Final Completion of the Work as a whole is the date on which the last element or part of the Work completed receives a Final Completion certificate.

15.2 Owner's Right of Occupancy. Owner may occupy or use all or any portion of the Work following Substantial Completion, or at any earlier stage of completion. Should Owner wish to use or occupy the Work, or part thereof, prior to Substantial Completion, Owner will notify Contractor in writing and identify responsibilities for security and maintenance. Work performed on the premises by third parties on Owner's behalf does not constitute occupation or use of the Work by Owner for purposes of this Article. All Work performed by Contractor after occupancy, whether in part or in whole, shall be at the convenience of Owner so as to not disrupt Owner's use of, or access to, occupied areas of the Project.

15.3 Acceptance and Payment.

15.3.1 Request for Final Payment. Following the certified completion of all Work, including all final Punch list items, cleanup, and the delivery of Record Documents, Contractor shall submit a certified Application for Final Payment and include all sums held as retainage and forward to Design Professional and OCM for review and approval.

15.3.2 Final Payment Documentation. Contractor shall submit, prior to or with the Application for Final Payment, final copies of all Close-Out Documents, maintenance and operating instructions, guarantees and warranties, certificates, Record Documents, and all other items required by the Contract. Contractor shall submit evidence of return of access keys and cards, evidence of delivery to Owner of attic stock, spare parts, and other specified materials. Contractor shall submit consent of surety to Final Payment form and an affidavit that all payrolls, bills for materials and equipment, subcontracted work, and other indebtedness connected with the Work, except as specifically noted, are paid, will be paid after payment from Owner, or otherwise satisfied within the period of time required by Tex. Gov't Code, Chapter 2251. Contractor shall furnish documentation establishing payment or satisfaction of all such obligations, such as receipts, releases, and waivers of claims and liens arising out of the Contract. Contractor may not subsequently submit a claim on behalf of Subcontractor or vendor unless Contractor's affidavit notes that claim as an exception.

15.3.3 Design Professional Approval. Design Professional will review a submitted Application for Final Payment promptly but in no event later than ten (10) days after its receipt. Prior to the expiration of this deadline, Design Professional will either: 1) return the Application

for Final Payment to Contractor with corrections for action and resubmission; or 2) accept it, note approval, and send to Owner.

15.3.4 Offsets and Deductions. Owner may deduct from the Final Payment all sums due from Contractor. If the Certificate of Final Completion notes any Work remaining, incomplete, or defects not remedied, Owner may deduct the cost of remedying such deficiencies from the Final Payment. On such deductions, Owner will identify each deduction, the amount, and the explanation of the deduction on or by the twenty-first (21st) day after Owner's receipt of an approved Application for Final Payment. Such offsets and deductions shall be incorporated via a final Change Order, including a CCD as may be applicable.

15.3.5 Final Payment Due. Final Payment is due and payable by Owner, subject to all allowable offsets and deductions, on the thirtieth (30th) day following Owner's approval of the Application for Payment. If Contractor disputes any amount deducted by Owner, Contractor shall give notice of the dispute on or before the thirtieth (30th) day following receipt of Final Payment. Failure to do so will bar any subsequent claim for payment of amounts deducted.

15.3.6 Effect of Final Payment. Final Payment shall not constitute a waiver of claims by Owner relating to the condition of the Work including those arising from:

15.3.6.1 Faulty or defective Work appearing after Substantial Completion (latent defects);

15.3.6.2 Failure of the Work to comply with the requirements of the Contract Documents;

15.3.6.3 Terms of any warranties required by the Contract, or implied by law; or

15.3.6.4 Claims arising from personal injury or property damage to third parties.

15.3.7 Waiver of Claims. Acceptance of final payment constitutes a waiver of all claims and liens by Contractor except those specifically identified in writing and submitted to ODR prior to the application for Final Payment.

15.3.8 Effect on Warranty. Regardless of approval and issuance of Final Payment, the Contract is not deemed fully performed by Contractor and closed until the expiration of all warranty periods.

ARTICLE 16.
WARRANTY AND GUARANTEE

16.1 Contractor's General Warranty and Guarantee. Contractor warrants to Owner that all Work is executed in accordance with the Contract, complete in all parts and in accordance with approved practices and customs, and of the required finish and workmanship. Contractor further warrants

that unless otherwise specified, all materials and equipment incorporated in the Work under the Contract are new. Owner may, at its option, agree in writing to waive any failure of the Work to conform to the Contract, and to accept a reduction in the Contract Sum for the cost of repair or diminution in value of the Work by reason of such defect. Absent such a written agreement, Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute and is not waived by any inspection or observation, or lack thereof, by Owner, Design Professional, or others, by making any progress payment or final payment, by the use or occupancy of the Work or any portion thereof by Owner, at any time, or by any repair or correction of such defect made by Owner.

16.1.1 Warranty Period. Except as may be otherwise specified or agreed, Contractor shall repair all defects in materials, equipment, or workmanship appearing within one (1) year from the date of Substantial Completion of the Work. If Substantial Completion occurs by phase, the warranty period for that particular Work begins on the date of Substantial Completion of that phase, or as otherwise stipulated on the Certificate of Substantial Completion for that particular Work.

16.1.2 Limits on Warranty. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

16.1.2.1 Modification or improper maintenance or operation by persons other than Contractor, Subcontractors, or any other individual or entity for whom Contractor is not responsible, unless Owner is compelled to undertake maintenance or operation due to the neglect of Contractor.

16.1.2.2 Normal wear and tear under normal usage after acceptance of the Work by Owner.

16.1.3 Events Not Affecting Warranty. Contractor's obligation to perform and complete the Work in a good and workmanlike manner in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of defective Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

16.1.3.1 Observations, or lack thereof, by Owner and/or Design Professional;

16.1.3.2 Recommendation to pay any progress or final payment by Design Professional;

16.1.3.3 The issuance of a certificate of Substantial Completion or any payment by Owner to Contractor under the Contract Documents;

16.1.3.4 Use or occupancy of the Project or any part thereof by Owner;

16.1.3.5 Any acceptance by Owner or any failure to do so;

16.1.3.6 Any review by Owner of a Shop Drawing or sample submittal; or

16.1.3.7 Any inspection, test or approval by others.

16.2 Separate Warranties. If a particular piece of equipment or component of the Work for which the Contract requires a separate warranty is placed in continuous service before Substantial Completion, the warranty period for that equipment or component will not begin until Substantial Completion, regardless of any warranty agreements in place between suppliers and/or Subcontractors and Contractor. Contractor shall assume any duty to repair not otherwise covered by those warranty agreements. Owner will certify the date of service commencement in the Substantial Completion certificate.

16.2.1 Assumption. In addition to Contractor's warranty and duty to repair, Contractor expressly assumes all warranty obligations required under the Contract for specific building components, systems, and equipment.

16.2.2 Assignment. Contractor may satisfy any such obligation by obtaining and assigning to Owner a complying warranty from a manufacturer, supplier, or Subcontractor. Where an assigned warranty is tendered and accepted by Owner which does not fully comply with the requirements of the Contract, Contractor remains liable to Owner on all elements of the required warranty not provided by the assigned warranty.

16.3 Correction of Defects. Upon receipt of written notice from Owner, or any agent of Owner designated as responsible for management of the warranty period, of the discovery of a defect, Contractor shall promptly remedy the defect(s), and provide written notice to Owner and designated agent indicating action taken. In case of emergency where delay would cause serious risk of loss or damage to Owner, or if Contractor fails to remedy within thirty (30) days, or within another period agreed to in writing, Owner may correct the defect and be reimbursed the cost of remedying the defect from Contractor or its surety.

16.4 Certification of No Asbestos Containing Materials or Work. Contractor shall provide a notarized certification to Owner that all equipment and materials used in fulfillment of its Contract responsibilities are non-Asbestos Containing Building Materials (ACBM). This certification must be provided no later than Contractor's application for Final Payment. Contractor shall insure that Texas Department of State Health Services licensed individual, consultants or companies are used for any required asbestos work including asbestos inspection, asbestos abatement plans/specifications, asbestos abatement, asbestos project management and third-party asbestos monitoring.

16.5 Compliance with Acts. Contractor shall warrant and ensure compliance with the following Acts by Contractor or Contractor's Subcontractors and assigns:

- Asbestos Hazard Emergency Response Act (AHERA-40 CFR 763-99 (7));
- National Emission Standards for Hazardous Air Pollutants (NESHAP-EPA 40 CFR 61, Subpart M-National Emission Standard for Asbestos); and

- Texas Asbestos Health Protection Rules (TAHPR-Tex. Admin. Code Title 25, Part 1, Ch. 295C, Asbestos Health Protection)

ARTICLE 17.
SUSPENSION AND TERMINATION

17.1 Suspension of Work for Cause. Owner may, at any time without prior notice, suspend all or any part of the Work, if after reasonable observation and/or investigation, Owner determines it is necessary to do so to prevent or correct any condition of the Work, which constitutes an immediate safety hazard, or which may reasonably be expected to impair the integrity, usefulness, or longevity of the Work when completed.

17.1.1 Cease Work. Owner will give Contractor a written notice of suspension for cause, setting forth the reason for the suspension and identifying the Work suspended. Upon receipt of such notice, Contractor shall immediately stop the Work so identified.

17.1.2 Investigation. As soon as practicable following the issuance of such a notice, Owner will initiate and complete a further investigation of the circumstances giving rise to the suspension, and issue a written determination of the findings. Contractor shall cooperate with Owner's investigation.

17.1.3 Outcome. If it is confirmed that the cause was within the control of Contractor, Contractor will not be entitled to an extension of Contract Time or any compensation for delay resulting from the suspension. If the cause is determined not to have been within the control of Contractor, and the suspension has prevented Contractor from completing the Work within the Contract Time, the suspension shall be considered an Excusable Delay and an extension of Contract Time will be granted through a Change Order.

17.1.4 Time. Suspension of Work under this provision will be no longer than is reasonably necessary to investigate and remedy the conditions giving rise to the suspension.

17.2 Suspension of Work for Owner's Convenience. Upon seven (7) days written notice to Contractor, Owner may at any time without breach of the Contract suspend all or any portion of the Work for its own convenience. When such a suspension prevents Contractor from completing the Work within the Contract Time, it shall be considered an Excusable Delay. A notice of suspension for convenience may be modified by Owner at any time on seven (7) days written notice to Contractor. If Owner suspends the Work for its convenience for more than sixty (60) consecutive days, Contractor may elect to terminate the Contract pursuant to the provisions of the Contract.

17.3 Termination by Owner for Cause.

17.3.1 Cause. Upon written notice to Contractor and its surety, Owner may, without prejudice to any right or remedy, terminate the Contract and take possession of the Site and of all materials, equipment, tools, construction equipment, and machinery thereon owned by Contractor under any of the following circumstances:

17.3.1.1 Persistent or repeated failure or refusal, except during complete or partial suspensions of work authorized under the Contract, to supply enough properly skilled workmen or proper materials;

17.3.1.2 Persistent disregard of laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction, including Owner;

17.3.1.3 Persistent failure to prosecute the Work in accordance with the Contract, and to ensure its completion within the Contract Time;

17.3.1.4 Failure to remedy defective work;

17.3.1.5 Failure to pay Subcontractors, laborers, and material suppliers pursuant to Tex. Gov't Code, Chapter 2251;

17.3.1.6 Persistent endangerment to the safety of labor or of the Work;

17.3.1.7 Failure to supply or maintain statutory bonds or to maintain required insurance pursuant to the Contract;

17.3.1.8 Any material breach of the Contract; or

17.3.1.9 Contractor's insolvency, bankruptcy, or demonstrated financial inability to perform the Work.

17.3.2 No Waiver. Failure by Owner to exercise the right to terminate in any instance is not a waiver of the right to do so in any other instance.

17.3.3 Notice. Owner may immediately terminate the Contract under the provisions of this Section 17.3 upon written notice to Contractor and Contractor's sureties. Owner may also give notice to Contractor and Contractor's sureties of Owner's intent to terminate the Contract under the provisions of this Section 17.3 at any later date upon written notice to Contractor and its sureties.

17.3.4 Cure. Should Contractor or its surety, after having received notice of Owner's intent to terminate at a later date, demonstrate to the satisfaction of Owner that Contractor or its surety are proceeding to correct such default with diligence and promptness, upon which the notice of intent to terminate was based, the notice of intent to terminate may be rescinded in writing by Owner. If so rescinded, the Work may continue without an extension of Contract Time.

17.3.5 Failure to Cure. Should Contractor or its surety fail, after having received notice of Owner's intent to terminate, to commence and continue correction of such default with diligence and promptness to the satisfaction of Owner within the date specified by Owner, Owner may arrange for completion of the Work and deduct the cost of completion from the unpaid Contract Sum.

17.3.5.1 This amount includes the cost of additional Owner costs such as Design Professional services, other consultants, and contract administration.

17.3.5.2 Owner will make no further payment to Contractor or its surety unless the costs to complete the Work are less than the Contract balance, then the difference shall be paid to Contractor or its surety. If such costs exceed the unpaid balance, Contractor or its surety will pay the difference to Owner.

17.3.5.3 This obligation for payment survives the termination of the Contract.

17.3.5.4 Owner reserves the right in termination for cause to take assignment of all the Contracts between Contractor and its Subcontractors, vendors, and suppliers. Owner will promptly notify Contractor of the contracts Owner elects to assume. Upon receipt of such notice, Contractor shall promptly take all steps necessary to effect such assignment.

17.3.6 Conversion to Termination for Convenience. In the event that any termination of the Contract for cause under this Section 17.3 is later determined to have been improper, the termination shall automatically convert to a termination for convenience of Owner and Contractor's recovery for termination shall be strictly limited to the payments allowable under Subsection 17.4.3.

17.4 Termination for Convenience of Owner. Owner reserves the right, without breach, to terminate the Contract prior to, or during the performance of the Work, for any reason. Upon such an occurrence, the following shall apply:

17.4.1 Notice. Owner will immediately notify Contractor and Design Professional in writing, specifying the reason for and the effective date of the Contract termination. Such notice may also contain instructions necessary for the protection, storage, or decommissioning of incomplete Work or systems, and for safety.

17.4.2 Contractor Action. Upon receipt of the notice of termination, Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due at that point in the Contract:

17.4.2.1 Stop all work.

17.4.2.2 Place no further subcontracts or orders for materials or services.

17.4.2.3 Terminate all subcontracts for convenience.

17.4.2.4 Cancel all materials and equipment orders as applicable.

17.4.2.5 Take action that is necessary to protect and preserve all property related to the Contract which is in the possession of Contractor.

17.4.3 Contractor Remedy. When the Contract is terminated for Owner's convenience, Contractor may recover from Owner payment for all Work completed including the corresponding pro rata portion of Contractor's overhead and profit. Contractor may not claim lost profits on other work or lost business opportunities.

17.5 Termination by Contractor. If the Work is stopped for a period of ninety (90) days under an order of any court or other public authority having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, through no act or fault of Contractor or Subcontractor or their agents or employees or any other persons performing any of the Work under a contract with Contractor, then Contractor may, upon thirty (30) additional days written notice to ODR, terminate the Contract and recover from Owner payment for all Work completed including the corresponding pro rata portion of Contractor's overhead and profit, but not lost profits on other work or lost business opportunities. If the cause of the Work stoppage is removed prior to the end of the thirty (30) day notice period, Contractor may not terminate the Contract.

17.6 Settlement on Termination. When the Contract is terminated for any reason, at any time prior to one hundred eighty (180) days after the effective date of termination, Contractor shall submit a final termination settlement proposal to Owner based upon recoverable costs as provided under the Contract. If Contractor fails to submit the proposal within the time allowed, Owner may determine the amount due to Contractor because of the termination and pay the determined amount to Contractor as final payment.

ARTICLE 18.
DISPUTE RESOLUTION

18.1 Contracts Less Than $250,000. The dispute resolution process provided for in Texas Government Code, Chapter 2260, shall be used by Contractor or Design Professional to attempt to resolve any claim for breach of Contract made by Contractor or Design Professional that is not resolved under procedures described throughout the Uniform General Conditions or any Supplementary or Special Conditions of the Contract, *where the amount in controversy is less than $250,000*.

18.2 Contracts $250,000 or Greater. Contractor or Design Professional and Owner shall use the following dispute resolution process prior to initiating any litigation or filing suit in a court of competent jurisdiction.

18.2.1 Mediation. If a dispute arises out of or relates to the Contract or the breach thereof in which the amount in controversy is $250,000 or greater, and if the dispute cannot be settled through negotiation, the parties agree first to try to settle the dispute by mediation using the procedures specified in this section prior to the commencement of any legal action. The parties commit to participate in the proceedings in good faith with the intention of resolving the dispute if at all possible.

18.2.1.1 The party seeking to initiate mediation of a dispute shall give written notice to the other party describing the nature of the dispute, the initiating party's claim

for relief and identifying one or more individuals with authority to settle the dispute on such party's behalf. The party receiving such notice shall have five (5) business days to designate by written notice one or more individuals with authority to settle the dispute on such party's behalf.

18.2.1.2 The parties shall then have ten (10) business days to submit to each other a written list of acceptable qualified mediators not affiliated with any of the parties. The mediator shall possess the qualifications required under Civil Practice and Remedies Code, § 154.052, be subject to the standards and duties prescribed by Civil Practice and Remedies Code, §154.053, and have the qualified immunity prescribed by Civil Practice and Remedies Code, §154.055, if applicable. The parties shall mutually agree on the mediator.

18.2.1.3 In consultation with the mediator selected, the parties shall promptly designate a mutually convenient time and place for the mediation, and unless circumstances require otherwise, such time to be not later than forty-five (45) days after selection of the mediator.

18.2.1.4 The parties agree to participate in the mediation to its conclusion. The mediation shall be terminated (i) by the execution of a settlement agreement by the parties, (ii) by a declaration of the mediator that the mediation is terminated, or (iii) by a written declaration of a party to the effect that the mediation process is terminated at the conclusion of one (1) full day's mediation session. Even if the mediation is terminated without a resolution of the dispute, the parties agree not to terminate negotiations and not to commence any legal action or seek other remedies prior to the expiration of five (5) days following the mediation. Notwithstanding the foregoing, any party may commence litigation within such five (5) day period if litigation could be barred by an applicable statute of limitations or in order to request an injunction to prevent irreparable harm.

18.2.1.5 The parties shall share the cost of the mediation process equally although each party's attorneys and witnesses or specialists are the direct responsibility of each party and their fees and expenses shall be the responsibility of the individual parties.

18.2.1.6 The entire mediation process is confidential, and no stenographic, visual or audio record shall be made. All conduct, statements, promises, offers, views and opinions, whether oral or written, made in the course of the mediation by any party, their agents, employees, representatives or other invitees and by the mediator are confidential and shall, in addition and where appropriate, be deemed to be privileged and shall not be discoverable or admissible for any purpose, including impeachment, in any litigation or other proceeding involving the parties.

18.3 Owner Retained Rights. Nothing herein shall hinder, prevent, or be construed as a waiver of Owner's right to seek redress on any disputed matter in a court of competent jurisdiction.

18.4 No Waiver. Except as may be expressly and specifically provided otherwise by Chapter 114, Texas Civil Practice & Remedies Code, nothing herein shall be construed as a waiver of sovereign immunity; nor constitute or be construed as a waiver of any of the privileges, rights, defenses, remedies, or immunities available to the State of Texas or the University of North Texas System.

18.5 No Attorney's Fees. In any litigation between Owner and Contractor or Design Professional arising from the Contract or Project, neither party will be entitled to an award of legal fees or costs in any judgment regardless of which is deemed the prevailing party.

18.6 Interest. Owner shall be billed in accordance with Chapter 2251 of Texas Government Code and interest, if any, on past due payments shall accrue and be paid in accordance with 2251 of the Texas Government Code.

ARTICLE 19.
MISCELLANEOUS

19.1 Right to Audit. Owner, or any of its duly authorized auditors or representatives including the State Auditor's Office, shall during regular business hours and upon reasonable notice have access to and the right to examine, and be permitted to audit and copy, any directly pertinent books, documents, papers, and records of Contractor, including, without limitation, complete documentation supporting accounting entries, books, correspondence, instructions, drawings, receipts, subcontracts, Subcontractor's quotes, proposals, purchase order, vouchers, memoranda, schedules, electronic data, pictures, videos, logs, minutes, notes, reports and other data relating to the Project. Further, Contractor or Design Professional agree to include in all subcontracts a provision to the effect that Subcontractor agrees that Owner or any of its duly authorized representatives shall have access to and the right to examine any directly pertinent books, documents, papers, and records of such Subcontractor relating to any claim arising from the Contract and subcontract, whether or not the Subcontractor is a party to the claim. The period of access and examination described herein shall continue until the later of seven (7) years after Final Payment or final disposition of any disputes, claims, litigation, or appeals arising out of the Contract.

19.2 Records and Inspection. Owner's representatives may (without limitation) conduct verifications such as counting employees at the construction site, witnessing the distribution of payroll, verifying information and amounts through interviews and written confirmations with Contractor employees, Subcontractors and vendors. Contractor's "records" as referred to in this contract shall include any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase orders, leases contracts, commitments, arrangements, notes, daily diaries, emails, superintendent reports, drawings, receipts, vouchers and memoranda and any and all other agreements, sources of information and matters that may in the Owner's judgment have any bearing on or pertain to

any matters, rights, duties or obligations under or covered by any Contract Documents. Such records shall include written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, negotiation notes, etc.); original bid estimates; estimating work sheets; correspondence; change order files (including documentation; invoices and related payment documentation; general ledger, information detailing cash and trade discounts earned, insurance rebates and dividends; and any other contractor records which may have a bearing on matters of interest to the Owner in connection with the contractor's dealings with the Owner (all foregoing hereinafter referred to as "records" to the extent necessary to adequately permit evaluation and verification of any or all of the following:

19.2.1 Deliverables: Compliance with contract requirements for deliverables

19.2.2 Plans and Specifications: Compliance with approved plans and specifications

19.2.3 Ethics Expectations: Compliance with Owner's business ethics expectations

19.2.4 Change Order Pricing: Compliance with contract provisions regarding the pricing of Change Orders

19.2.5 Invoice Accuracy: Accuracy of Contractor representations regarding the pricing of invoices

19.2.6 Claims: Accuracy of Contractor representations related to claims submitted by the Contractor or any of his payees.

19.3 Audit of Subcontractor: Contractor shall require all payees receiving $10,000 or more in connection with this contract to comply with the audit requirements herein by including the requirements hereof in a written contract agreement.

19.4 Overpricing or Overcharges: If an audit inspection or examination discloses overpricing or overcharges to the Owner (of any nature) by the Contractor and/or Subcontractors in excess of $100,000, in addition to adjusting for overcharges, the reasonable actual cost of the Owner's audit shall be reimbursed to the Owner by Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of Contractor's records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of Owner's finding to Contractor.

19.5 Documentation Requirements: In addition to the normal paperwork documentation the Contractor typically furnishes to the Owner, in order to facilitate efficient use of Owner resources when reviewing and/or auditing the Contractor's billings and related reimbursable cost records, Contractor agrees to furnish upon request the following types of information in the specified computer (PC) readable file format(s), as applicable:

Type of Record	PC Readable File Format
Monthly Job Cost Detail	.pdf and Excel
Detailed Job Cost History To Date	.pdf and Excel
Monthly Labor Distribution Detail (if not already separately detailed in the Job Cost Detail)	.pdf and Excel
Total Job To Date Labor Distribution Detail (if not already separately detailed in the Job Cost History To Date)	.pdf and Excel
Employee Timesheets Documenting Time Worked By All Individuals Who Charge Reimbursable Time To The Project	.pdf
Daily Foreman Reports Listing Names And Hours And Tasks Of Personnel Who Worked On The Project	.pdf
Daily Superintendent Reports	.pdf
Detailed Subcontract Status Reports (showing original subcontract value, approved subcontract change orders, subcontractor invoices, payments to subcontractors, etc.)	.pdf and Excel
Copies Of Executed Subcontracts With All Subcontractors	.pdf
Copies Of All Executed Change Orders Issued To Subcontractors	.pdf
Copies Of All Documentation Supporting All Reimbursable Job Costs (subcontractor payment applications, vendor invoices, internal cost charges, etc.)	.pdf

19.6 Supplementary or Special Conditions. When the Work contemplated by Owner is of such a character that the foregoing Uniform General Conditions of the Contract cannot adequately cover necessary and additional contractual relationships, the Contract may include Supplementary General or Special Conditions as described below:

19.6.1 Supplementary Conditions. Supplementary Conditions may describe the standard procedures and requirements of contract administration. Supplementary Conditions may expand upon matters covered by the Uniform General Conditions, where necessary, provided the expansion does not weaken the character or intent of the Uniform General

Conditions. Supplementary Conditions are of such a character that it is to be anticipated that Owner may normally use the same, or similar, conditions to supplement each of its several projects.

19.6.2 Special Conditions. Special Conditions shall relate to a particular Project and be unique to that Project but shall not weaken the character or intent of the Uniform General Conditions.

19.7 Federally Funded Projects. On federally funded projects, Owner may waive, suspend, or modify any provision in these Uniform General Conditions which conflicts with any federal statue, rule, regulation, or procedure, where such waiver, suspension, or modification is essential to receipt by Owner of such federal funds for the Project. In the case of any Project wholly financed by federal funds, any standards required by the enabling federal statute, or any federal rules, regulations, or procedures adopted pursuant thereto, shall be controlling.

19.8 Internet-based Project Management Systems. At its option, Owner may administer its design and construction management through an Internet-based management system. In such cases, Contractor shall conduct communication through this media and perform all Project related functions utilizing this database system. This includes correspondence, submittals, Requests for Information, vouchers, or payment requests and processing, amendment, Change Orders, and other administrative activities.

19.8.1 Accessibility and Administration.

19.8.1.1 When used, Owner will make the software accessible via the Internet to all Project team members.

19.8.1.2 Owner shall administer the software.

19.8.2 Training. When used, Owner shall provide training to the Project team members.

19.9 Computation of Time. In computing any time period set forth in this Contract, the first day of the period shall not be included, but the last day shall be.

19.10 Survival of Obligations. All representations, indemnifications, warranties and guarantees made in accordance with the Contract Documents will survive final payment, completion and acceptance of the Work, as well as termination for any reason. All duties imposed upon the Contractor by reason of termination, including without limitation the duty to assign subcontracts and contracts with vendors and suppliers, shall likewise survive the termination of the Contract.

19.11 No Waiver of Performance. The failure of either party in any instance to insist on the performance of any of the terms, covenants or conditions of the Contract Documents, or to exercise any of the rights granted thereunder, shall not be construed as waiver of any such term, covenant, condition or right with respect to further performance.

19.12 Governing Law and Venue. The Contract shall be governed by the laws of the State of Texas. Venue for any suit arising from the Contract will be in a court of competent jurisdiction subject to

the mandatory venue statute set forth in § 105.151 of the Texas Education Code, or if mandatory venue is not applicable in the county in which the Project is located.

19.13 Captions and Catch Lines. The captions and catch lines used throughout the Uniform General Conditions and elsewhere in the Contract Documents are for ease of reference only and have no effect on the meaning of the terms and conditions set forth herein.

19.14 Independent Contractor Status. The Contract Documents create an independent contractor relationship between the Owner and Contractor and neither party's employees or contractors shall be considered employees, contractors, partners or agents of the other party.

19.15 No Third-Party Beneficiaries. The parties do not intend, nor shall any clause be interpreted to create in any third party, any obligations to, or right of benefit by, such third party under these Contract Documents from either the Owner or Contractor.

19.16 Child Support Obligor. Notwithstanding anything to the contrary within the Contract Documents, it is understood and agreed between the parties that in accordance with the laws of the State of Texas, a child support obligor who is more than thirty (30) days delinquent in paying child support, and a business entity in which an obligor is a sole proprietor, partner, shareholder, or owner with an ownership interest of at least twenty-five percent (25%), is not eligible to receive payments from state funds under a contract to provide property, materials or services until all arrearages have been paid or the obligor is in compliance with a written repayment agreement.

19.17 Buy America Requirements for Iron and Steel Used in Construction. In accordance with Texas Government Code 2252, Section 2252.202, all iron or steel products (i.e., rolled structural shapes including wide flange beams and columns, angles, bars, plates, sheets, hollow structural sections, pipe, etc.) shall be produced, manufactured and fabricated in the United States.

19.18 No Assignment. This Contract may not be assigned by either party without the prior written consent of the other, except either party may, upon notice to the other party but without the other party's consent, assign this Contract to a present or future affiliate or successor, provided that any such assignment by Contractor shall be contingent on Owner's determination that the assignee is qualified to perform the Work, is in good standing with the State of Texas and otherwise eligible to do business with the State of Texas.

19.19 Severability. If any provision, sentence, clause or article of this Contract is found to be invalid or unenforceable for any reason, the remaining provisions shall continue in effect as if the invalid or unenforceable provision were not in the Contract. All provisions, sentences, clauses and articles of this Contract are severable for this purpose.

19.20 Parties Bound. Execution of this Contract by each party binds the entity represented as well as its employees, agents, successors and assigns to its faithful performance.

19.21 Public Information. Owner shall release information to the extent required by the Texas Public Information Act and other applicable law. If requested, Contractor shall make public information available to Owner in an electronic format.

19.22 Business Ethics Expectations

19.22.1 Contractor: During the course of pursuing contracts with the Owner and while performing the Work in accordance with the Contract, Contractor agrees to maintain business ethics standards aimed at avoiding any impropriety or conflict of interest which could be construed to have an adverse impact on the Owner's best interests

19.22.2 Reasonable Action: Contractor shall take reasonable actions to prevent any actions or conditions which could result in a conflict with the Owners' best interests. These obligations shall apply to the activities of Contractor employees, agents, subcontractors, subcontractor employees, consultants of Contractor, etc.

19.22.3 Gifts and Other Considerations: Contractor and its employees, agents, subcontractors, and material suppliers (or their representatives) should not make or cause to be made any cash payments, commissions, employment, gifts, entertainment, free travel, loans free work, substantially discounted work, or any other considerations to the Owner's representatives, employees or their relatives.

19.22.4 Subcontractors: Contractor and its employees, agents or subcontractors (or their relatives) should not receive any cash payments, commissions, employment, gifts, entertainment, free travel, loans, free work, or substantially discounted work or any other considerations from subcontractors, or material suppliers or any other individuals, organizations, or businesses receiving funds in connection with the Project.

19.22.5 Other Jobs: Contractor shall not receive the benefit of discounted bids or reduced payments on other jobs as an offset to bids, base subcontracts, and/or change orders on the Project.

19.22.6 Owner Notification: It is expected that the ODR be notified as soon as possible whenever anyone aware of these business ethics expectations believes there has been a failure to comply with the provisions herein or an attempt to have someone violate the business ethics expectations.

- Notifications may be made anonymously.
- Contractor representatives and/or subcontractor representatives familiar with the Project shall provide upon request a Certified Management Representation Letter in a form agreeable to the Owner stating that they are not aware of any situations violating the business ethics expectations outlined herein or any similar potential conflict of interest situations in connection with the Project.

19.22.7 Subcontractor Contracts: Contractor agrees to include the Business Ethics Expectation clause in all contracts with Subcontractors, subconsultants and material suppliers receiving more than $10,000 in funds in connection with the Project.

19.22.8 Interviews and Audits: Contractor and any other third party receiving more than $10,000 in connection with the Project shall permit interviews of employees and audits of its records by ODR to evaluate compliance with business ethics expectations. Such reviews and audits

will encompass all dealings and activities of Contractor's employees, agents, representatives, vendors, subcontractors, and other third parties paid by Contractor.

19.23 Entire Agreement. The Contract Documents supersede in full all prior discussions and agreements (oral and written) between the parties relating to the subject matter hereof and constitute the entire agreement.

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SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

1.2 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators 2021.

B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 104 degrees F environment.
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

C. Wiring Terminations:
1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.2 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.4 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.5 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class F.

F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

G. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe sleeves.

B. Manufactured sleeve-seal systems.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

1.3 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) 2022a.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

1.4 SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

A. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor.
   2. Provide sealant for watertight joint.
   3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
   4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

B. Pipe Passing Through Below Grade Exterior Walls:
   1. Zinc coated or cast iron pipe.
   2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

C. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

D. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

2.2 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.
   3. Elastomer element size and material in accordance with manufacturer's recommendations.
   4. Glass reinforced plastic pressure end plates.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Provide sleeves when penetrating footings, floors, walls, partitions, and roofs. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
   2. Aboveground Piping:
      a. Pack solid using mineral fiber complying with ASTM C592.
      b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
   3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
   4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

E. Manufactured Sleeve-Seal Systems:
   1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   3. Locate piping in center of sleeve or penetration.
   4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
   5. Tighten bolting for a water-tight seal.
   6. Install in accordance with manufacturer's recommendations.

F. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

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SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

1.2 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments 2022.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014 (Reapproved 2020).

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014 (Reapproved 2021).

D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

A. Manufacturers:
1. AMETEK, Inc.; U.S. Gauge.
2. Ashcroft Inc.
3. Dwyer Instruments, Inc.
4. Flo Fab Inc.
5. Miljoco Corporation.
6. Palmer Wahl Instrument Corporation.
7. Tel-Tru Manufacturing Company.
8. Trerice, H.O. Compnay.
9. Watts Regulator.
10. Weiss Instruments, Inc.
11. Winters Instruments.

B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: Steel with brass bourdon tube.
2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi and kPa.

2.2 PRESSURE GAUGE TAPPINGS

A. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

B. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc.
2. Flo Fab Inc.
3. Palmer Wahl Instrument Company.
4. Tel-Tru Manufacturing Company.
5. Trerice, H.O. Company.
6. Weiss Instruments, Inc.
7. Winters Instruments.

B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: In inch length to suit installation; aluminum.
4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.

C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.5 TEST PLUGS

A. Manufacturers:
1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Trerice, H.O. Company.
6. Watts Regulator Company.
7. Weiss Instruments.

B. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gauges in steam systems.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

F. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 SCHEDULES

A. Pressure Gauges, Scale Range: 0 to 100 psi.

B. Stem Type Thermometers, Scale Range: 30 to 200 deg. F.

END OF SECTION

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SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Applications.
B. Ball valves.
C. Butterfly valves.
D. Check valves.
E. Gate valves.
F. Chainwheels.

1.2 RELATED REQUIREMENTS

A. Section 22 07 19 - Plumbing Piping Insulation.
B. Section 22 10 05 - Plumbing Piping.

1.3 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Non-rising stem.
E. OS&Y: Outside screw and yoke.
F. PTFE: Polytetrafluoroethylene.
G. RS: Rising stem.
H. SWP: Steam working pressure.
I. TFE: Tetrafluoroethylene.
J. WOG: Water, oil, and gas.

1.4 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
E. ASME B31.9 - Building Services Piping 2020.
F. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2019).
G. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).
H. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.
I. MSS SP-45 - Drain and Bypass Connections 2020.

J. MSS SP-67 - Butterfly Valves 2022.

K. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends 2011.

L. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends 2018.

M. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.

N. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .

O. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.

P. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.5 SUBMITTALS

A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.6 QUALITY ASSURANCE

A. Manufacturer:
1. Obtain valves for each valve type from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Provide the following valves for the applications if not indicated on drawings:
1. Shutoff: Ball, butterfly, gate.
2. Swing Check (Pump Outlet):
a. 2 NPS and Smaller: Bronze swing check valves with bronze disc.
b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, metal seat check valves.

B. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

C. Required Valve End Connections for Non-Wafer Types:
1. Copper Tube:
a. 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

c. 5 NPS and Larger: Grooved or flanged ends.

2.2 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
1. Handwheel: Valves other than quarter-turn types.
2. Hand Lever: Quarter-turn valves 6 NPS and smaller.
3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.

E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.

F. General ASME Compliance:
1. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Valve Bypass and Drain Connections: MSS SP-45.

I. Source Limitations: Obtain each valve type from a single manufacturer.

2.3 BRONZE, BALL VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. One Piece, Reduced Port with Bronze Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 400 psig.
3. CWP Rating: 600 psig.
4. Body: Bronze.
5. Ends: Press.
6. Seats: PTFE.

C. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged bronze or dezincified-brass alloy.

5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel vented.
9. Manufacturers:
   a. Apollo Flow Controls; Conbraco Industries.
   b. Crane; Crane Energy Flow Solution.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO Inc.
   f. Watts.

2.4 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug Style: Bi-directional dead-end service without use of downstream flange.
   1. Comply with MSS SP-67, Type I.
   2. CWP Rating: 200 psig.
   3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
   4. Stem: One or two-piece stainless steel.
   5. Seat: EPDM.
   6. Disc: Stainless steel.
   7. Manufacturers:
      a. Conabraco Industries, Inc.; Apollo Valves.
      b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
      c. Crane Co.; Crane Valve Group; Jenkins Valves or Stockham Division.
      d. Hammond Valve.
      e. Kitz Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO Inc.
      h. Red-White Valve Corporation.
      i. Tyco Valves & Controls; a unit of Tyco Flow Control.
      j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2.5 BRONZE, SWING CHECK VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125: CWP Rating: 200 psig (1380 kPa).
   1. Comply with MSS SP-80, Type 3.
   2. Design: Y-pattern, horizontal or vertical flow.
   3. Body: Bronze, ASTM B62.
   4. Ends: Threaded.
   5. Disc: Bronze.
   6. Manufacturers:
      a. American Valve, Inc.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Milwaukee Valve Company.
      d. NIBCO Inc.
      e. Red-White Valve Corporation.

2.6 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125 with Lever and Weight-Closure Control.
   1. Comply with MSS SP-71, Type I.
   2. Description:
      a. CWP Rating: 200 psig.
      b. Design: Clear or full waterway.
      c. Body: ASTM A126, gray iron with bolted bonnet.
      d. Ends: Flanged as indicated.
      e. Trim: Bronze.
      f. Gasket: Asbestos free.
      g. Closer Control: Factory installed, exterior lever, and weight.
   3. Manufacturers:
      a. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves and Stockham Division.
      b. Grinnel Corporation.
      c. Hammond Valve.
      d. Milwaukee Valve Company.
      e. Mueller Company.
      f. NIBCO Inc.
      g. Watts Industries.

2.7 IRON, GATE VALVES

A. NRS or OS & Y:
   1. Comply with MSS SP-70, Type I.
   2. Class 125: CWP Rating: 200 psig:.
   3. Body: ASTM A126, gray iron with bolted bonnet.
   4. Ends: Flanged.
   5. Trim: Bronze.
   6. Disc: Solid wedge.
   7. Packing and Gasket: Asbestos free.
   8. Manufacturers:
      a. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves, or Stockham Division.
      b. Flo Fab Inc.
      c. Hammond Valve.
      d. Kitz Corporation.
      e. Legend Valve.
      f. Milwaukee Valve Company.
      g. NIBCO Inc.
      h. Watts Regulator Company.

2.8 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Attachment: For connection to ball and butterfly valve stems.
   2. Sprocket Rim with Chain Guides: Ductile iron. Include zinc coating.
   3. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

B. Manufacturers:
   1. Babbit Steam Specialty Company.
   2. Roto Hammer Industries.
   3. Trumbull Industries.

PART 3 EXECUTION

3.1 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Swing Check: Install horizontal maintaining hinge pin level.

E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing work.

1.2 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

E. MFMA-4 - Metal Framing Standards Publication 2004.

F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems:
   1. Manufacturers:
      a. Cooper B-Line, a division of Eaton Corporation.
      b. Power-Strut Div.; Tyco International Ltd.
      c. Thomas & Betts Corporation.
      d. Tolco, Inc.
      e. Unistrut, a brand of Atkore International Inc.
   2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   3. Comply with MFMA-4.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
      c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
      d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:
   1. General Construction and Requirements:
      a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
      b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
      c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
      d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.

E. Anchors and Fasteners:
   1. Manufacturers - Mechanical Anchors:
      a. B-Line Systems, Inc.; a division of Cooper Industries.
      b. Empire Industries.
      c. Hilti, Inc.
      d. ITW Red Head, a division of Illinois Tool Works, Inc.
      e. Powers Fasteners, Inc.
      f. Simpson Strong-Tie Company Inc.
   2. Manufacturers - Powder-Actuated Fastening Systems:
      a. Hilti, Inc.
      b. ITW Ramset, a division of Illinois Tool Works, Inc.
      c. Masterset Fastening Systems, Inc.
      d. Powers Fasteners, Inc.
      e. Simpson Strong-Tie Company Inc.
   3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
   4. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

H. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Secure fasteners according to manufacturer's recommended torque settings.

J. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Pipe markers.
D. Ceiling tacks.

1.2 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

1.3 SUBMITTALS

A. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
B. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Piping: Pipe markers.
B. Tanks: Nameplates.
C. Valves: Tags and ceiling tacks where located above lay-in ceiling.
D. Water Treatment Devices: Nameplates.
E. Water Heaters and All Other Plumbing Equipment: Nameplates.

2.2 NAMEPLATES

A. Minimum Size: Lenght and width vary for required label content, but not less than 2-1/2 inch by 1 inch.
B. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.
   4. Plastic: Comply with ASTM D709.
C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is identified (plans, details, and schedules), plus the specification number and title where the equipment is specified.

2.3 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.4 PIPE MARKERS

A. Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Label Contents: Include identification of piping system service using same designations as used on the 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 a separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: 1-1/2 inch minimum.

2.5 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Plumbing Valves: Green.
   4. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

F. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Piping insulation for supplies and drains for handicap-accessible lavatories and sinks.

C. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019, with Editorial Revision (2023).

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2019).

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2023.

F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.

G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

J. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

K. ICC A117.1 - Supply and Drain Protective Shield Covers.

L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER

A. Manufacturers:
1. CertainTeed Corporation.
2. Johns Manville Corporation.
3. Knauf Insulation.
4. Owens Corning Corporation.
5. Manson Insulation Inc.; Alley-K.
6. Owens Corning Corporation.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
1. Aeroflex USA, Inc.
2. Armacell LLC.
3. K-Flex USA LLC.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

2.4 JACKETS

A. PVC Plastic.
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
   1. Manufacturers:
      a. Engineered Brass Company.
      b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
      c. McGuire Manufacturing.
      d. Plumberex.
      e. Truebro; a brand of IPS Corporation.
      f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
   2. Description: Manufactured plastic wraps for covering plumbing fixture hot and cold water supplies, trap, and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
   3. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
      a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
      b. Comply with ICC A117.1.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES

A. Plumbing Systems:
1. Domestic Cold Water:
   a. Pipe Size Range: All Sizes
      1) Type: Glass Fiber
      2) Thickness: 1 inch
2. Domestic Hot and Recirculated Water:
   a. Pipe Size Range: NPS 1-1/4 and smaller
      1) Type: Glass Fiber
      2) Thickness: 1 inch
   b. Pipe Size Range: NPS 1-1/2 and larger
      1) Type: Glass Fiber
      2) Thickness: 1-1/2 inch
3. Roof Drain and Overflow Drain Bodies:
   a. Pipe Size Range: All Sizes
      1) Type: Glass Fiber
      2) Thickness: 1 inch
4. Stormwater and Overflow:
   a. Pipe Size Range: All Sizes
      1) Type: Glass Fiber
      2) Thickness: 1 inch
5. Condensate Piping from HVAC Systems:
   a. Pipe Size Range: All Sizes
      1) Type: Glass Fiber or Flexible Elastomeric
      2) Thickness: 1 inch

END OF SECTION

SECTION 22 10 05 - PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sanitary waste piping, buried within 5 feet of building.

B. Sanitary waste piping, above grade.

C. Domestic water piping, buried within 5 feet of building.

D. Storm drainage piping, buried within 5 feet of building.
   1. Storm drainage piping, above grade.
   2. Natural gas piping, buried within 5 feet of building.
   3. Piping for HVAC condensate.
   4. Natural gas piping, above grade.
   5. Pipe hangers and supports.

1.2 RELATED REQUIREMENTS

A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

1.3 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.

D. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV 2021.

E. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV 2017.

F. ASME B31.1 - Power Piping 2022.

G. ASME B31.9 - Building Services Piping 2020.

H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

I. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings 2021.

J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2023.

L. ASTM B32 - Standard Specification for Solder Metal 2020.

M. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes 2020.

N. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.

O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

P. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV) 2020.

Q. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube 2016.

R. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings 2016.

S. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings 2020a.

T. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems 2020.

U. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings 2020.

V. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.

W. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2021.

X. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

Y. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing 2023.

Z. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems 2023.

AA. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing 2023a.

BB. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2021.

CC. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2020.

DD. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

EE. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.

FF. NSF 372 - Drinking Water System Components - Lead Content 2022.

GG. PPI TR-4 - PPI HSB Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe 2021.

HH. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.2 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.
1. Fittings: Cast iron.
2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless.
1. Fittings: Cast iron.
2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

C. PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.3 SANITARY WASTE PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.
1. Fittings: Cast iron.
2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. Copper Tube: ASTM B306, DWV.
1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, sovent.
2. Joints: ASTM B32, alloy Sn50 solder.

D. PVC Pipe: ASTM D2665.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.
3. PVC piping installed in return air plenums shall be wrapped to meet ASTM E84 25/50 rating or shall be manufactured to meet applicable ratings to be installed in plenums.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, annealed.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.

B. Cross-Linked Polyethylene (PEX-a) Pipe: ASTM F876 or ASTM F877.
1. PPI TR-4 Pressure Design Basis:
   a. 160 psig at maximum 73 degrees F.
   b. 100 psig at maximum 180 degrees F.
   c. 80 psig at maximum 200 degrees F.
2. Fittings: Brass and copper.
3. Joints: ASTM F1960 cold-expansion fittings.

2.5 **DOMESTIC WATER PIPING, ABOVE GRADE, AND PIPING FOR HVAC CONDENSATE**

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.
3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
   a. Manufacturers:
      1) Elkhart Products Corporation.
      2) Grinnell Products, a Tyco Business.
      3) NIBCO Inc.

B. Cross-Linked Polyethylene (PEX-a) Pipe: ASTM F876 or ASTM F877.
1. PPI TR-4 Pressure Design Basis:
   a. 160 psig at maximum 73 degrees F.
   b. 100 psig at maximum 180 degrees F.
   c. 80 psig at maximum 200 degrees F.
2. Fittings: Brass and copper.
3. Joints: ASTM F1960 cold-expansion fittings.

2.6 STORM DRAINAGE PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.
2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.7 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

2.8 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
2. Joints: Threaded or welded to ASME B31.1.

2.9 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.
5. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
   a. Bases: High-density polypropylene.
   b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   d. Attachment and Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
   e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
   2. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
   3. Wall Support for Pipe Sizes to 3 inch: Cast iron hook.
   4. Wall Support for Pipe Sizes 4 inch and Over: Welded steel bracket and wrought steel clamp.

C. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
   2. Hangers for Cold Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
   3. Hangers for Hot Pipe Sizes 2 to 4 inch: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 6 inch and Larger: Adjustable steel yoke, cast iron pipe roll, double hanger.
   5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

C. Provide access where valves and fittings are not exposed.

D. Install valves with stems upright or horizontal, not inverted. See Section 22 05 23.

E. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

F. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

G. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as indicated.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   8. Provide copper plated hangers and supports for copper piping.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings.

Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed, and clean.

3.4 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
   1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
   2. Provide 18 gauge, 0.0478-inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.5 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe Size: 1/2 inch to 1-1/4 inch:
         1) Maximum Hanger Spacing: 6.5 ft.
         2) Hanger Rod Diameter: 3/8 inches.
      b. Pipe Size: 1-1/2 inch to 2 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 3/8 inch.
      c. Pipe Size: 2-1/2 inch to 3 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 1/2 inch.
      d. Pipe Size: 4 inch to 6 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 5/8 inch.
      e. Pipe Size: 8 inch to 12 inch:
         1) Maximum hanger spacing: 14 ft.
         2) Hanger Rod Diameter: 7/8 inch.

B. Piping Applications:
   1. Under slab, domestic water piping, NPS 2 and smaller, shall be: Type L, drawn-temper copper tubing, wrought-copper fittings, brazed or mechanical pressure-seal joints.
   2. Under slab, domestic water, building service piping, NPS 3 to NPS 6, shall be: Type K, wrought copper tubing, solder joint fittings, brazed or mechanical pressure-seal joints.
   3. Above ground, domestic water piping, all sizes, shall be one of the following:
      a. Type L, drawn-temper copper tubing, wrought-copper fittings, soldered or mechanical pressure-seal joints.
      b. PEX-a piping with engineered polymer (EP) or lead-free brass ASTM F1960 cold-expansion fittings.
   4. Piping for HVAC condensate, all sizes, shall be: Type L, drawn-temper copper tubing, wrought-copper fittings, soldered or mechanical pressure-seal joints.
   5. Under slab, soil, waste and vent piping, all sizes, shall be one of the following:
      a. Cast iron, hub-and-spigot, gaskets, and gasketed joints.
      b. Cast iron, hubless, CISPI hubless couplings, and coupled joints.

c. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

6. Above ground, soil and waste piping, all sizes, shall be one of the following:
   a. Cast iron, hub-and-spigot, gaskets, and gasketed joints.
   b. Cast iron, hubless, sovent stack fittings, CISPI hubless couplings, and coupled joints.
   c. Copper DWV tube, copper drainage fittings, and soldered joints.
   d. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
7. Above ground, vent piping, all sizes, shall be one of the following:
   a. Cast iron, hub-and-spigot, gaskets, and gasketed joints.
   b. Cast iron, hubless, CISPI hubless couplings, and coupled joints.
   c. Copper DWV tube, copper drainage fittings, and soldered joints.
   d. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

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SECTION 22 10 06 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Drains.
B. Cleanouts.
C. Hose bibbs.
D. Hydrants.
E. Washing machine boxes and valves.
F. Refrigerator or icemaker valve and recessed box.
G. Backflow preventers.
H. Double check valve assemblies.
I. Water hammer arrestors.
J. Mixing valves.
K. Balancing Valves.
L. Stainers.
M. Flexible Connectors.
N. Trap Seal Primer Device.

1.2 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains 2019.
B. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers 2017.
C. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent 2021.
D. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies 2021.
E. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
F. NSF 372 - Drinking Water System Components - Lead Content 2022.
G. PDI-WH 201 - Water Hammer Arresters 2017.

1.3 SUBMITTALS

A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company.
   2. Josam Company.

3. MIFAB, Inc.
4. Tyler Pipe; Wade Division.
5. Watts Drainage Products Inc.
6. Zurn Industries, LLC.

B. Floor Drain:
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

C. Floor Sink:
1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, nickel bronze frame, full or half grate (refer to schedule on drawings).

2.3 CLEANOUTS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company.
2. Josam Company.
3. MIFAB, Inc.
4. Tyler Pipe; Wade Division.
5. Watts Drainage Products Inc.
6. Zurn Industries, LLC.

B. Cleanouts at Interior Finished Floor Areas:
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

C. Cleanouts at Interior Finished Wall Areas:
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

D. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.4 HOSE BIBBS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company.
2. Watts Regulator Company.
3. Zurn Industries, LLC.
4. Approved equivalent manufacturer.

B. Interior Hose Bibbs:
1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome-plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

2.5 HYDRANTS

A. Manufacturers:
1. Josam Company.
2. Jay R. Smith Manufacturing Company.
3. MIFAB, Inc.
4. Tyler Pipe; Wade Division.
5. Watts Drainage Products.
6. Zurn Industries, LLC.

B. Wall Hydrants:
1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.

C. Post Hydrants, nonfreeze draining type:
1. ASME A112.21.3M; freeze resistant, self draining exposed-outlet post hydrant with bronze casing and casing guard, garden hose threaded outlet complying with ASME B1.20.7, loose key operation, casing and rod of length required for burial of valve below frost line, and integral vacuum breaker.

2.6 WASHING MACHINE BOXES AND VALVES

A. Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch waste, slip in finishing cover.

2.7 **REFRIGERATOR OR ICEMAKER VALVE AND RECESSED BOX**

A. Box Manufacturers:
1. Acorn Engineering Company.
2. IPS Corporation/Water-Tite.
3. LSP Products Group, Inc.
4. Oatey Supply Chain Services, Inc.

B. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.8 BACKFLOW PREVENTERS

A. Manufacturers:
1. Conbraco Industries, Inc.
2. Watts Regulator Company, a part of Watts Water Technologies.
3. Zurn Industries, LLC.

B. Reduced Pressure Backflow Preventer Assembly:
1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
2. Size: _____ inch assembly with threaded gate valves.

2.9 DOUBLE CHECK-VALVE ASSEMBLIES

A. Manufacturers:
1. Conbraco Industries, Inc.
2. Watts Regulator Company, a part of Watts Water Technologies.
3. Zurn Industries, LLC.

B. Double Check Valve Assembly:
1. ASSE 1012; cast bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.
2. Size: 3/4 to 2 inch, NPS assembly with threaded full port ball valves.

2.10 BEVERAGE-DISPENSING-EQUIPMENT BACKFLOW PREVENTERS

A. Requirements:
1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8.

4. Body: Stainless Steel.
5. End Connections: Threaded.

2.11 WATER HAMMER ARRESTORS

A. Manufacturers:
1. AMTROL, Inc.
2. Jay R. Smith Manufacturing Company.
3. Josam Company.
4. MIFAB, Inc.
5. Precision Plumbing Products, Inc.
6. Sioux Chief Manufacturing Company, Inc.
7. Tyler Pipe; Wade Division.
8. Watts Regulator Company, a part of Watts Water Technologies.
9. Zurn Industries, LLC.

B. Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.12 MIXING VALVES

A. Thermostatic Mixing Valves:
1. Manufacturers:
a. Conbraco Industies, Inc.
b. Honeywell International Inc.
c. Leonard Valve Company.
d. Powers; a division of Watts Water Technologies, Inc.
e. Taco Inc.
f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Co.
g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Valve: Chrome-plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
a. Volume control shut-off valve on outlet.
b. Strainer stop checks on inlets.
c. Adjustable, temperature-control handle.

2.13 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
1. Type: Y-pattern globe valve with two readout ports and memory-setting indicator. Ball type valve for balancing applications is prohibited.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:
1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.

8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.14 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
6. Drain: Factory installed, hose-end drain valve.

2.15 FLEXIBLE CONNECTORS

A. Manufacturers:
1. Flex-Hose Company, Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Gasket & Shim, Inc.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. TOZEN Corporation.
10. Unaflex Universal Metal Hose; a Hyspan Company.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.16 TRAP SEAL PRIMER DEVICE

A. Manufacturers:
1. Jay R. Smith Manufacturing Company.
2. MIFAB, Inc.
3. Precision Plumbing Products, Inc.
4. Sioux Chief Manufacturing Company, Inc.
5. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

B. Supply-Type, Trap-Seal Primer Device: ASSE 1018; 125 psig minimum pressure rating, bronze body.
1. Inlet/Outlet Connections: NPS 1/2 threaded, union, or solder joint.
2. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
3. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finish.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be a source of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or systems.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixted air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

D. Install Y-pattern strainers for water on supply side of each control valve, water pressure reducing valve, solenoid valve, and pump.

E. Install draining-type post hydrants with 1 cu.yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu.ft. of concrete block at grade.

F. Install floor cleanouts at elevation to accommodate finished floor.

G. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

H. Pipe relief from backflow preventer to nearest drain.

I. Install water hammer arrestors in water piping according to PDI-WH 201.

J. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

K. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

END OF SECTION

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Commercial gas-fired water heaters.

B. Commercial electric water heaters.

C. Diaphragm-type compression tanks.

D. In-line circulator pumps.

E. Submersible sump pumps.

1.2 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Current Edition.

B. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less 2019, with Errata (2020).

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2023.

E. UL 174 - Standard for Household Electric Storage Tank Water Heaters Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Indicate pump type, capacity, power requirements.
   3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   4. Provide electrical characteristics and connection requirements.

B. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Certifications:
   1. Water Heaters: NSF approved.
   2. Gas Water Heaters: AHRI Directory of Certified Product Performance.
   3. Electric Water Heaters: UL listed and labeled to UL 174.
   4. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.
   5. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
   6. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

1.5 WARRANTY

A. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.1 WATER HEATERS

A. Manufacturers:
1. A.O. Smith Water Products Co.
2. Bock Water Heaters, Inc.
3. Bradford White Corporation.
4. Lochinvar Corporation.
5. Rheem Manufacturing Company.
6. State Industries.

B. Commercial Gas-Fired Water Heaters:
1. Type: Automatic, natural gas-fired, vertical storage.
2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
3. Performance: Refer to equipment schedule on the contract drawings.
4. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
5. Accessories:
   a. Water Connections: Brass.
   b. Dip Tube: Brass.
   c. Drain valve.
   d. Anode: Magnesium.
6. Applications:
   a. Automatic storage water heater.
7. Controls: Automatic direct immersion thermostat with temperature range adjustable minimum 175 degrees F differential, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, intermittent electronic ignition monitoring pilot and main flame, trial for re-ignition for momentary loss of flame, shutdown of pilot and main burner in "2 to 4" seconds after loss of flame, and automatic flue damper.

C. Commercial Electric Water Heaters:
1. Type: Factory-assembled and wired, electric, vertical storage.
2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
3. Performance: Refer to equipment schedule on the contract drawings.
4. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
5. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
6. Accessories:
   a. Water Connections: Brass.
   b. Dip Tube: Brass.
   c. Drain valve.
   d. Anode: Magnesium.

e. Temperature and Pressure Relief Valve: ASME labeled.

7. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers:
1. Amtrol Inc.
2. A.O. Smith Water Products Co.
3. Honeywell International Inc.
4. State Industries.
5. Taco, Inc.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.3 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:
1. Bell & Gossett, a xylem brand.
2. PACO Pumps; Grundfos Pumps Corp., USA.
3. TACO Comfort Solutions.
4. Thrush Company, Inc.

B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against a stationary ceramic seat.

F. Drive: Flexible coupling.

G. Performance: Refer to equipment schedule on the contract drawings.

2.4 SUBMERSIBLE SUMP PUMPS

A. Type: Completely submersible, vertical, centrifugal.

B. Casing: Cast iron pump body and oil filled motor chamber.

C. Impeller: Hytrel (steel coated with thermoplastic polyester elastomer); open non-clog, stainless steel shaft.

D. Bearings: Ball bearings.

E. Accessories: Oil resistant 6 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

F. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.

G. Controls: Oil-Minder Control and Pump System designed to activate the pump to remove water from elevator pits in accordance with ASME A17.1, and will provide pumping of water only, even if an oil condition is detected. Controller to be mounted in NEMA 4x weathertight corrosion resistant polycarbonate enclosure. Controller to provide local and remote alarm in the event of a high water condition or high oil condition.

H. Performance: Refer to equipment schedule on the contract drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Pumps:

1. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION

SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

C. Static pressure gauges.

1.2 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping.

1.3 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments 2022.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014 (Reapproved 2020).

1.4 SUBMITTALS

A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

B. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

1.5 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi and KPa.

2.2 PRESSURE GAUGE TAPPINGS

A. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

B. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

A. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
   1. Size: 9 inch scale.
   2. Window: Clear glass.
   3. Stem: in inch length to suit installation; aluminum.

4. Accuracy: plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
5. Calibration: Degrees F.

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: plus or minus 1 percent of scale range or one scale division to a maximum of 1.5 percent of scale range.
5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.5 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

2.6 STATIC PRESSURE GAUGES

A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

B. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometers in air duct systems on flanges.

F. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

G. Coil and conceal excess capillary on remote element instruments.

H. Provide instruments with scale ranges selected according to service with largest appropriate scale.

I. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

J. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

K. Locate test plugs adjacent thermometers and thermometer sockets.

3.2 SCHEDULE

A. Pressure Gauges, Scale Range: 0 to 100 psi for chilled water, 0 to 200 psi for heating hot water.

B. Pressure Gauge Tappings, Location:
1. Major coils - inlets and outlets.
2. Heat exchangers - inlets and outlets.
3. Chiller - inlets and outlets.
4. Boiler - inlets and outlets.

C. Stem Type Thermometers, Scale Range: 0 to 100 deg. F for chilled water, 30 to 240 deg. F for heating hot water, 0 to 150 deg. F for air ducts.

END OF SECTION

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SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ball valves.
B. Butterfly valves.
C. Check valves.
D. Gate valves.
E. Chainwheels.

1.2 RELATED REQUIREMENTS

A. Section 23 07 19 - HVAC Piping Insulation.
B. Section 23 21 13 - Hydronic Piping.

1.3 ABBREVIATIONS AND ACRONYMS

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. PTFE: Polytetrafluoroethylene.
G. RS: Rising stem.
H. TFE: Tetrafluoroethylene.
I. WOG: Water, oil, and gas.

1.4 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
E. ASME B31.9 - Building Services Piping 2020.
F. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2019).
G. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).
H. AWWA C606 - Grooved and Shouldered Joints 2022.
I. MSS SP-45 - Drain and Bypass Connections 2020.
J. MSS SP-67 - Butterfly Valves 2022.
K. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends 2011.
L. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends 2018.

M. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .

1.5 SUBMITTALS

A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.6 QUALITY ASSURANCE

A. Manufacturer:
1. Obtain valves for each valve type from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.
6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:
1. Maintain valve end protection and protect flanges and specialties from dirt.
2. Store valves in shipping containers and maintain in place until installation.
   a. Store valves indoors in dry environment.
   b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

C. Exercise the following precautions for handling:
1. Handle large valves with sling, modified to avoid damage to exposed parts.
2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

B. Provide the following valves for the applications if not indicated on drawings:
1. Throttling (Hydronic): Butterfly and Ball.
2. Isolation (Shutoff): Butterfly, Gate, and Ball.
3. Swing Check (Pump Outlet):
   a. Size 2 inch and Smaller: Bronze with bronze disc.
   b. 2-1/2 NPS and Larger: Iron with lever and weight.
4. Dead-End: Butterfly, single-flange (lug) type.

C. Chilled, Condenser, and Heating Hot Water Valves:
1. 2 NPS and Smaller, Bronze Valves:
   a. Threaded ends.
   b. Ball: Full port, one piece, stainless steel trim.
   c. Swing Check: Bronze disc, Class.

d. Gate: NRS, Class 150.

2. Size 2-1/2 inch and Larger, Iron Valves:
   a. 2-1/2 NPS to 4 NPS: flanged or threaded end for copper tubing; flanged, grooved or threaded ends for steel piping ends.
   b. Ball: 2-1/2 NPS to 10 inch, Class 150.
   c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
   d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
   e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
   f. Swing Check: Metal seats, Class 125.
   g. Grooved-End Check: 3 inch to 12 inch, 300 CWP.
   h. Gate: NRS, Class 125.

2.2 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Handwheel: Valves other than quarter-turn types.
   2. Hand Lever: Quarter-turn valves 6 NPS and smaller.
   3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
   1. Gate Valves: Rising stem.
   2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   3. Butterfly Valves: Extended neck.

E. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
   3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
   4. Solder Joint Connections: ASME B16.18.
   5. Grooved End Connections: AWWA C606.

F. General ASME Compliance:
   1. Building Services Piping Valves: ASME B31.9.

G. Bronze Valves:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

H. Valve Bypass and Drain Connections: MSS SP-45.

I. Source Limitations: Obtain each valve type from a single manufacturer.

2.3 BRONZE, BALL VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Stainless Steel Trim:
   1. Comply with MSS SP-110.

2. WSP Rating: 150 psi.
3. WOG Rating: 400 psi.
4. Body: Forged bronze or dezincified-brass alloy.
5. End Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel vented.
9. Manufacturers:
   a. Apollo Flow Controls; Conbraco Industries.
   b. Crane; Crane Energy Flow Solutions.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Watts.

2.4 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug Style; Bidirectional dead-end service without use of downstream flange:
   1. Comply with MSS SP-67, Type I.
   2. Lug Style, CWP Ratings:
      a. Sizes 2 to 12 inch: 150 psi.
      b. Sizes 14 to 24 inch: 100 psi.
      c. Vacuum Service: Down to 29.9 in-Hg.
   3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
   4. Stem: One or two-piece stainless steel.
   5. Seat: EPDM.
   6. Disc: Coated ductile iron.
   7. Manufacturers:
      a. Bray Controls; a division of Bray International.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
      d. Crane Co.; Crane Valve Group; Jenkins Valves or Stockham Division.
      e. Hammond Valve.
      f. Kitz Corporation.
      g. Milwaukee Valve Company.
      h. NIBCO INC.
      i. Red-White Valve Corporation.
      j. Tyco Valves & Controls; a unit of Tyco Flow Control.
      k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

2.6 IRON, FLANGED END SWING CHECK VALVES

A. Manufacturers:
   1. Cincinnati Valve Company.
   2. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves, and Stockham Division.
   3. Grinnell Corporation.
   4. Hammond Valve.
   5. Milwaukee Valve Company.
   6. Mueller Company.
   7. NIBCO INC.
   8. Powell, Wm. Co.
   9. Watts Industries, Inc. Water Products Div.

2.7 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125:
1. Comply with MSS SP-71, Type I.
2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Gasket: Asbestos free.
8. Closer Control: Factory installed, exterior lever, and weight.

2.8 IRON, GROOVED-END SWING CHECK VALVES

A. Class 300:
1. CWP Rating: 300 psi.
2. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM.
4. Disc: Ductile iron or stainless steel.
5. Coating: Black, non-lead paint.
6. Manufacturers:
   a. Anvil International, Inc..
   b. Shurjoint Piping Products.
   c. Tyco Fire Products LP; Grinnell Mechanical Products.
   d. Victaulic Company.

2.9 IRON, GATE VALVES

A. NRS or OS & Y:
1. Comply with MSS SP-70, Type I.
2. Body Material: Gray iron with bolted bonnet.
3. Ends: Flanged.
4. Trim: Bronze.
5. Disc: Solid wedge.
6. Packing and Gasket: Asbestos free.
7. Manufacturers:
   a. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves, or Stockham Division.
   b. Flo Fab Inc.
   c. Hammond Valve.
   d. Kitz Corporation.
   e. Legend Valve.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Powell Valves.
   i. Watts Regulator Company.

2.10 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Sprocket Rim with Chain Guides: Ductile iron.
3. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

B. Manufacturers:
1. Babbit Steam Specialty Company.

2. Roto Hammer Industries.
3. Trumbull Industries.

PART 3 EXECUTION

3.1 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Swing Check: Install horizontal maintaining hinge pin level.

E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment components.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

E. MFMA-4 - Metal Framing Standards Publication 2004.

F. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Prefabricated Trapeze-Framed Metal Strut Systems:
   1. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
   2. Strut Channel or Bracket Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
   4. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

C. Hanger Rods:
   1. Threaded zinc-plated steel unless otherwise indicated.
   2. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Piping up to 1 inch: 1/4 inch diameter.
      c. Piping larger than 1 inch: 3/8 inch diameter.
      d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:
   1. General Requirements:
      a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
      b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
      c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
      d. Insulation inserts to consist of polyisocyanurate (urethane) insulation surrounded by a 360 degree, galvanized steel jacketing.
   2. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

E. Nonpenetrating Rooftop Supports for Low-Slope Roofs:

1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
12. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

H. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
   5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

J. Secure fasteners according to manufacturer's recommended torque settings.

K. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vibration isolation requirements.

B. Vibration-isolated equipment support bases.

C. Vibration isolators.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

C. Shop Drawings - Vibration Isolation Systems:
1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

1.6 QUALITY ASSURANCE

A. Comply with applicable building code.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.

D. Piping Isolation:
1. Provide vibration isolators for piping supports:
   a. Located in equipment rooms.
   b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
   c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.
2. Minimum Static Deflection:
   a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
   b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
5. Use modular seal where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

E. Thrust Restraint Applications:
1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.
2. Minimum Static Deflection: Same as static deflection of equipment.
3. Limit lateral movement to 0.25 inch or less unless otherwise indicated.

2.2 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
   a. Kinetics Noise Control, Inc
   b. Mason Industries
   c. Vibration Eliminator Company, Inc
   d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Vibration-Isolated Structural Steel Bases:

1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

C. Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 03 30 00.
6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
7. Pump Applications: Size and configure bases for piping elbow supports as required.

2.3 VIBRATION ISOLATORS

A. Manufacturers:
1. Vibration Isolators:
a. Kinetics Noise Control, Inc
b. Mason Industries
c. Vibration Eliminator Company, Inc
2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
a. Color code or otherwise identify springs to indicate load capacity.
b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Nonseismic Applications:
1. Resilient Material Isolator Pads:
a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) isolator material.
b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Open (Unhoused) Spring Isolators:
a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
c. Furnished with integral leveling device for positioning and securing supported equipment.

3. Resilient Material Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection.
4. Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
6. Thrust Restraints:
   a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:
   1. Vibration-Isolated Equipment Support Bases:
      a. Provide specified minimum clearance beneath base.
   2. Spring Isolators:
      a. Position equipment at operating height; provide temporary blocking as required.
      b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
      c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
   3. Isolator Hangers:
      a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.

b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.

4. Thrust Restraints:
   a. Adjust restraint movement under normal operating static pressure.
5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
7. Adjust isolators to be free of isolation short circuits during normal operation.
8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

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SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Adhesive-backed duct markers.
D. Pipe markers.
E. Ceiling tacks.

1.2 REFERENCE STANDARDS

A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.3 SUBMITTALS

A. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
B. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.
B. Air Terminal Units: Nameplates.
C. Fans: Nameplates.
D. Control Panels: Nameplates.
E. Ductwork: Adhesive-backed duct markers.
F. Piping: Pipe markers.
G. Pumps: Nameplates.
H. Valves: Tags.

2.2 NAMEPLATES

A. Minimum size: Length and width vary for required label content, but not less than 2-1/2 by 1 inch.
B. Letter Color: White.
C. Letter Height: 1/4 inch.
D. Background Color: Black.
E. Plastic: Comply with ASTM D709.
F. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is identified (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

2.3 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

B. Valve Tag Chart: Typewritten valve schedule, letter size list in anodized aluminum frame.

2.4 ADHESIVE-BACKED DUCT MARKERS

A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

B. Label Content: Include identification of duct service using same designations or abbreviations used on Drawings, duct size, and arrow indicating flow direction.
   1. Flow Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as a separate unit on each duct label to indicate flow direction.
   2. Lettering Size: 1-1/2 inch minimum.

C. Style: Individual Label.

D. Color: Green/White.

2.5 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Label Contents: Include indentification of piping service using same designations as used on the 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 a separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: 1-1/2 inch minimum.

2.6 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install valve tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install ductwork with adhesive-backed duct markers. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

F. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

1.2 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).

C. NEBB (TAB) - Procedural Standard for Testing Adjusting and Balancing of Environmental Systems 2019.

1.3 SUBMITTALS

A. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   3. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   4. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Identification and types of measurement instruments to be used and their most recent calibration date.
      d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      e. Final test report forms to be used.
      f. Detailed step-by-step procedures for TAB work for each system and issue, including:
         1) Terminal flow calibration (for each terminal type).
         2) Diffuser proportioning.
         3) Branch/submain proportioning.
         4) Total flow calculations.
         5) Rechecking.
         6) Diversity issues.
      g. Details of how TOTAL flow will be determined; for example:
         1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
         2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.

h. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure: Report data in I-P (inch-pound) units only.
6. Include the following on the title page of each report:
   a. Name of Testing, Adjusting, and Balancing Agency.
   b. Address of Testing, Adjusting, and Balancing Agency.
   c. Telephone number of Testing, Adjusting, and Balancing Agency.
   d. Project name.
   e. Project location.
   f. Project Architect.
   g. Project Engineer.
   h. Project Contractor.
   i. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
1. AABC (NSTSB), AABC National Standards for Total System Balance.
2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:
   a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
   b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.
   12. Hydronic systems are flushed, filled, and vented.
   13. Pumps are rotating correctly.
   14. Proper strainer baskets are clean and in place.
   15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
   1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

N. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.7 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.8 SCOPE

A. Test, adjust, and balance the following:
1. Plumbing Pumps.
2. HVAC Pumps.
3. Forced Air Furnaces.
4. Packaged Roof Top Heating/Cooling Units.
5. Computer Room Air Conditioning Units.
6. Air Handling Units.
7. Fans.
8. Air Terminal Units.
9. Air Inlets and Outlets.

3.9 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Sheave Make/Size/Bore.

B. Pumps:
1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.

C. Cooling Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Water flow, design and actual.
11. Water pressure drop, design and actual.
12. Entering water temperature, design and actual.
13. Leaving water temperature, design and actual.
14. Saturated suction temperature, design and actual.

15. Air pressure drop, design and actual.

D. Heating Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Entering water temperature, design and actual.
9. Leaving water temperature, design and actual.
10. Entering air temperature, design and actual.
11. Leaving air temperature, design and actual.
12. Air pressure drop, design and actual.

E. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Sheave Make/Size/Bore.
11. Number of Belts/Make/Size.
12. Fan RPM.

F. Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Sheave Make/Size/Bore.
8. Number of Belts/Make/Size.
9. Fan RPM.

G. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.

H. Terminal Unit Data:
1. Manufacturer.

2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

I. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Design air flow.
6. Test (final) air flow.
7. Percent of design air flow.

END OF SECTION

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SECTION 23 07 13 - DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

B. Jacketing and accessories.

1.2 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).

D. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings 2019 (Reapproved 2022).

E. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers 2015.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. K value: 0.27 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Density: 1 pound per cubit foot

B. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

C. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

2.3 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, noncombustible blanket.
   1. K Value: 0.23 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Density: 2 pounds per cubic foot

B. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

C. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

2.4 **FIRE-RATED INSULATION SYSTEMS**

A. Fire-Rated Board. Structural-grade, press-molded, xonolite calcium silicate, freproofing board suitable for operating temperatures up to 1700 deg. F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authoritirs having jurisdiction.

2.5 JACKETING AND ACCESSORIES

A. Aluminum Jacket:
   1. Thickness: 0.016 inch sheet.
   2. Finish: Embossed.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

B. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.

1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
2. Thickness: 34 mil, 0.034 inch.
3. Finish: Embossed.
4. Color: Silver.
5. Water Vapor Transmission: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
6. Mold Resistance: Pass when tested in accordance with ASTM C1338.
7. Emissivity: 0.30 when tested in accordance with ASTM C1371.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts Conveying Air Below Ambient Temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

D. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with aluminum jacket.

E. Where fire rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating. Insulated duct access panels and doors to achieve same fire rating as duct.

F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with outdoor jacket finished as specified in Section 2.05 Jackets.

G. Slope exterior ductwork to shed water.

H. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
   3. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.3 SCHEDULES

A. Exhaust Ducts Within 10 ft of Exterior Openings:
   1. Type: Mineral Fiber Blanket
   2. Thickness: 2 inch or Installed R-value of 6.0

B. Supply, Return & Outside Air Ducts:
   1. Type: Mineral Fiber Blanket
   2. Thickness: 2 inch or Install R-value of 6.0

C. Ducts Exposed to Outdoors:
   1. Type: Mineral Fiber Board with field applied jacket

2. Thickness: 3" Thickness or Installed R-value of 8.0

D. Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum:
   1. Type: Fire-rated blanket or board
   2. Thickness: As required to achieve 2-hour fire rating

END OF SECTION

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019, with Editorial Revision (2023).

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2019).

C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2023.

D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.

E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, RIGID

A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

C. Vapor Barrier Lap Adhesive: Compatible with insulation.

D. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 180 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.4 JACKETING AND ACCESSORIES

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil, 0.010 inch.
      e. Connections: Brush on welding adhesive.
   2. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

D. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

E. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

F. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.

G. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

H. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

I. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULE

A. Heating Systems:
1. Heating Water Supply and Return Indoor Applications: NPS 1-1/2 inch and smaller, preformed glass fiber, 1-1/2 inches thick; NPS 2 and larger, preformed glass fiber, 2 inches thick. Outdoor Applications: all sizes, preformed glass fiber, 2 inches thick with field applied jacket.

B. Cooling Systems:
1. Chilled Water Indoor Applications: NPS 3/4 and larger, preformed glass fiber, 1-1/2 inches thick. Outdoor Applications: all sizes, preformed glass fiber, 2 inches thick with field applied jacket.
2. Refrigerant Suction: all sizes, flexible elastomeric, 1 inch thick; provide 2 inches thick for outdoor applications.
3. Refrigerant Hot Gas: all sizes, flexible elastomeric, 1 inch thick; provide 2 inches thick for outdoor applications.

END OF SECTION

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SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 GENERAL

1.1 SUMMARY

A. See Section 01 91 13 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 91 13.

B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.

D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
1. Control system.
2. Major and minor equipment items.
3. Piping systems and equipment.
4. Ductwork and accessories.
5. Terminal units.
6. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.2 REFERENCE STANDARDS

A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process 2007, with Errata (2012).

1.3 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

B. Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
1. System name.
2. List of devices.
3. Step-by-step procedures for testing each controller after installation, including:
   a. Process of verifying proper hardware and wiring installation.
   b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
   c. Process of performing operational checks of each controlled component.
   d. Plan and process for calibrating valve and damper actuators and all sensors.
   e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to

specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.

5. Description of the instrumentation required for testing.
6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.

D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
2. Full as-built set of control drawings.
3. Full as-built sequence of operations for each piece of equipment.
4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
    a. Floor.
    b. Room number.
    c. Room name.
    d. Air handler unit ID.
    e. Reference drawing number.
    f. Air terminal unit tag ID.
    g. Heating and/or cooling valve tag ID.
    h. Minimum air flow rate.
    i. Maximum air flow rate.
5. Full print out of all schedules and set points after testing and acceptance of the system.
6. Full as-built print out of software program.
7. Electronic copy on disk of the entire program for this facility.
8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
10. Control equipment component submittals, parts lists, etc.
11. Warranty requirements.
12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
    a. Sequences of operation.
    b. Control drawings.
    c. Points lists.
    d. Controller and/or module data.
    e. Thermostats and timers.
    f. Sensors and DP switches.
    g. Valves and valve actuators.
    h. Dampers and damper actuators.
    i. Program setups (software program printouts).

E. Project Record Documents: See Section 01 78 00 for additional requirements.

1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.

F. Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:
1. Follow the recommendations of ASHRAE Guideline 1.1.
2. Control system manufacturer's recommended training.
3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

G. Training Manuals: See Section 01 79 00 for additional requirements.
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.1 PREPARATION

A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.

B. Furnish additional information requested by the Commissioning Authority.

C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.

D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.

E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.

F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

G. Provide temperature and pressure taps in accordance with Contract Documents.
1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.

3.2 INSPECTING AND TESTING - GENERAL

A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.

B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

C. Provide two-way radios for use during the testing.

D. Valve/Damper Stroke Setup and Check:
   1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
   2. Set pump/fan to normal operating mode.
   3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
   4. Command valve/damper open; verify position is full open and adjust output signal as required.
   5. Command valve/damper to a few intermediate positions.
   6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

E. Isolation Valve or System Valve Leak Check: For valves not by coils.
   1. With full pressure in the system, command valve closed.
   2. Use an ultra-sonic flow meter to detect flow or leakage.

F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.3 TAB COORDINATION

A. TAB: Testing, adjusting, and balancing of HVAC.

B. Coordinate commissioning schedule with TAB schedule.

C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.

D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.

E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.

F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.4 CONTROL SYSTEM FUNCTIONAL TESTING

A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.

B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.

C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
   1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
   2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.

E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.

F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
   1. Setpoint changing features and functions.
   2. Sensor calibrations.

G. Demonstrate to the Commissioning Authority:
   1. That all specified functions and features are set up, debugged and fully operable.
   2. That scheduling features are fully functional and setup, including holidays.
   3. That all graphic screens and value readouts are completed.
   4. Correct date and time setting in central computer.
   5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
   6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
   7. Power failure and battery backup and power-up restart functions.
   8. Global commands features.
   9. Security and access codes.
   10. Occupant over-rides (manual, telephone, key, keypad, etc.).
   11. O&M schedules and alarms.
   12. Occupancy sensors and controls.
   13. Fire alarm interlocks and response.
   14. All control strategies and sequences not tested during controlled equipment testing.

H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.5 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 78 00 for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.6 DEMONSTRATION AND TRAINING

A. See Section 01 79 00 for additional requirements.

B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.

D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.

E. TAB Review: Instruct Owner's personnel for minimum 8 hours, after completion of TAB, on the following:
   1. Review final TAB report, explaining the layout and meanings of each data type.
   2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
   3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
   4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
   5. Other salient information that may be useful for facility operations, relative to TAB.

F. HVAC Control System Training: Perform training in at least three phases:
   1. Phase 1 - Basic Control System: Provide minimum of 8 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
      a. This training may be held on-site or at the manufacturer's facility.
      b. If held off-site, the training may occur prior to final completion of the system installation.
      c. For off-site training, Contractor shall pay expenses of up to two attendees.
   2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 8 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
      a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
      b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
      c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
      d. Every display screen, allowing time for questions.
      e. Point database entry and modifications.
   3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 4 hours of training. Tailor training session to questions and topics solicited beforehand from Owner.

Also be prepared to address topics brought up and answer questions concerning operation of the system.

G. Provide the services of manufacturer representatives to assist instructors where necessary.

H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

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SECTION 23 09 13 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Control panels.

B. Control Valves:
   1. Globe pattern.
   2. Butterfly pattern.
   3. Electronic operators.

C. Dampers.

D. Damper Operators:
   1. Electric operators.

E. HVAC&R Sensors:
   1. Temperature sensors.
   2. Humidity sensors.
   3. Static pressure (air pressure) sensors.
   4. Current sensors.
   5. Damper position indicators.
   6. Carbon dioxide sensors.

F. Thermostats:
   1. Low-limit temperature cutout switch (freezestat).

G. Time clocks.

H. Sensors with transmitters:
   1. Air pressure transmitters.
   2. Water pressure transmitters (liquid differential pressure transmitters).

I. Energy Metering:
   1. Hydronic energy meters.

J. Flow Sensors and Transmitters:
   1. Airflow measurement array (AFMA).
   2. Ultrasonic flow meters.
   3. Turbine flow meters.
   4. Flow switches.

K. Level Switches:
   1. Float Sensors:
      a. Liquid level switch.

1.2 RELATED REQUIREMENTS

A. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

PART 2 PRODUCTS

2.1 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.2 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

B. Provide common keying for all panels.

C. All DDC controllers located indoors shall be installed in NEMA 1 enclosures.

D. All DDC controllers located outdoors shall be installed in NEMA 3R enclosures.

2.3 CONTROL VALVES

A. Globe Pattern:
   1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
   2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
   3. Hydronic Systems:
      a. Replaceable plugs and seats of stainless steel.
      b. Size for 5 psig maximum pressure drop at design flow rate.
      c. two-way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two-way valve operators to close valves against pump shut off head.

B. Butterfly Pattern:
   1. Carbon steel, 316 stainless steel, cast iron or nickel aluminum bronze body, stainless steel disc, stainless steel stem, resilient replaceable seat for service to 180 degrees F full lugged ends, extended neck.
   2. Hydronic Systems:
      a. Size for 1 psig maximum pressure drop at design flow rate.

C. Electronic Operators:
   1. Integral self-locking gear train, mecanical travel stops and two adjustable travel limit switches with electrically isolated contacts. Gear assembly shall be made of hardened steel. No plastic components shall be acceptable.
   2. Rated for continuous duty against the maximum system operating pressure. Actuator shall have an input voltage of 24 VAC.
   3. Valves exposed to exterior elements shall be NEMA-4 rated.
   4. Sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head.

Actuators shall control against system maximum working pressures.

5. Normal and failure positions shall be as indicated in the Operating Sequences.
6. Visual mechanical position indication, showing valve position.
7. Equipped with an integral position potentiometer to indicate the stem position of the valve if required by the sequence of operation.
8. Manual declutch lever to enable manual operation of the valve. It shall be possible for an operator to manually modulate valves located in mechanical rooms in the event of loss of power.

2.4 DAMPERS

2.5 DAMPER OPERATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
   1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.

B. Electric Operators:
   1. Electronic damper actuators shall be direct-couple rotary type, sutiable for mounting directly on the damper end shaft. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range. Damper actuators used on economizer and/or outside air dampers shall be spring return.
   2. Terminal unit damper actuators shall be electric, low voltage, utilizing floating control. On single duct VAV applications, VAV box damper actuators shall be an integral part of the DDC VAV box controller.

2.6 HVAC&R SENSORS

A. Temperature Sensors:
   1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
   2. Construct RTD of nickel or platinum with base resistance of 10,000 ohms at 70 degrees F.
   3. Performance Characteristics:
      a. RTD:
         1) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.
         2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
         3) Chilled Water Accuracy: Plus/minus 0.50 degrees F minimum.
         4) All Other Accuracy: Plus/minus 0.75 degrees F minimum.
         5) Range: Minus 40 degrees F through 220 degrees F minimum.
      b. Thermistor:
         1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
         2) Range: Minus 25 degrees F through 122 degrees F minimum.
      c. Sensing Range:
         1) Use RTD type sensors for extended ranges beyond minus 30 to 230 degrees F.
      d. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
      e. Room Temperature Sensors with Integral Digital Display:
         1) Provide a four button keypad with the following capabilities:
            (a) Indication of space and outdoor temperatures.
            (b) Setpoint adjustment to accommodate room setpoint.

(c) Display and control fan operation status.
(d) Manual occupancy override and indication of occupancy status.

f. Temperature Averaging Elements:
1) Use on duct sensors for ductwork 10 sq ft or larger.
2) Use averaging elements where prone to stratification with sensor length 8 ft, 16 ft, or 24 ft.
3) Provide for all mixed air and heating coil discharge sensors regardless of duct size.

g. Insertion Elements:
1) Use in ducts not affected by temperature stratification or smaller than 11 sq inches.
2) Provide dry type, insertion elements for liquids, installed in 316 stainless steel immersion wells, with minimum insertion length of 2.5 inches.

B. Humidity Sensors:
1. Duct Mounted Sensor: Voltage type encased in a die-cast metal, weather-proof housing.
a. Input Power, Voltage Type: Class 2; 12-30 VDC/24 VAC, 15mA max.
b. Input Power, mA Type: Class 2; Loop powered 12-30 VDC only, 30 mA max.
c. Output Voltage Type: 3-wire observed polarity.
d. Output mA Type: 2-wire, not polarity sensitive (clipped and capped).
e. Humidity:
1) Accuracy 3 percent at 5 to 95percent relative humidity at 77 degrees F, multi-point calibration, NIST traceable.

C. Static Pressure (Air Pressure) Sensors:
1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
2. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
3. Accuracy: One percent of full scale with repeatability 0.3 percent.
4. Output: 0 to 5 vdc with power at 12 to 28 vdc.

D. Current Sensors:
1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 in-wc.
2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.
3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

E. Damper Position Indicators: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 to 100 percent damper travel.

F. Carbon Dioxide Sensors, Duct and Wall:
1. General: Provide nondispersive infrared (NDIR), diffusion sampling CO2 sensors with integral transducers and linear output.
2. Air Temperature: Range of 32 to 122 degrees F.
3. Relative Humidity: Range of 0 to 95 percent (noncondensing).
4. Power Input: Class 2; 12 to 30VDC or 24VAC 50/60 Hz; 100mA max.
5. Output: 0-10 VDC or 4-20 mA.
6. Range: 0-2000 ppm with an accuracy of plus or minus 5%.

2.7 THERMOSTATS

A. Low-Limit Temperature Cutout Switch (low-limit thermostat or freezestat):
1. Configuration: Vapor-filled capillary.
2. Sensing Length: 20 feet.

3. Setpoint Adjust: Slider.
4. Switch Type: SPDT, snap-action, form C in dust-protected enclosure.
5. Sensing Range: 15 to 55 degrees F.
6. Mounting: Locate on cooling coil intake side.
7. Field Interface: Connect load line-voltage to stater.
8. Manual Reset
9. Electrical Rating: Pilot duty, 125 VA at 125 to 600 VAC.

2.8 TIME CLOCKS

A. Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.

2.9 SENSORS WITH TRANSMITTERS

A. Air Pressure Transmitters:
   1. General: Provide dry media differential pressure transducers to monitor duct and room pressure.
      a. Media Compatibility: Dry air.
      b. Input Power: Class 2; 12 to 30 VDC; 2-wire: 20 mA max.
      c. Output: Field selectable, 2-wire, loop-powered 4 to 20 mA (DC only, clipped and capped).
      d. Pressure Ranges: 4 and 7, field selectable.
      e. Display:
         1) Signed 3-1/2 digit LCD, indicates pressure.
         2) Over-range indicator.
      f. Accuracy: Plus/minus 1 percent f.s. (full scale) of selected range (combined linearity & hysteresis).

B. Water Pressure Transmitters (Liquid Differential Pressure Transmitters):
   1. General: Provide wet media differential pressure transducers with 10 ft (3.5 m) shielded cable, to allow remote pressure sensing capability using existing plumbing runs.
      a. Input Power: Class 2; 15 to 30 VDC, 24VAC nominal, 50/60 Hz.
      b. Output: 3-wire transmitter; user-selectable, 4 to 20 mA (0 to 5V/0 to 10V).
      c. Sensor:
         1) Media Compatibility: 17 to 4 PH stainless steel.
         2) Status Indication: Dual color LED.
         3) Accuracy at 77 degrees F for less than or equal 20 ft:
            (a) Ranges A and B: Plus/minus 1 percent F.S. typical.
            (b) Range C: Plus/minus 1.5 percent F.S. typical.
            (c) Range D: Plus/minus 2 percent F.S. typical.
         4) Surge Damping: Electronic; 1 second averaging.
         5) Long Term Stability: Plus/minus 0.25 percent.
      d. Pressure Ranges:
         1) 0 psi to 50 psi (Gauge): 5 psid/10 psid/25 psid/50 psid (pressure differential).
         2) 0 psi to 100 psi (Gauge): 10 psid/20 psid/50 psid/100 psid (pressure differential).
         3) 0 psi to 250 psi (Gauge): 25 psid/50 psid/125 psid/250 psid (pressure differential).
      e. Enclosure: NEMA 250, Type 4.

2.10 ENERGY METERING

A. Hydronic Energy Meters:
1. Provide Btu/h meter with wall-mounted hardware capable of being installed remotely from the flow meter.
2. Include LCD display for local indication of energy rate including settings and parameters during configuration.
3. Factory configure to the specific application with field configuration by the user via the front panel keypad without the requirement of a computer or special interface.
4. Output to indicate energy rate, energy total, flow rate, and supply/return temperature.
5. Integral transmitter to provide a linear analog or configurable pulse output signal representing the energy rate with the signal compatible with the building automation system DDC hardware to which the output is connected.

2.11 FLOW SENSORS AND TRANSMITTERS

A. Airflow Measurement Array (AFMA):
1. Airflow Straighteners:
a. Provide AFMA with airflow straightener(s) when required by installation instructions.
b. In the absence of published documentation, provide airflow straighteners if there is any duct obstruction within 5 duct diameters upstream of the AFMA.
c. Construction to consist of 0.125 inch aluminum honeycomb with the straightener depth not less than 1.5 inches.
2. Outdoor Air Temperature: In outside air measurement or in low-temperature air delivery applications, provide an AFMA certified by the manufacturer to be accurate as specified over a temperature range of minus 20 to 120 degrees F.
3. Airflow Resistance:
a. Resistance to Airflow Through the AFMA and the Airflow Straightener: Not to exceed 0.085 in-wc at an airflow velocity of 2,000 fpm.
4. Electronic:
a. Each electronic AFMA to consist of an array of velocity sensing elements of the resistance temperature detector (RTD) or thermistor type.
b. Sensing Elements: Distributed across the duct cross section in the quantity and pattern specified or recommended by the published application data of the manufacturer.
c. Electronic AFMA's: Accuracy of plus/minus 5 percent over a range of 125 to 5,000 fpm and temperature compensated output over a range of 32 to 212 degrees F.

B. Ultrasonic Flow Meters:
1. Provide ultrasonic flow meters complete with matched transducers, self aligning installation hardware, and transducer cables.
2. Optimize ultrasonic transducers for the specific pipe and process conditions for the application.
3. Flow Meter Accuracy: Plus/minus 1 percent of rate from 0.98 fps to 40 fps.
4. Include dry contact outputs, 4 to 20 mA, 0 to 10 VDC.

C. Turbine Flow Meters:
1. Dual Axial Insertion Type: Include ball valve and threadolet. Provide other hardware required to allow meter insertion and removal with system in service to avoid shutdown(s).
2. Accuracy for the Insertion Turbine Flow Meter: Plus/minus 0.5 percent of the rate at calibrated velocity, within plus/minus of the rate over a 10 to 1 turn down and within plus/minus 2 percent of the rate over a 50 to 1 turn down.

3. Repeatability: Plus/minus 0.25 percent of reading.
4. The meter flow sensing element to operate over a range suitable for the installed location with a pressure loss limited to 1 percent of operating pressure at maximum flow rate.
5. Include dry contact outputs, 4 to 20 mA, 0 to 10 VDC.
6. Fabricate the turbine rotor assembly of Series 300 stainless steel and use Teflon seats.

D. Flow Switches:
1. Repetitive Accuracy: Plus/minus 10 percent of actual flow setting.
2. Switch Actuation: Adjustable over the operating range and sized for the application, such that the setpoint is between 25 and 75 percent of the full range.
3. Provide Form C snap-action contacts, rated for the application.
4. Furnish nonflexible paddle with magnetically actuated contacts, rated for service at a pressure greater than the installed conditions.

2.12 LEVEL SWITCHES

A. Float Sensors:
1. Liquid Level Switch:
a. Wetted Materials:
1) Float: Solid polypropylene.
2) Magnet: Ceramic.
b. Switch Type: SPDT snap switch.
c. Electrical Rating: 5 amp at 125/250 VAC.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Conceal tubing. Run exposed only in mechanical rooms, storage rooms and like, in neat manner and properly supported.

C. Mount freeze protection thermostats using flanges and element holders.

D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

E. Provide thermostats in aspirating boxes in front entrances.

F. Provide valves with position indicators and with pilot positioners where sequenced with other controls.

G. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors.

H. Provide isolation (two position) dampers of parallel blade construction.

I. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

J. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION

SECTION 23 09 23 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. System description.

B. Operator interface.

C. Power supplies and line filtering.

1.2 RELATED REQUIREMENTS

A. Section 23 09 13 - Instrumentation and Control Devices for HVAC.

B. Section 23 09 93 - Sequence of Operations for HVAC Controls.

C. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks 2020, with Errata and Amendments (2022).

B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests 2019h.

C. UL (DIR) - Online Certifications Directory Current Edition.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for each system component and software module.

C. Shop Drawings:
   1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
   2. List connected data points, including connected control unit and input device.
   3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
   4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
   5. Indicate description and sequence of operation of operating, user, and application software.

D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.
   2. Include submittals data in final "Record Documents" form.

E. Operation and Maintenance Data:
   1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
   2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
   3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

C. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units with communications to Building Management System specified in Section 23 09 23.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 09 13.

E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

G. Integrate all controllers and system components into Owner's existing Building Management System, where applicable.

2.2 OPERATOR INTERFACE

A. PC Based Work Station:
   1. Resides on high speed network with building controllers.
   2. Connected to server for full access to all system information.

B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.

C. BACnet protocol to comply with ASHRAE Std 135.

2.3 CONTROLLERS

A. Building Controllers:
   1. General:
      a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
      b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
      c. Share data between networked controllers.

d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
e. Utilize real-time clock for scheduling.
f. Continuously check processor status and memory circuits for abnormal operation.
g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
h. Communication with other network devices to be based on assigned protocol.

2. Communication:
a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
b. Perform routing when connected to a network of custom application and application specific controllers.
c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:
a. Outdoors and/or in Wet Ambient Conditions:
1) Mount within NEMA 3R enclosures.
b. Conditioned Space:
1) Mount within NEMA 1 enclosures.

4. Provisions for Serviceability:
a. Diagnostic LEDs for power, communication, and processor.
b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

6. Power and Noise Immunity:
a. Maintain operation at 90 to 110 percent of nominal voltage rating.
b. Perform orderly shutdown below 80 percent of nominal voltage.
c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. Custom Application Controller:

1. General:
a. Provide sufficient memory to support controller's operating system, database, and programming requirements.
b. Share data between networked, microprocessor based controllers.
c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
d. Utilize real-time clock for scheduling.
e. Continuously check processor status and memory circuits for abnormal operation.
f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
g. Communication with other network devices to be based on assigned protocol.

2. Communication:
a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:
a. Outdoors and/or in Wet Ambient Conditions:
1) Mount within NEMA 3R enclosures.

b. Conditioned Space:
1) Mount within NEMA 1 enclosures.

4. Provisions for Serviceability:
a. Diagnostic LED's for power, communication, and processor.
b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

6. Power and Noise Immunity:
a. Maintain operation at 90 to 110 percent of nominal voltage rating.
b. Perform orderly shutdown below 80 percent of nominal voltage.
c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

C. Application Specific Controllers:
1. General:
a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
b. Customized for operation within the confines of equipment served.
c. Communication with other network devices to be based on assigned protocol.

2. Communication:
a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:
a. Outdoors and/or in Wet Ambient Conditions:
1) Mount within NEMA 3R enclosures.
b. Conditioned Space:
1) Mount within NEMA 1 enclosures.

4. Provisions for Serviceability:
a. Diagnostic LEDs for power, communication, and processor.
b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

6. Power and Noise Immunity:
a. Maintain operation at 90 to 110 percent of nominal voltage rating.
b. Perform orderly shutdown below 80 percent of nominal voltage.
c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

D. Input/Output Interface:
1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.

2. All Input/Output Points:
a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.

3. Binary Inputs:
a. Allow monitoring of On/Off signals from remote devices.

b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
c. Sense dry contact closure with power provided only by the controller.

4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
   a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
   b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
   a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
   b. Outputs provided with three position (On/Off/Auto) override switches.
   c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
   a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
   b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
   c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
   a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
   b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
      1) VAV terminal units.
      2) Duct mounted heating coils.
   c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
   a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
   b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.4 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:
1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.

9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:
   1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
   2. Minimum surge protection attributes:
      a. Dielectric strength of 1000 volts minimum.
      b. Response time of 10 nanoseconds or less.
      c. Transverse mode noise attenuation of 65 dB or greater.
      d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 09 93.

C. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.3 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.

3.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate complete and operating system to Owner.

END OF SECTION

SECTION 23 09 34 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.

1.2 RELATED REQUIREMENTS

A. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 73 - Power System Studies: Additional criteria for selection and adjustment of equipment and associated protective devices specified in this section.

D. Section 28 46 00 - Fire Detection and Alarm: For interface with variable-frequency motor controllers.

1.3 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 1989 (Corrigendum 2019).

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

C. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).

D. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives 2020.

E. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems 2022.

F. NEMA ICS 7.2 - Application Guide for AC Adjustable Speed Drive Systems 2021.

G. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems 2005.

H. NEMA MG 1 - Motors and Generators 2021.

I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.

K. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2) Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
   2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
   3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
   4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.

5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 VARIABLE-FREQUENCY MOTOR CONTROLLERS

A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.

B. Provide products listed, classified, and labeled as suitable for purpose intended.

C. Controller Assemblies: Comply with NEMA ICS 7, NEMA ICS 7.1, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.

D. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA ICS 7.2, NEMA MG 1 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
   1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 1 design letter or inverter duty rating for induction motors.
   2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
   3. Motor nameplate data.
   4. Requirements for speed control range, speed regulation, and braking.
   5. Motor suitability for bypass starting method, where applicable.

E. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.

F. Operating Requirements:
   1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
   2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
   3. Efficiency: Minimum of 96 percent at full speed and load.
   4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
   5. Overload Rating:

a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.

G. Power Conversion System: Microprocessor-based, pulse width modulation type consisting of rectifier/converter, DC bus/link, and inverter.
1. Rectifier/Converter: Diode-based, 6-pulse type unless otherwise indicated.

H. Control System:
1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
3. Control Functions:
a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
2) Vector Control: Provide selectable autotuning function.
b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
c. Selectable braking control; DC injection or flux braking.
d. Adjustable minimum/maximum speed limits.
e. Adjustable pulse width modulation switching carrier frequency.
f. Adjustable motor slip compensation.
g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
4. Status Indications:
a. Motor run/stop status.
b. Motor forward/reverse status.
c. Local/remote control status.
d. Output voltage.
e. Output current.
f. Output frequency.
g. DC bus voltage.
h. Motor speed.
5. Protective Functions/Alarm Indications:
a. Overcurrent.
b. Motor overload.
c. Undervoltage.
d. Overvoltage.
e. Controller overtemperature.
f. Input/output phase loss.
g. Output short circuit protection.
h. Output ground fault protection.
6. Inputs:
a. Digital Input(s): Six.
b. Analog Input(s): Two.
7. Outputs:
a. Analog Output(s): Two.
b. Relay Output(s): Three.

8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
   a. Serial Communications: RS-485; support for BACnet MS/TP protocol.
   b. Remote Monitoring Capabilities:
      1) Motor run/stop status.
      2) Hand-off-auto status.
      3) Fault information.
      4) Discrete input/output status.
      5) Analog input/output values.
   c. Remote Control Capabilities:
      1) Motor run/stop command.
      2) Hand-off-auto selection.
      3) Speed adjustment.
      4) Fault reset.
9. Features:
   a. Password-protected security access.
   b. Event log.

I. Power Conditioning/Filtering:
   1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.
   2. Reactor Impedance: 3 percent, unless otherwise indicated or required.

J. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
   1. Disconnects: Circuit breaker or disconnect switch type.
      a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
      b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
      c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
   2. Provide door-mounted remote operator interface.

K. Service Conditions:
   1. Provide controllers and associated components suitable for operation under following service conditions without derating:
      a. Altitude: Less than 3,300 feet.
      b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
   2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.

L. Short Circuit Current Rating:
   1. Provide controllers with listed short circuit current rating not less than available fault current at installed location as determined by short circuit study performed in accordance with Section 26 05 73.
   2. Provide line/input reactors where specified by manufacturer for required short circuit current rating.

M. Conductor Terminations: Suitable for use with conductors to be installed.

N. Enclosures:
   1. Comply with NEMA ICS 6.
   2. NEMA 250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.

b. Outdoor Locations: Type 3R or Type 4.
3. Finish: Manufacturer's standard unless otherwise indicated.
4. Cooling: Forced air or natural convection as determined by manufacturer.

O. Interface with Other Work:
1. Provide products compatible with other systems requiring interface with controllers.
2. Interface with building automation system.
a. Capable of remote monitoring and control of controllers.
3. Interface with fire alarm control system as specified in Section 28 46 00.
a. Capable of affecting operation of selected HVAC equipment for selected fire alarm system events.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.

C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 23 05 29.

F. Install controllers plumb and level.

G. Provide grounding and bonding in accordance with Section 26 05 26.

H. Install field-installed devices, components, and accessories.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

3.2 PROTECTION

A. Protect installed controllers from subsequent construction operations.

END OF SECTION

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SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.2 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting.

B. Section 09 91 23 - Interior Painting.

C. Section 33 52 16 - Gas Hydrocarbon Piping.

1.3 REFERENCE STANDARDS

A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators 2019.

B. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators 2019.

C. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2023.

D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

E. ASME B31.1 - Power Piping 2022.

F. ASME B31.9 - Building Services Piping 2020.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2023.

J. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements 2015.

K. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements 2015.

L. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2015.

M. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends 2011.

1.4 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

B. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

2.2 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

2.3 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.
   5. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
      a. Bases: High density polypropylene.
      b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
      c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
      d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
      e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

2.4 BALL VALVES

A. Construction, 2 Inches and Smaller: MSS SP-110, Class 150, 600 psi CWP, chrome-plated bronze ball, bronze body, full port, reinforced TFE seat, bronze blowout-proof strem, threaded packnut design with adjustable-stem packing, threaded or welded ends.

2.5 PLUG VALVES

A. Construction 2-1/2 Inches and Larger: MSS SP-78, 125 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.6 STRAINERS

A. Size 2 inch and Under:
   1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 1-1/2 inch to 4 inch:
   1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

C. Size 5 inch and Larger:
   1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.7 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A. Compliance Requirements:
   1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
   2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.

B. Materials in Contact With Gas:
   1. Housing: Aluminum, steel (free of non-ferrous metals).
   2. Seals and Diaphragms: NBR-based rubber.

C. Maximum Inlet Operating Pressure: 10 psi.
   1. Appliance Regulator: 1 psi.
   2. Line Pressure Regulator: 2 psi.

D. Maximum Body Pressure: 10 psi.

E. Output Pressure Range: 1 inch wc to 80 inch wc.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

G. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

1. Painting of interior piping systems and components is specified in Section 09 91 23.
2. Painting of exterior piping systems and components is specified in Section 09 91 13.

H. Install valves with stems upright or horizontal, not inverted.

I. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

J. Inserts:
1. Provide inserts for placement in concrete formwork.

K. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

3.3 APPLICATION

A. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers for piping 2 inches and smaller.

B. Provide plug valves in natural gas systems for shut-off service for piping 2-1/2 inches and larger.

3.4 SERVICE CONNECTIONS

A. Provide new gas service complete with gas meter and regulators in accordance with Section 33 52 16. Gas service distribution piping to have initial minimum pressure of 2 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.5 SCHEDULES

A. Pipe Hanger Spacing:
1. Metal Piping:
   a. Pipe Size: 1/2 inches to 1-1/4 inches:
      1) Maximum Hanger Spacing: 6.5 ft.
      2) Hanger Rod Diameter: 3/8 inches.
   b. Pipe Size: 1-1/2 inches to 2 inches:
      1) Maximum Hanger Spacing: 10 ft.
      2) Hanger Rod Diameter: 3/8 inch.
   c. Pipe Size: 2-1/2 inches to 3 inches:
      1) Maximum Hanger Spacing: 10 ft.
      2) Hanger Rod Diameter: 1/2 inch.
   d. Pipe Size: 4 inches to 6 inches:
      1) Maximum Hanger Spacing: 10 ft.
      2) Hanger Rod Diameter: 5/8 inch.

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic system requirements.
B. Heating water piping, above grade.
C. Chilled water piping, above grade.
D. Equipment drains and overflows.
E. Pipe hangers and supports.
F. Unions, flanges, mechanical couplings, and dielectric connections.
G. Valves:
   1. Pressure independent temperature control valves and balancing valves.

1.2 RELATED REQUIREMENTS

A. Section 08 31 00 - Access Doors and Panels.
B. Section 23 05 53 - Identification for HVAC Piping and Equipment.
C. Section 23 07 19 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2023.
B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.
C. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250 2018.
D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.
F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
G. ASME B31.9 - Building Services Piping 2020.
H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
I. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service 2019a.
J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2023.
K. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).
L. ASTM B32 - Standard Specification for Solder Metal 2020.
M. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.
N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.
O. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2021a.

P. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) 2020.

Q. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2021.

R. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 2020.

S. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.

T. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers 1992 (Reapproved 2022).

U. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications 2007 (Reapproved 2019).

V. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2019.

W. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).

X. AWWA C606 - Grooved and Shouldered Joints 2022.

Y. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

1.4 SUBMITTALS

A. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

B. Product Data:
1. Include data on pipe materials, pipe fittings, valves, and accessories.
2. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

C. Shop Drawings: Indicate pipe fittings, particulars such as gages, sizes, and configuration prior to start of work for [all piping] systems. Provide drawings in 1/4" per foot scale or larger.

1.5 QUALITY ASSURANCE

A. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
3. Grooved mechanical joints may be used in accessible locations only.
   a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
   b. Grooved mechanical connections and joints comply with AWWA C606.
      1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
      2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
   c. Use rigid joints unless otherwise indicated.
4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
   1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
   2. For throttling, bypass, or manual flow control services, use ball or butterfly valves.
   3. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.
   4. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

2.2 HEATING WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Threaded Joints: ASME B16.3, malleable iron fittings.
   3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
   4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16 22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn, using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
   3. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

2.3 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Threaded Joints: ASME B16.3, malleable iron fittings.

3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16 22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:

B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
1. Fittings: ASTM D2466 or D2467, PVC.
2. Joints: Solvent welded in accordance with ASTM D2855.

2.5 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58. Refer to Section 230529 Hangers and Supports for HVAC Piping and Equipment.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.6 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:
1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:
1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick, preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.
2. Mechanical Couplings: Comply with ASTM F1476.
3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections:
1. Waterways:
   a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
   b. Dry insulation barrier able to withstand 600-volt breakdown test.
   c. Construct of galvanized steel with threaded end connections to match connecting piping.
   d. Suitable for the required operating pressures and temperatures.
2. Flanges:
   a. Dielectric flanges with same pressure ratings as standard flanges.
   b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
   c. Dry insulation barrier able to withstand 600-volt breakdown test.
   d. Construct of galvanized steel with threaded end connections to match connecting piping.
   e. Suitable for the required operating pressures and temperatures.

2.7 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES AND BALANCING VALVES

A. Control Valves: Factory-fabricated pressure independent with internal differential pressure regulator (DPRV), which automatically adjusts to normal changes in system pressure and provides 100 percent control valve authority at all positions of the valve.
1. PICV to accurately control the flow from 0 to 100 percent full rated flow with an operating pressure differential range of 3 to 60 psig.
2. Provide control valve to incorporate control, balancing, and flow limiting. Hydronic system pressure independent control valve bodies to comply with ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure and have the following characteristics:
   a. 2 NPS and Smaller: Class 150 bronze body with union connections, stainless steel trim trim, stainless steel rising stem, stainless steel disc or ball, and screwed ends with backseating capacity repackable under pressure.
   b. 2-1/2 NPS and Larger: Class 125 iron or ductile iron body, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, flanged ends with backseating capacity repackable under pressure.
   c. Pressure Control Seat: Brass construction with vulcanized EPDM.
   d. Sizing: Line-size.
   e. Close-Off (Differential) Pressure Rating: Combination of actuator, DPRV action, and trim to provide a minimum close-off pressure rating of 150 percent of total system (pump) head.

B. Electronic Actuators: Direct-mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.

C. Provide actuator with visible position indication. Fail positions on power failure to include in-place, open or closed as indicated in the controls specifications.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interference with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls, and floors.

G. Slope piping and arrange to drain at low points.

H. Grooved Joints:
1. Install in accordance with the manufacturer's latest published installation instructions.
2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

I. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

J. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.

K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 07 19.

L. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00 .

M. Use eccentric reducers to maintain top of pipe level.

N. Install valves with stems upright or horizontal, not inverted.

3.3 SCHEDULES

A. Piping Applications:
1. Hot-water heating piping, above ground, NPS 2 and smaller, shall be one of the following:
a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or mechanical pressure-seal joints.
b. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; threaded or pressure-seal joints.
2. Hot-water heating piping, above ground, NPS 2-1/2 and larger, shall be one of the following:
a. Typle L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints; pressure seal joints are acceptable on piping NPS 4 and smaller.
b. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints; pressure seal joints are acceptable on piping NPS 4 and smaller.
c. Schedule 40 steel pipe, grooved, mechanical joint coupling and fitting; and grooved mechanical joints.
3. Chilled-water piping, above ground, NPS 2 and smaller, shall be one of the following:
a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or mechanical pressure-seal joints.
b. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; threaded or pressure-seal joints.
4. Chilled-water piping, above ground, NPS 2-1/2 and larger, shall be one of the following:
a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints; pressure seal joints are acceptable on piping NPS 4 and smaller.
b. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints; pressure seal joints are acceptable on piping NPS 4 and smaller.
c. Schedule 40 steel pipe, grooved, mechanical joint coupling and fitting; and grooved mechanical joints.
5. Condensate drain piping shall be one of the following:
a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or mechanical pressure-seal joints.
b. Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

B. Hanger Spacing for Copper Tubing.
1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. 2-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
7. 6 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 8 Inches: Maximum span, 16 feet; minimum rod size, 5/8 inch.
9. 10 Inches: Maximum span, 18 feet; minimum rod size, 3/4 inch.
10. 12 inches: Maximum span, 19 feet; minimum rod size, 7/8 inch.

C. Hanger Spacing for Steel Piping.
1. 1/2 Inch, 3/4 Inch, and 1 Inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.

4. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 6 Inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. 8 Inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. 10 Inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. 12 Inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.

D. Hanger Spacing for Plastic Piping.
1. 1/2 Inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
2. 3/4 Inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
3. 1 Inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
4. 1-1/4 Inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
5. 1-1/2 Inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.
6. 2 Inches: Maximum span, 69 inches; minimum rod size, 3/8 inch.

END OF SECTION

SECTION 23 21 14 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion tanks.
B. Air vents.
C. Air separators.
D. Strainers.
E. Suction diffusers.
F. Pump connectors.
G. Combination pump discharge valves.

1.2 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2023.

1.3 SUBMITTALS

A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 EXPANSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM diaphragm or bladder seal factory precharged to 12 psi, and steel support stand.
B. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.2 AIR VENTS

A. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
B. Float Air Vent:
   1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

C. Maximum Fluid Pressure: 150 psi.

D. Maximum Fluid Temperature: 250 degrees F.

2.3 AIR SEPARATORS

A. In-line Air Separators:
1. Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi operating pressure.
2. Maximum Allowable Service Temperature: 450 degrees F.

2.4 STRAINERS

A. Size 2 inch and Under:
1. Provide threaded, grooved, or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:
1. Provide flanged or grooved iron body for 175 psi working pressure, Y pattern with 1/16 inch stainless steel perforated screen.
2. Body Material by Fluid Service:

C. Size 5 inch and Larger:
1. Provide flanged or grooved iron body for 175 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen.
2. Liquid Fluid Service: Up to 285 psi at 100 degrees F.

2.5 SUCTION DIFFUSERS

A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning.

B. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.6 PUMP CONNECTORS

A. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
1. Maximum Allowable Working Pressure: 150 psig at 250 degrees F.
2. Accommodate the Following:
a. Axial Deflection in Compression and Expansion: 3/4 inch.
b. Lateral Movement: 3/4 inch.
c. Angular Rotation: 15 degrees.
d. Force developed by 1.5 times specified maximum allowable operating pressure.
3. End Connections: Same as specified for pipe jointing.
4. Provide necessary accessories including, but not limited to, swivel joints.

2.7 COMBINATION PUMP DISCHARGE VALVES

A. Quarter-Turn Plug Type: Flanged cast-iron body with bolt-on bonnet, position indicator, stainless steel stem, backflow preventer, memory stop, metering connectors, bubble-tight shutoff, and wrench-adjustable plug flow regulator.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Provide manual air vents at system high points and as indicated.

C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

D. Provide air separator on suction side of system circulation pump and connect to expansion tank.

E. Provide valved drain and hose connection on strainer blowdown connection.

F. Provide pump suction fitting on suction side of base-mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.

H. Support pump fittings with floor-mounted pipe and flange supports.

I. Pipe relief valve outlet to nearest floor drain.

J. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

END OF SECTION

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SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Circulators.
B. In-line pumps.
C. End-suction pumps.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.
B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
C. Section 23 07 19 - HVAC Piping Insulation.
D. Section 23 09 34 - Variable-Frequency Motor Controllers.
E. Section 23 21 13 - Hydronic Piping.
F. Section 23 21 14 - Hydronic Specialties.
G. Section 25 35 00 - Integrated Automation Instrumentation and Terminal Devices for HVAC.

1.3 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
B. UL 778 - Standard for Motor-Operated Water Pumps Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.
C. 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 Pump Seals: One for each type and size of pump.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Armstrong Fluid Technology, Inc.
B. Bell & Gossett, a Xylem Inc. brand.
C. Grunfoss.
D. Taco.
E. Paco Pumps.
F. Peerless Pump Company.

2.2 GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Electrical Requirements:
   1. Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.
   2. Variable Frequency Drives (VFDs): Provide in accordance with Section 23 09 34, except for integral-VFDs.
   3. Enclosures: Provide unspecified product(s) required to fit motor:

2.3 CIRCULATORS

A. Horizontal shaft, single-stage pump with direct connected, resilient-mount, oil lubricated motor for discharge pressures of up to 125 psi.

B. Casing: Cast iron, with flanged pump connections.

C. Impeller: Non-ferrous keyed to shaft.

D. Bearings: Oil-lubricated bronze sleeve.

E. Shaft: Alloy steel with bronze sleeve, integral thrust collar.

F. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.

G. Drive: Flexible coupling.

H. Electrical:
   1. Motor: 1,750 rpm unless indicated otherwise; see Section 23 05 13.
   2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.4 IN-LINE PUMPS

A. Type: Vertical, single stage, close coupled, radially split casing, for in-line mounting, for 175 psi working pressure.

B. Casing: Cast iron with seal flush connection, threaded suction, and discharge ports with gauge port and drain plug.

C. Impeller: Stainless steel, fully enclosed, keyed directly to motor shaft or extension.

D. Shaft: Stainless steel with stainless steel impeller cap screw or nut and stainless steel sleeve.

E. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.

F. Electrical:
   1. Motor: 1,750 rpm, open drip-proof (ODP); see Section 23 05 13.

2.5 END-SUCTION PUMPS

A. Type: Horizontal shaft, single stage, direct connected, radially split casing, for 125 psi maximum working pressure.

B. Casing: Cast iron with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Bearings: Grease lubricated roller or ball bearings.

E. Shaft: Stainless steel.

F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

G. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 250 degrees F maximum continuous duty temperature.

H. Drive: Flexible coupling with coupling guard.

I. Baseplate: Cast iron or fabricated steel with integral drain rim.

J. Electrical:
   1. Motor: 1,750 rpm, total-enclosed, fan-cooled (TEFC); see Section 23 05 13.
   2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals, piped to and discharging into floor drains.

G. Check, align, and certify alignment of base-mounted pumps prior to start-up.

H. Install close-coupled and base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. See Section 03 30 00.

I. Lubricate pumps before start-up.

J. Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tappings.

K. Controls Human-Machine Interface (HMI): HVAC operator terminal; see Section 25 35 00.

END OF SECTION

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SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ducts.
B. Air plenums and casings.
C. Ducts for kitchen exhaust applications.

1.2 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting: Weld priming, weather resistant, paint or coating.
B. Section 09 91 23 - Interior Painting: Weld priming, paint or coating.
C. Section 11 40 00 - Foodservice Equipment: Kitchen range hoods.
D. Section 23 01 30.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.
E. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
F. Section 23 33 00 - Air Duct Accessories.
G. Section 23 33 19 - Duct Silencers.
H. Section 23 36 00 - Air Terminal Units.
I. Section 23 37 00 - Air Outlets and Inlets: Fabric air distribution devices.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
B. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip 2022a.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.
E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
G. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements 2015.
H. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements 2015.
I. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2015.
J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
K. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.
L. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

N. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines 2001.

O. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors Current Edition, Including All Revisions.

P. UL 1978 - Grease Ducts Current Edition, Including All Revisions.

Q. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all duct systems. Provide drawings in 1/4" per foot scale or larger.

D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

1.6 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.

C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23 33 19.

D. Duct Shape and Material in accordance with Allowed Static Pressure Range:

E. Duct Sealing and Leakage in accordance with Static Pressure Class:
1. Low Pressure Service: Up to 2 in-wc:
   a. Seal: Class C, apply to seal off transverse joints.
   b. Leakage:
      1) Rectangular: Class 24 or 24 cfm/100 sq ft.
      2) Round: Class 12 or 12 cfm/100 sq ft.

--- Medium Pressure service ranges from 3 to 6 in-wc. ---
--- High Pressure service ranges from 6 to 10 in-wc. ---

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2. Medium and High Pressure Service: Above 3 in-wc:
   a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
   b. Leakage:
      1) Rectangular: Class 6 or 6 cfm/100 sq ft.
      2) Round: Class 3 or 3 cfm/100 sq ft.

F. Duct Fabrication Requirements:
1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
3. Construct tee's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.2 METAL DUCTS

A. Material Requirements:
1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Rectangular Metal Duct:
1. Rectangular Double Wall Insulated: Rectangular spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
   a. Insulation:
      1) Thickness: 1 inch.
      2) Material: Fiberglass.

C. Flat-Oval Metal Ducts:
1. Flat-Oval Single Wall Duct: Machine made from a round spiral lock seam duct.
   a. Fittings: Manufacture at least two gauges heavier metal than the duct.
   b. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

D. Round Metal Ducts:
1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
2. Round Double Wall Insulated Duct: Round spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
   a. Insulation:
      1) Thickness: 1 inch.
      2) Material: Fiberglass.
3. Round Connection System: Interlocking duct connection system per SMACNA (DCS).

E. Round Spiral Duct:
1. Round spiral lock seam duct with galvanized steel outer wall.

F. Connectors, Fittings, Sealants, and Miscellaneous:
   1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
   2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
   3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
      a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
      b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
      c. For Use with Flexible Ducts: UL labeled.
   4. Gasket Tape:
      a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
   5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

G. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form a spiral helix.
   1. Insulation: R6 insulation with polyethylene vapor barrier film.
   2. Pressure Rating: 10 in-wc positive and 5 in-wc negative.
   3. Maximum Velocity: 5500 fpm.
   4. Temperature Range: Minus 20 degrees F to 250 degrees F.

2.3 AIR PLENUMS AND CASINGS

A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.

B. Minimum Fabrication Requirements:
   1. Fabricate acoustic plenum or casing with reinforcing turned inward.
   2. Provide 16 gauge, 0.059-inch sheet steel back facing and 22 gauge, 0.029-inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers.
   3. Construct panels 3 inches thick packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16 gauge, 0.059-inch sheet steel.
   4. Mount floor mounted plenum or casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18 gauge, 0.052-inch expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

C. Access Doors:
   1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
   2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
   3. Provide clear wire glass observation ports, minimum 6 by 6 inch size.

2.4 DUCTS FOR KITCHEN EXHAUST APPLICATIONS

A. Provide ductwork, fittings, and appurtenances per NFPA 96, SMACNA (KVS), UL 1978, and UL 2221 requirements and guidelines.

B. Class 1 duct for air with gas and grease particle exhaust at an air velocity of 1,500 to 2,500 fpm.

C. Where ducts are not self-draining back to equipment, provide low-point drain pocket with the copper drain pipe to a sanitary sewer.

D. Design, fabricate, and install liquidtight preventing exhaust leakage into building.

E. Dishwasher Exhaust Duct:
   1. Duct Size: 1 in-wc pressure class stainless steel.
   2. Fabricate using single wall, 20 gauge, 0.035-inch Type 304 stainless steel with external welded joints.
   3. Seal joints during installation with factory-supplied overlapping V-bands and sealant.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Comply with safety standards NFPA 90A and NFPA 90B.

C. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Flexible Ducts: Connect to metal ducts with adhesive plus sheet metal screws.

F. Kitchen Range Hoods: Install when provided by Section 11 40 00 then fit-out with respective ductwork and accessories to interconnect exhaust system.

G. Kitchen Hood Exhaust: Provide residue traps at the base of vertical risers with provisions for the cleanout.

H. Duct sizes indicated are inside clear dimensions.

I. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

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. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

L. Use double nuts and lock washers on threaded rod supports.

M. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.

N. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

O. Duct Accessories, Terminal Units, Inlets, and Outlets: Interconnect as indicated in Sections 23 33 00, 23 36 00, and 23 37 00.

P. Duct Insulation: Provide duct insulation in compliance with Section 23 07 13.

Q. Painting: Provide surface finish as indicated on drawings and Sections 09 91 13 and 09 91 23.

3.2 CLEANING

A. Clean thoroughly each duct system as indicated within Section 23 01 30.51.

B. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters or bypass during cleaning. Provide adequate access to the ductwork for cleaning purposes.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Turning vanes.
B. Backdraft dampers - metal.
C. Combination fire and smoke dampers.
D. Duct access doors.
E. Duct test holes.
F. Fire dampers.
G. Flexible duct connectors.
H. Volume control dampers.

1.2 RELATED REQUIREMENTS

A. Section 23 31 00 - HVAC Ducts and Casings.

1.3 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
B. NFPA 92 - Standard for Smoke Control Systems 2021, with Amendment.
C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.
F. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.
G. UL 555C - Standard for Safety Ceiling Dampers Current Edition, Including All Revisions.
H. UL 555S - Standard for Smoke Dampers Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: For each type of product.
B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Fusible Links: One of each type and size.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 **TURNING VANES**

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. 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."

C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.2 BACKDRAFT DAMPERS - METAL

A. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 COMBINATION FIRE AND SMOKE DAMPERS

A. Dynamic; fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

B. Provide factory sleeve and collar for each damper.

C. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.

D. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on exterior of duct and link to damper operating shaft.

E. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.

F. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.4 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
   1. Less Than 12 inches Square: Secure with sash locks.
   2. Up to 18 inches Square: Provide two hinges and two sash locks.
   3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.
   4. Larger Sizes: Provide an additional hinge.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.5 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 FIRE DAMPERS

A. Dynamic; fabricate in accordance with NFPA 90A and UL 555, and as indicated.

B. Ceiling (Radiation) Dampers: Galvanized steel, 22 gauge, 0.0299 inch frame and 16 gauge, 0.0598 inch flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
   1. Boot Fitting: Factory-provided el type (90 degree). Include field-provided collar.
   2. Rated for three hour service in compliance with UL 555C.

C. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

D. Fusible Links: UL 33, separate at 165 degrees F.

2.7 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
      a. Net Fabric Width: Approximately 2 inches wide.
   2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

C. Maximum Installed Length: 14 inch.

2.8 MANUAL **VOLUME DAMPERS**

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch.
   2. Blade: 24 gauge, 0.0239 inch, minimum.

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gauge, 0.0478 inch, minimum.

D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

E. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 31 00 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

G. Demonstrate re-setting of fire dampers to Owner's representative.

H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

K. Use turning vanes only where indicated.

L. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof ventilators.
B. Ceiling exhaust fans.
C. Inline centrifugal fans and blowers.
D. Kitchen hood upblast roof exhausters.
E. Utility vent blowers.
F. Utility vent blower sets.

1.2 RELATED REQUIREMENTS

A. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.

1.3 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.
B. AMCA 99 - Standards Handbook 2016.
C. AMCA 204 - Balance Quality and Vibration Levels for Fans 2020.
D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.
E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.
F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2022.
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
I. UL 705 - Power Ventilators Current Edition, Including All Revisions.
J. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Fan Belts: One set for each individual fan.

1.5 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.1 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

G. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.2 ROOF VENTILATORS

A. Manufacturers:
1. Carnes, a division of Carnes Company Inc
2. Acme Engineering & Manufacturing Corp
3. Greenheck Fan Corporation
4. Loren Cook Company
5. PennBarry, Division of Air System Components
6. Twin City Fan & Blower

B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

C. Roof Curb: 16 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.

D. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.

F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

G. Performance Ratings: As indicated on drawings.

2.3 CEILING EXHAUST FANS

A. Manufacturers:
1. Broan-Nu Tone, L.L.C.
2. Carnes, a division of Carnes Company Inc
3. Greenheck Fan Corporation
4. Panasonic Corporation of North America
5. Loren Cook Company
6. PennBarry, Division of Air System Components
7. Twin City Fan & Blower

B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

C. Grille: Aluminum with baked white enamel finish.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

E. Performance Ratings: As indicated on drawings.

2.4 INLINE CENTRIFUGAL FANS AND BLOWERS

A. Manufacturers:
1. Acme Engineering & Manufacturing Corp.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. PennBarry, Division of Air System Components.
5. Twin City Fan & Blower.

B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

C. Forward Curved Blower:
1. Adjustable belt or direct-driven, resiliently-mounted induction motor, heavy duty ball bearings, galvanized steel housing for indoor or outdoor service lined with acoustic insulation, and removable service panels.
2. Operation: As indicated on drawings.
3. Accessories: Provide backdraft damper and intake hood with bird screen.

D. Disconnect Switch: Cord and plug in housing for thermal overload protected motor.

E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

F. Performance Ratings: As indicated on drawings.

2.5 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

A. Manufacturers:
1. Carnes, a division of Carnes Company Inc.
2. Greenheck Fan Corporation.
3. PennBarry, Division of Air System Components.
4. Twin City Fan & Blower.

B. Belt Drive Fan:
1. Fan Wheel:
a. Type: Non-overloading, backward inclined centrifugal.
b. Material: Aluminum, statically and dynamically balanced.
2. Housing:
a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
b. Rigid internal support structure.
c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
e. Provide breather tube for fresh air motor cooling and wiring.

C. Shafts and Bearings:
1. Fan Shaft:
a. Ground and polished steel with anti-corrosive coating.
b. First critical speed at least 25 percent over maximum cataloged operating speed.
2. Bearings:
a. Permanently sealed or pillow block type.
b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.

c. 100 percent factory tested.

D. Drive Assembly:
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
2. Belts: Static free and oil resistant.
3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. Motor pulley adjustable for final system balancing.
5. Readily accessible for maintenance.

E. Disconnect Switches:
1. Factory mounted and wired.
2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
a. Indoor Clean, Dry Locations: Type 1.
b. Outdoor Locations: Type 3R.
3. Finish for Painted Steel Enclosures: Provide manufacturer's standard unless otherwise indicated.
4. Positive electrical shutoff.
5. Wired from fan motor to junction box installed within motor compartment.

F. Roof Curb: 16 inch high self-flashing of aluminum with continuously welded seams, built-in cant strips, insulation and curb bottom, curb bottom, ventilated double wall, and factory installed nailer strip.

G. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

H. Options/Accessories:
1. Birdscreen:
a. Provide galvanized steel construction.
2. Clean Out Port: Removable grease repellent compression rubber plug allows access for cleaning wheel through windband.
3. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by NFPA 96.
4. Drain Connection:
a. Aluminum construction.
b. Allows single-point drainage of grease, water, or other residues.
5. Grease Trap:
a. Aluminum.
b. Includes drain connection.
c. Collects grease residue.
6. Hinge Kit:
a. Aluminum hinges.
b. Hinges and restraint cables mounted to base (sleeve).
c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.
7. Heat Baffle: Prevents heat from radiating into motor compartment.

I. Performance Ratings: As indicated on drawings.

2.6 UTILITY VENT BLOWER SETS

A. Manufacturers:
1. Acme Engineering & Manufacturing Corp.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. PennBarry, Division of Air System Components.
5. Twin City Fan & Blower.

B. Belt Drive Fan:
   1. Fan Wheel:
      a. Type: Non-overloading, backward inclined centrifugal.
      b. Material: Aluminum, statically and dynamically balanced.
   2. Housing:
      a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
      b. Rigid internal support structure.
      c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
      d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
      e. Provide breather tube for fresh air motor cooling and wiring.

C. Shafts and Bearings:
   1. Fan Shaft:
      a. Ground and polished steel with anti-corrosive coating.
      b. First critical speed at least 25 percent over maximum cataloged operating speed.
   2. Bearings:
      a. Permanently sealed or pillow block type.
      b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
      c. 100 percent factory tested.

D. Drive Assembly:
   1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
   2. Belts: Static free and oil resistant.
   3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
   4. Motor pulley adjustable for final system balancing.
   5. Readily accessible for maintenance.

E. Disconnect Switches:
   1. Factory mounted and wired.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   3. Finish for Painted Steel Enclosures: Provide manufacturer's standard unless otherwise indicated.
   4. Positive electrical shutoff.
   5. Wired from fan motor to junction box installed within motor compartment.

F. Roof Curb: 16 inch high; self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, curb bottom, ventilated double wall, and factory installed nailer strip.

G. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

H. Options/Accessories:
   1. Dampers: Provide gravity type.
   2. Drain Connection:
      a. Allows single-point drainage of grease, water, or other residues.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Hung Cabinet Fans:
   1. Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

E. Provide sheaves required for final air balance.

F. Install backdraft dampers on inlet to roof and wall exhausters.

END OF SECTION

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single-duct terminal units.
   1. Single-duct, variable-volume units.

B. Fan-powered units.

1.2 RELATED REQUIREMENTS

A. Section 23 09 93 - Sequence of Operations for HVAC Controls.

B. Section 23 31 00 - HVAC Ducts and Casings.

1.3 REFERENCE STANDARDS

A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils 2001, with Addenda (2011).

B. AHRI 880 (I-P) - Performance Rating of Air Terminals 2017.

C. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Addendum (2022).

D. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units 2016.

E. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) 2019.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

I. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems 2008.

1.4 SUBMITTALS

A. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum eight years of documented experience.

PART 2 PRODUCTS

2.1 SINGLE-DUCT, VARIABLE-VOLUME UNITS

A. Manufacturers:
   1. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp.
   2. Krueger-HVAC
   3. Enviromental Technologies, Inc.
   4. Metalaire, a brand of Metal Industries Inc.
   5. Price Industries, Inc.
   6. Titus.

7. Trane, a brand of Ingersoll Rand.

B. General:
   1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
   2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

C. Unit Casing:
   1. Minimum 22 gauge, 0.0299 inch galvanized steel.
   2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
   3. Unit Discharge: Rectangular, with slip-and-drive connections.
   4. Acceptable Liners:
      a. 3/4 inch thick, coated, fibrous-glass complying with ASTM C1071.
         1) Secure with adhesive.
         2) Coat edges exposed to airstream with NFPA 90A approved sealant.
         3) Cover liner with non-porous foil.
      b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

D. Sound Attenuator:
   1. Provide if required to meet scheduled acoustical performance requirements.
   2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
   3. At 2000 fpm inlet velocity, the minimum operating pressure with attenuator added not to exceed 0.14 inch wg.

E. Damper Assembly:
   1. Heavy-gauge, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
   2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
   3. Incorporate low leak damper blades for tight airflow shutoff.
      a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 inch wg inlet static pressure, tested in accordance with ASHRAE Std 130.

F. Hot Water Heating Coil:
   1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
   2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
      a. Two rows with ten fins-per-inch heating capacity density.
   3. Coil leak tested to minimum 350 psig.
   4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.

G. Electric Heating Coil:
   1. Listed and provided by the terminal unit manufacturer.
   2. Coil Casing: 20 gauge, 0.0359 inch galvanized steel.
   3. Heating Elements: Nickel chrome, supported by ceramic insulators.
   4. Integral Control Panel: NEMA 250, Type 2 enclosure with hinged access door for access to all controls and safety devices.
   5. Furnish a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow.

6. Provide the following additional components, mounted and/or wired within the control enclosure:
   a. Fused or non-fused door interlocking disconnect switch.
   b. Mercury contactors.
   c. Fuse block.
7. Factory wired, including all limit switches and steps of control as indicated on the equipment schedule, with the SSR (solid-state relay) proportional heat control.
8. Provide SCR (Silicon Controlled Rectifier) controller.

H. Electrical Requirements:
1. Single-point power connection.
2. Equipment wiring to comply with requirements of NFPA 70.

I. Controls:
1. DDC (Direct-Digital Controls):
   a. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
   b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
      1) Occupied and unoccupied operating mode.
      2) Remote reset of temperature or CFM set points.
      3) Proportional, plus integral control of room temperature.
      4) Monitoring and adjusting with portable terminal.
   c. Room Sensor:
      1) Compatible with temperature controls specified.
      2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
   a. Signal accuracy: Plus/minus five percent throughout terminal operating range.
3. Control Sequence:
   a. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg inlet static pressure.
   b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.
   c. See Section 23 09 93.

2.2 FAN-POWERED PARALLEL UNITS

A. Manufacturers:
1. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp.
2. Enviromental Technologies, Inc.
3. Krueger.
4. Metalaire, a brand of Metal Industries Inc.
5. Price Industries, Inc.
6. Titus.
7. Trane, a brand of Ingersoll Rand.

B. General:
1. Factory-assembled and wired, AHRI 880 (I-P) rated, horizontal fan-powered terminal unit with blower, blower motor, mixing plenum, and primary air damper contained in a single unit housing.

C. Unit Casing:
1. Minimum 22 gauge, 0.0299 inch galvanized steel.
2. Primary Air Inlet Collar: Suitable for standard flexible duct sizes.

3. Unit Discharge: Rectangular, suitable for flanged duct connection.
4. Plenum Inlet: Filter rack with disposable filters.
   a. 1 inch thick disposable fiberglass filters.
   b. Minimum Efficiency Reporting Value (MERV): 6, when tested in accordance with ASHRAE Std 52.2.
5. Acceptable Liners:
   a. 3/4 inch thick, coated, fibrous-glass complying with ASTM C1071.
      1) Secure with adhesive.
      2) Coat edges exposed to airstream with NFPA 90A approved sealant.
      3) Cover liner with non-porous foil.

D. Sound Attenuator:
1. Provide if required to meet scheduled acoustical performance requirements.
2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.

E. Primary Air Damper Assembly:
1. Heavy-gauge, galvanized steel or extruded aluminum construction with solid shaft rotating in bearings.
2. Provide indicator on damper shaft or alternative method for indicating damper position over full range of 90 degrees.
3. Incorporate low leak (2 percent) damper blades for tight airflow shutoff.
4. Fan(s): Forward curved, centrifugal type.
5. Fan Motor:
   a. ECM (Electrically Commutated Motor):
   b. Fan motor shaft directly connected to fan and and isolated from unit casing to prevent transmission of vibration.

F. Electric Heating Coil:
1. Listed and provided by the terminal unit manufacturer.
2. Coil Casing: Minimum 20 gauge, 0.0359 inch galvanized steel.
3. Heating Elements: Open wire, nickel chrome, supported by ceramic insulators.
4. Integral Control Panel: NEMA 250, Type 2 enclosure, with hinged access door for access to all controls and safety devices.
5. Provide a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow or electrical interlock to prevent heater operation when fan is not running.
6. Provide the following additional components, mounted and/or wired within the control enclosure:
   a. Fused or non-fused door interlocking disconnect switch.
   b. Mercury contactors.
   c. Fuse block.
7. Provide SCR (Silicon Controlled Rectifier) controller.

G. Hot Water Heating Coil:
1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal unit with flanged discharge for attachment to downstream ductwork.
2. Heavy-gauge aluminum fins, mechanically bonded to tubes.
3. Copper Tubes: 0.016 inch minimum wall thickness with male solder header connections.
4. Coil leak tested to minimum 305 psig.
5. Base performance data on tests run in accordance with AHRI 410.

H. Electrical Requirements:
1. Single-point power connection.
2. Equipment wiring to comply with requirements of NFPA 70.

I. Controls:
   1. DDC (Direct-Digital Controls):
      a. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
      b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
         1) Occupied and unoccupied operating mode.
         2) Remote reset of temperature or CFM set points.
         3) Proportional, plus integral control of room temperature.
         4) Monitoring and adjusting with portable terminal.
      c. Room Sensor:
         1) Compatible with temperature controls specified.
         2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
   2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
      a. Signal accuracy: Plus/minus five percent throughout terminal operating range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that conditions are suitable for installation.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

C. Provide ceiling access doors or locate units above easily removable ceiling components.

D. Support units individually from structure in accordance with SMACNA (SRM).

E. Do not support from ductwork.

F. Connect to ductwork in accordance with Section 23 31 00.

G. Verify that electric power is available and of the correct characteristics.

3.3 FIELD QUALITY CONTROL

A. Provide manufacturer's field representative to inspect field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
   1. Leak Test:
      a. After installation, fill water coils and test for leaks.
      b. Repair leaks and retest until no leaks exist.
   2. Operational Test:
      a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
      b. Test and adjust controls and safeties.
      c. Replace damaged and malfunctioning controls and other equipment.
      d. Remove and replace malfunctioning units and retest as specified above.

3.4 CLEANING

A. Vacuum clean coils and inside of units.

B. Install new filters.

END OF SECTION

SECTION 23 40 00 - HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disposable, extended area panel filters.

B. Filter frames and housings.

C. Filter gauges.

1.2 REFERENCE STANDARDS

A. AHRI 850 (I-P) - Performance Rating of Commercial and Industrial Air Filter Equipment 2013 (Reaffirmed 2023).

B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Addendum (2022).

1.3 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

PART 2 PRODUCTS

2.1 FILTER MANUFACTURERS

A. AAF International/American Air Filter

B. The Camfil Group

C. Or Approved Equal.

2.2 PERFORMANCE REQUIREMENTS

A. Comply with the rating requirements in AHRI 850 (I-P).

2.3 DISPOSABLE, EXTENDED AREA PANEL FILTERS

A. Media: UL 900, pleated, lofted, synthetic blend; supported and bonded to welded wire grid by corrugated aluminum separators.
   1. Nominal thickness: 2 inches.

B. Minimum Efficiency Reporting Value (MERV): 8, when tested in accordance with ASHRAE Std 52.2.

C. Minimum Efficiency Reporting Value (MERV-A): 8A, when tested in accordance with ASHRAE Std 52.2 Appendix J.

D. Rating, per ASHRAE Std 52.2:
   1. Initial resistance at 500 FPM face velocity: 0.31 inch WG.
   2. Recommended final resistance: 1.0 inch WG.

2.4 FILTER FRAMES AND HOUSINGS

A. General: Fabricate filter frames and supporting structures of 16 gauge, 0.0598 inch galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.

B. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for 24 by 24 inches filter media, minimum 2 inches thick; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.

2.5 FILTER GAUGES

A. Manufacturers:
1. Dwyer Instruments, Inc
2. H.O. Trerice Co
3. Weiss Instruments
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-0.5 inch WG, 2 percent of full scale accuracy.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

END OF SECTION

SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Casing construction.
B. Fan section.
C. Coil section.
D. Filter and air cleaner section.
E. Damper section.
F. Access section.
G. Controls.
H. Roof mounting curb.

1.2 RELATED REQUIREMENTS

A. Section 23 34 13 - Axial HVAC Fans.

1.3 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).
B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils 2001, with Addenda (2011).
C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.
D. AMCA 99 - Standards Handbook 2016.
E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.
F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.
G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2022.
H. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.
I. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2012, with Editorial Revision (2015).
J. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Addendum (2022).
K. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
L. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating 2011 (Reapproved 2021).
M. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
N. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
O. UL 508 - Industrial Control Equipment Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
   2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
   3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
   4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
   5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Manufacturer's Instructions: Include installation instructions.

D. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Carrier Corporation

B. Daikin Applied

C. Trane Inc

D. York International Corporation / Johnson Controls Inc

E. Aaon.

2.2 CASING CONSTRUCTION

A. Full Perimeter Base Rail:
   1. Construct of galvanized steel.
   2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.

B. Casing:
   1. Construct of one piece, insulated, double wall panels.
   2. Provide mid-span, no through metal, internal thermal break.
   3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
   4. Casing Air Pressure Performance Requirements:
      a. Able to withstand up to 8 in-wc positive or negative static pressure.
      b. Not to exceed 0.0042 inches per inch deflection at 1.5 times design static pressure up to a maximum of plus 8 in-wc in positive pressure sections and minus 8 in-wc in negative pressure sections.

C. Access Doors:
   1. Construction, thermal and air pressure performance same as casing.
   2. Provide surface mounted handles on hinged, swing doors.

D. Outdoor Unit Roof:
   1. Factory install single layer outer roof above inner roof.
   2. Slope at a minimum of 0.125 inches per foot from one side of unit to the other side, or from center to sides of unit.
   3. Roof assembly to overhang each unit wall or base rail to overhang curb to facilitate water runoff and prevent water intrusion into roof curb to base connection.

E. Outside Air and Exhaust Air Weather Hood:
   1. Fabricate from same material as casing outer panel.
   2. Extend hood past perimeter of unit casing opening so as not to instruct airflow path.
   3. Paint hoods with same finish as external surface of outdoor units.
   4. Provide inlet hood for each fresh air damper with a sine wave moisture eliminator to prevent entrainment of water into the unit from outside air.
   5. Provide exhaust hoods for each exhaust air opening.
   6. Size each hood for 100 percent of nominal fresh air damper capacities.
   7. Protect each hood with bird screen to prevent nesting at intake or exhaust air flow paths.

F. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.

G. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.

H. Insulation:
   1. Provide minimum thermal thickness of 12 R throughout.
   2. Completely fill panel cavities in each direction to prevent voids and settling.
   3. Comply with NFPA 90A.

I. Drain Pan Construction:
   1. Provide cooling coil sections with an insulated, double wall, stainless steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
   2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
   3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
   4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.

J. Bottom Inlet Units: Provide steel or aluminum walking grate on structural supports.

K. Louvers: Stationary, of galvanized steel, 4 inches deep with plenum, nylon bearings, 1/2-inch mesh, 0.04-inch galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-L. Furnish adjustable louvers with hollow vinyl bulb edging on blades and foam side stops to limit leakage to maximum 2 percent at 4 in-wc differential pressure when sized for 2,000 fpm face velocity.

L. Marine Lights:
   1. Provide factory-mounted, water- and dust-resistant LED fixture(s) where indicated on drawings, with the following characteristics:
      a. Non-ferrous metal housing.
      b. Glass or polycarbonate lens.
      c. Factory wired to a single switch within factory provided service module.

d. Instant on white light with minimum 8,000 hour service life.

2. Provide factory installed service module including GFCI receptacle independent from load side; designed to receive power from field supplied 120 volt source.

M. Finish:

1. Outdoor Units:
   a. Coat external surface of unit casing with primer and minimum 1.5 mil, enamel paint finish.
   b. Comply with salt spray test in accordance with ASTM B177/B177M.
   c. Color: Manufacturer's standard color.
2. Indoor Units:
   a. Provide exterior, galvanized steel panels with painted surface complying with ASTM B177/B177M.
   b. Color: Manufacturer's standard color.

2.3 FAN SECTION

A. Type: Air foil, single width, single inlet, centrifugal type fan, in compliance with AMCA 99. Refer to Section 23 34 13

B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.

E. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.

F. Fan Accessories:

G. Flexible Duct Connections:

1. For separating fan, coil, and adjacent sections.

H. Drives:

1. Comply with AMCA 99.
2. Bearings: Heavy duty pillow block type, ball bearings, with ABMA STD 9 L-10 life at 50,000 hours.
3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
5. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.4 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.

C. Eliminators: Three break of Type 304 stainless steel, mounted over drain pan.

D. Air Coils:
1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

E. Fabrication:
1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
2. Fins: Aluminum.
3. Casing: Die formed channel frame of galvanized steel.

F. Water Heating Coils:
1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

G. Water Cooling Coils:
1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

2.5 HOSE KITS AND VALVES

A. Hoses:
1. Provide hoses for all units for connection to main water supply and return headers.
2. Length: 2 feet.
3. Material: Braided stainless steel rated to minimum 400 psi at 265 degrees F.

B. Manual Balancing Valves:
1. Brass body for shutoff and hydronic balancing.

C. Ball Valves:
1. Brass body for shutoff and hydronic balancing.
2. Provide pressure/temperature ports.

D. Y Strainers:
1. Bronze body.
2. "Y" type configuration with brass cap.
3. Maximum Operating Pressure: Minimum 450 psi.
4. Screen: Stainless steel.

2.6 FILTER AND AIR CLEANER SECTION

A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.

B. Hi-Efficiency Filters:
1. Media: 2 inch MERV-8 prefilter and 2 inch closely spaced, pleated, fine fiber, hi-efficiency MERV-13 final filter, sealed into a rigid frame, and capable of operating up to a maximum of 625 fpm without loss of efficiency and holding capacity.
2. Filter Rack: Side-access designed to hold rigid frames.
3. Minimum Efficiency Reporting Value: 8 MERV and 13 MERV when tested in accordance with ASHRAE Std 52.2.

C. Differential Pressure Gauge:

1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

2.7 DAMPER SECTION

A. Damper Blades:
1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
2. Self-lubricating stainless steel or synthetic sleeve bearings.
3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
5. Arrange in parallel or opposed-blade configuration.

2.8 ACCESS SECTION

A. Provide where indicated on drawings to allow for inspection, cleaning, and maintenance of field-installed components.

B. Construct access doors same as previously specified within this Section.

2.9 CONTROLS

A. Combination VFD - Disconnects:
1. Provide factory mounted, combination VFD - disconnect for each fan motor.
2. Factory mount in full metal enclosure and wire to fan motor.
3. Mount VFD-disconnect on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
4. Include control transformer with sufficient capacity to support the following items:
   a. VFD and controls.
   b. Binary output on-off wiring.
   c. Analog output speed-signal wiring.
   d. Wires that interface between VFD and direct digital controller.

B. Factory Installed Direct Digital Control (DDC) System:
1. Control Options:
   a. Electronic End Devices:
      1) Accommodate integration into existing building systems.
   b. Mixing Section Spring Return Damper Actuators:
      1) Outdoor Air Damper: Normally closed.
      2) Return Air Damper: Normally open.
   c. Fan Discharge Temperature and Temperature Averaging Sensors: Suitable for integration into the BAS system.
   d. Low Limit Switches:
      1) Factory wire to momentary push-button reset circuit.
      2) Provide separate low limit for each coil in a coil stack.
   e. Airflow Switches: Pipe to both filter sides to indicate fan status.
   f. Dirty Filter Switches: Pipe to both filter sides to indicate filter status.
   g. Condensate Overflow Switches:
      1) Comply with UL 508.
      2) Factory install float switch in drain pan to detect high water condensate level.
      3) Shut down air handling unit in the event of primary drain blockage.
      4) Locate float switch above primary drain line connection and below drain pan rim.

h. Provide Relays for each Binary Output of Controller for User Interface of the following:
   1) Motor starters for supply, return, and exhaust fans.
   2) Relief dampers.

C. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.

D. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.

2.10 ROOF MOUNTING CURB

A. Roof Vibration Isolation Mounting Curb: 24 inches high galvanized steel, channel frame with gaskets and nailer strips.

B. Include roof curb accessories for each roof mounted unit.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Bolt sections together with gaskets.

C. Install flexible duct connections between fan inlet and discharge ductwork and air handling unit sections. Ensure that metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.

D. Provide fixed sheaves required for final air balance.

E. Make connections to coils with unions or flanges.

F. Hydronic Coils:
   1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
   2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
   3. Locate water supply at bottom of supply header and return water connection at top.
   4. Provide manual air vents at high points complete with stop valve.
   5. Ensure water coils are drainable and provide drain connection at low points.

G. Cooling Coils:
   1. Pipe drain and overflow to nearest floor drain.

3.2 SYSTEM STARTUP

A. Provide manufacturer's field representative to perform systems startup.

B. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.

C. Adjust for proper operation within manufacturer's published tolerances.

3.3 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, and maintenance of each component.

END OF SECTION

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SECTION 26 05 05 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that abandoned wiring and equipment serve only abandoned facilities.

B. Demolition drawings are based on casual field observation.

C. Report discrepancies to Architect and Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 24 hours in advance.
   4. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner at least 24 hours before partially or completely disabling system.
   2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
   3. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

3.4 CLEANING AND REPAIR

A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps and broken electrical parts.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.
B. Metal-clad cable.
C. Wiring connectors.
D. Electrical tape.
E. Heat shrink tubing.
F. Wire pulling lubricant.
G. Cable ties.
H. Firestop sleeves.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.
B. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
D. Section 28 46 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.
G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
H. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable 2018.
I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
J. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.

M. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.

N. UL 183 - Manufactured Wiring Systems Current Edition, Including All Revisions.

O. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.

P. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.

Q. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.

R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

S. UL 1569 - Metal-Clad Cables Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.

I. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

J. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

K. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
         3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
   2. Control Circuits: 14 AWG.

L. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

M. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
   3. Color Code:
      a. 480Y/277 V, 3 Phase, 4 Wire System:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
         4) Neutral/Grounded: Gray.
      b. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.

3) Phase C: Blue.
4) Neutral/Grounded: White.

c. Equipment Ground, All Systems: Green.
d. Isolated Ground, All Systems: Green with yellow stripe.
e. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC.
b. Encore Wire Corporation.
c. General Cable Technologies Corporation.
d. Service Wire Co.
e. Southwire Company.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2.4 METAL-CLAD CABLE

A. Manufacturers:
1. AFC Cable Systems Inc.
2. Encore Wire Corporation.
3. Service Wire Co.
4. Southwire Company.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Grounding: Full-size integral equipment grounding conductor.
1. Provide additional isolated/insulated grounding conductor where indicated or required.

G. Armor: Steel, interlocked tape.

2.5 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
   5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   7. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

F. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
      a. Burndy LLC.
      b. Ilsco.
      c. Thomas & Betts Corporation.

G. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:
      a. Burndy LLC.
      b. Ilsco.
      c. Thomas & Betts Corporation.

H. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
   1. Manufacturers:
      a. Burndy LLC.
      b. Ilsco.
      c. Thomas & Betts Corporation.

2.6 ACCESSORIES

A. Electrical Tape:
   1. Manufacturers:
      a. 3M.
      b. Plymouth Rubber Europa.
   2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.

3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

D. Cable Ties: Material and tensile strength rating suitable for application.

E. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
1. Products:
a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built.

PART 3 EXECUTION

3.1 INSTALLATION

A. Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
8. Provide oversized neutral/grounded conductors where indicated and as specified below.
a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

H. Terminate cables using suitable fittings.
1. Metal-Clad Cable (Type MC):
   a. Use listed fittings.
   b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
   c. MC cable shall be permitted where allowed by NFPA 70, local codes or the local AHJ. MC cable shall be used for 20A branch circuits for switch or receptacle drops, lighting fixture whips, or short flex connections to devices where concealed in ceilings, walls, and partitions and where it will not subject to vibration or movement. MC cable should not be used in wet locations.
   d. All homeruns and branch circuit feeders shall be installed in non-flexible metallic conduits. Cable shall transition to rigid type conduit within ceiling space outside room for portion of branch circuit back to source panels or adjacent rooms.
   e. MC cable shall not be used for HVAC, elevator/escalator, and kitchen equipment branch circuits or within mechanical, electrical or telecommunication equipment rooms.

I. Install conductors with a minimum of 12 inches of slack at each outlet.

J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

L. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
      b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

N. Insulate ends of spare conductors using vinyl insulating electrical tape.

O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2022.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 780 - Standard for the Installation of Lightning Protection Systems 2023.

E. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:
1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.

E. Bonding and Equipment Grounding:
   1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
   2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
   3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
   4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
   5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
   6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
   7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:

a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
b. Metal gas piping.
c. Metal process piping.

8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
a. Exceptions:
1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
a. Exceptions:
1) Use exothermic welded connections for connections to metal building frame.
4. Manufacturers - Mechanical and Compression Connectors:
a. Advanced Lightning Technology (ALT).
b. Burndy LLC.
c. Harger Lightning & Grounding.
d. Thomas & Betts Corporation.
5. Manufacturers - Exothermic Welded Connections:
a. Burndy LLC.
b. Cadweld, a brand of Erico International Corporation.
c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

D. Identify grounding and bonding system components in accordance with Section 26 05 53.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

C. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

D. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

E. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

D. MFMA-4 - Metal Framing Standards Publication 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Installer's Qualification Statement: Include evidence of compliance with specified requirements.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.
3. Manufacturers:
a. Cooper Crouse-Hinds, a division of Eaton Corporation.
b. Erico International Corporation.
c. O-Z/Gedney, a brand of Emerson Electric Co.
d. Thomas & Betts Corporation.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
1. Manufacturers:
a. Cooper Crouse-Hinds, a division of Eaton.
b. Erico International Corporation.
c. O-Z/Gedney, a brand of Emerson Electric Co.
d. Thomas & Betts Corporation.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
3. Channel Material:
a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
6. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation.
b. Thomas & Betts Corporation.
c. Unistrut, a brand of Atkore International Inc.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2 inch diameter.
b. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
e. Outlet Boxes: 1/4 inch diameter.
f. Luminaires: 1/4 inch diameter.

F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.

5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Hammer-driven anchors and fasteners are not permitted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
   5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: Also comply with Section 26 05 33.13.

I. Box Support and Attachment: Also comply with Section 26 05 33.16.

J. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.

K. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.

L. Secure fasteners according to manufacturer's recommended torque settings.

M. Remove temporary supports.

END OF SECTION

SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Intermediate metal conduit (IMC).
C. PVC-coated galvanized steel rigid metal conduit (RMC).
D. Flexible metal conduit (FMC).
E. Liquidtight flexible metal conduit (LFMC).
F. Electrical metallic tubing (EMT).
G. Rigid polyvinyl chloride (PVC) conduit.
H. Liquidtight flexible nonmetallic conduit (LFNC).
I. Conduit fittings.
J. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.
B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
E. Section 26 05 33.16 - Boxes for Electrical Systems.
F. Section 26 05 33.23 - Surface Raceways for Electrical Systems.
G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
H. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2020.
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2020.
C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit 2018.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2020.
F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.
G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.

J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.

K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.

M. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.

N. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.

O. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.

P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.

Q. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.

R. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

S. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.

T. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:
1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
2. Include proposed locations of roof penetrations and proposed methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:
1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

K. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

M. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet.

N. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

2.2 CONDUIT REQUIREMENTS

A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 3/4 inch (21 mm) trade size.
   2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   3. Control Circuits: 1/2 inch (16 mm) trade size.
   4. Underground, Interior: 3/4 inch (21 mm) trade size.
   5. Underground, Exterior: 1 inch (27 mm) trade size.

D. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit.
   2. Nucor Tubular Products.
   3. Western Tube, a division of Zekelman Industries.
   4. Wheatland Tube, a division of Zekelman Industries.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc.
      b. O-Z/Gedney, a brand of Emerson Electric Co.

c. Thomas & Betts Corporation.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
1. Allied Tube & Conduit.
2. Nucor Tubular Products.
3. Western Tube, a division of Zekelman Industries.
4. Wheatland Tube, a division of Zekelman Industries.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc.
b. O-Z/Gedney, a brand of Emerson Electric Co.
c. Thomas & Betts Corporation.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.5 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Thomas & Betts Corporation.
2. Robroy Industries.
3. Allied Tube & Conduit.
4. Calbond.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

D. Interior Coating: Urethane, minimum thickness of 2 mil.

E. PVC-Coated Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
6. Interior Coating: Urethane, minimum thickness of 2 mil.

F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.6 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, Inc.
2. Electri-Flex Company.
3. International Metal Hose.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Manufacturers:
   a. Bridgeport Fittings Inc.
   b. O-Z/Gedney, a brand of Emerson Electric Co.
   c. Thomas & Betts Corporation.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

2.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. AFC Cable Systems, Inc.
2. Electri-Flex Company.
3. International Metal Hose.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
1. Manufacturers:
   a. Bridgeport Fittings Inc.
   b. O-Z/Gedney, a brand of Emerson Electric Co.
   c. Thomas & Betts Corporation.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

2.8 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Allied Tube & Conduit.
2. Nucor Tubular Products.
3. Western Tube, a division of Zekelman Industries.
4. Wheatland Tube, a division of Zekelman Industries.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
1. Manufacturers:
   a. Bridgeport Fittings Inc.
   b. O-Z/Gedney, a brand of Emerson Electric Co.
   c. Thomas & Betts Corporation.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use compression (gland) or set-screw type.
   a. Do not use indenter type connectors and couplings.
5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.9 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
1. Cantex Inc.
2. Carlon, a brand of Thomas & Betts Corporation.
3. JM Eagle.
4. Allied Tube & Conduit.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Manufacturers:
1. AFC Cable Systems, Inc.
2. Electri-Flex Company.
3. International Metal Hose.

B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.11 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

G. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

H. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   3. Unless otherwise approved, do not route conduits exposed:
      a. Across floors.
      b. Across roofs.
      c. Across top of parapet walls.
      d. Across building exterior surfaces.
   4. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   5. Arrange conduit to maintain adequate headroom, clearances, and access.
   6. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   7. Arrange conduit to provide no more than 150 feet between pull points.
   8. Route conduits above water and drain piping where possible.
   9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
   11. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.

I. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
   4. Use conduit clamp to support single conduit from beam clamp or threaded rod.
   5. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
   6. Use of wire for support of conduits is not permitted.
   7. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

J. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

L. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 23 16.13.
2. Minimum Cover, Unless Otherwise Indicated or Required:
   a. Underground, Exterior: 24 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.
3. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.

M. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Secure conduits to prevent floating or movement during pouring of concrete.

N. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.

O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.

4. Where conduits are subject to earth movement by settlement or frost.

P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
   1. Where conduits pass from outdoors into conditioned interior spaces.
   2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

Q. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

R. Provide grounding and bonding in accordance with Section 26 05 26.

END OF SECTION

SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 2 PRODUCTS

1.1 BOXES

A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use suitable concrete type boxes where flush-mounted in concrete.
4. Use suitable masonry type boxes where flush-mounted in masonry walls.
5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Use shallow boxes where required by the type of wall construction.
7. Do not use "through-wall" boxes designed for access from both sides of wall.
8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
12. Wall Plates: Comply with Section 26 27 26.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
3. Junction and Pull Boxes Larger Than 100 cubic inches:
   a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

END OF SECTION

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SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Warning signs and labels.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.3 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
B. NFPA 70E - Standard for Electrical Safety in the Workplace 2021.
C. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
   a. Switchgear:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify power source and circuit number. Include location when not within sight of equipment.
      4) Use identification nameplate to identify main and tie devices.
      5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
   b. Switchboards:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify power source and circuit number. Include location when not within sight of equipment.
      4) Use identification nameplate to identify main overcurrent protective device.
      5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
   c. Panelboards:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify power source and circuit number. Include location when not within sight of equipment.
      4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
      5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
   d. Transformers:
      1) Identify kVA rating.
      2) Identify voltage and phase for primary and secondary.
      3) Identify power source and circuit number. Include location when not within sight of equipment.
      4) Identify load(s) served. Include location when not within sight of equipment.
   e. Enclosed switches, circuit breakers, and motor controllers:
      1) Identify voltage and phase.
      2) Identify power source and circuit number. Include location when not within sight of equipment.
      3) Identify load(s) served. Include location when not within sight of equipment.
   f. Enclosed Contactors:
      1) Identify ampere rating.
      2) Identify voltage and phase.
      3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
      4) Identify coil voltage.
      5) Identify load(s) and associated circuits controlled. Include location.
   g. Centralized Emergency Lighting Inverters:
      1) Identify input and output voltage and phase.

2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
3) Identify load(s) served. Include location.

2. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
3. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
4. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
5. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
6. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
7. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
8. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
   a. Minimum Size: 3.5 by 5 inches.
   b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
9. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
10. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
11. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
12. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Identification for Communications Conductors and Cables: Comply with Section 27 10 00.
3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
5. Use underground warning tape to identify direct buried cables.

C. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
    a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
        1) Color Code:
            (a) Emergency Power System: Red.
            (b) Fire Alarm System: Red.
        2) Field-Painting: Comply with Section 09 91 23 and 09 91 13.
        3) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
5. Use underground warning tape to identify underground raceways.
6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.

D. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
    a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 09 91 13 per the same color code used for raceways.
3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
    a. For exposed boxes in public areas, use only identification labels.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Manufacturers:
    a. Brimar Industries, Inc.
    b. Kolbi Pipe Marker Co.
    c. Seton Identification Products.
2. Materials:
    a. Indoor Clean, Dry Locations: Use plastic nameplates.
    b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Manufacturers:
    a. Brady Corporation.
    b. Brother International Corporation.
    c. Panduit Corp.

2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
   a. Use only for indoor locations.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. System designation where applicable:
      1) Emergency Power System: Identify with text "EMERGENCY".
      2) Fire Alarm System: Identify with text "FIRE ALARM".
   b. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. System Designation: 1 inch.
   b. Equipment Designation: 1/2 inch.
   c. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
5. Color:
   a. Normal Power System: White text on black background.
   b. Emergency Power System: White text on red background.
   c. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

H. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

2.3 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation.
2. HellermannTyton.
3. Panduit Corp.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

A. Manufacturers:
1. Brady Corporation.
2. Brimar Industries, Inc.
3. Seton Identification Products.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

D. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:
   a. Emergency Power System: Text "EMERGENCY".

F. Color: Black text on orange background unless otherwise indicated.

2.5 WARNING SIGNS AND LABELS

A. Manufacturers:
1. Brimar Industries, Inc.
2. Clarion Safety Systems, LLC.
3. Insite Solutions, LLC.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:

1. Materials:
   a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
   b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Secure rigid signs using stainless steel screws.

G. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

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SECTION 26 05 83 - WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 05 33.13 - Conduit for Electrical Systems.

C. Section 26 05 33.16 - Boxes for Electrical Systems.

D. Section 26 27 26 - Wiring Devices.

E. Section 26 28 16.16 - Enclosed Switches.

F. Section 26 29 13 - Enclosed Controllers.

1.3 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MATERIALS

A. Disconnect Switches: As specified in Section 26 28 16.16 and in individual equipment sections.

B. Wiring Devices: As specified in Section 26 27 26.

C. Flexible Conduit: As specified in Section 26 05 33.13.

D. Wire and Cable: As specified in Section 26 05 19.

E. Boxes: As specified in Section 26 05 33.16.

2.2 EQUIPMENT CONNECTIONS

A. Connections:
   1. Electrical Connection: Flexible conduit.
   2. Provide field-installed disconnect switch.

PART 3 EXECUTION

3.1 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY
A. This Section includes commissioning process requirements for Electrical systems, assemblies, and equipment.
B. This project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in “SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS”.

1.2 RELATED SECTIONS
A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS
B. SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS
C. SECTION 23 08 00 – COMMISSIONING OF HVAC SYSTEMS
D. SECTION 28 08 00 – COMMISSIONING OF FIRE ALARM SYSTEMS

1.3 DEFINITIONS
A. Refer to section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

1.4 SUBMITTALS
A. Certificate Of Readiness, signed by the Contractor, certifying that systems, assemblies, equipment, components, and associated controls are ready for testing.
B. Manufacturer’s completed start-up reports for equipment and systems.

1.5 CONTRACTOR'S RESPONSIBILITIES
A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for details of Electrical contractor’s responsibilities related to commissioning.
B. Attend commissioning meetings.
C. Provide information requested by the CxA for functional testing and for final commissioning documentation.
D. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
E. Functional testing of systems will be carried out solely by Electrical contractor’s personnel, under the direction of CxA. Provide experienced personnel, familiar with the systems being installed under this project.
F. Provide all personnel, tools, materials, and equipment to support the commissioning process. Facilitate the coordination of the commissioning work with the CxP and incorporate commissioning activities into the master construction schedule.
G. Incorporate all commissioning related activities into the construction schedule, ensuring that activities do not delay construction/project completion.
H. Notify the Owner's Representative and the CxP in writing that equipment and system are ready for functional testing.
I. Perform equipment startups using authorized manufacturing representatives.
J. Provide written documentation to the CxP that equipment and system are fully operational and ready to be functionally performance tested.
K. Perform commissioning tests at the direction of the CxP.
L. Attend construction phase commissioning coordination meetings.
M. Provide qualified personnel for participation in commissioning tests.
N. Provide equipment, materials, and labor necessary to correct deficiencies found during the commissioning process.
O. Participate in plumbing systems, assemblies, equipment, and component maintenance orientations and inspections as directed by the CxP.
P. Provide information requested by the CxP for commissioning documentation and testing.
Q. Perform all quality control functions to ensure equipment and system are installed properly. Ensure equipment and systems are brought to a state of readiness and full functionality prior to commencing the commissioning functional performance testing process.

R. Provide qualified and owner approved representative to attend end of warranty testing.

1.6 CxA'S RESPONSIBILITIES

A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.
B. CxA will direct commissioning testing.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in Division 26 Sections. Provide submittals, test data, inspector record, and certification to the CxA.
B. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for detailed requirements of commissioning of Electrical systems.
C. Perform commissioning tests at the direction of the CxA.
D. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
E. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
F. Tests will be performed using design conditions whenever possible.

3.2 SYSTEM START-UP

A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies, and has so certified.

3.3 TESTING PREPARATION

A. Certify that Electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
B. Certify that Electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
D. Inspect and verify the position of each device and interlock identified on checklists.
E. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.

3.4 FUNCTIONAL TESTING

A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for detailed requirements of commissioning of Electrical systems.
B. Provide measuring instruments and logging devices to record test data as directed by the CxA.

3.5 DEFERRED TESTING

A. Initial commissioning will be done as soon as contract work is completed, though building may not be at full occupancy and equipment may not be at full loading.
B. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods. If testing cannot be carried out under these conditions to adequately verify system performance, testing will be deferred until such time as conditions are more satisfactory.
   1. Contractor is to provide services of personnel and participate in deferred or seasonal testing process in the same manner as he would in non-seasonal testing.
   2. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.6 RE-TESTING

A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for detailed requirements of re-testing of Electrical systems.

3.7 SYSTEMS TO BE COMMISSIONED

A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for list of Electrical systems to be commissioned.

END OF SECTION

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SECTION 26 28 13 - FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.2 RELATED REQUIREMENTS

A. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

B. Section 26 24 13 - Switchboards: Fusible switches.

C. Section 26 24 16 - Panelboards: Fusible switches.

D. Section 26 28 16.16 - Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses 2012.

B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses Current Edition, Including All Revisions.

E. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses Current Edition, Including All Revisions.

F. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
   1. Spare Fuse Cabinet: Include dimensions.

C. 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 Fuses: One set(s) of three for each type and size installed.
   3. Fuse Pullers: One set(s) compatible with each type and size installed.

4. Spare Fuse Cabinet Keys: Two.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation.

B. Littelfuse, Inc.

C. Mersen.

2.2 APPLICATIONS

A. Service Entrance:
1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Feeders:
1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

C. General Purpose Branch Circuits: Class RK1, time-delay.

D. Individual Motor Branch Circuits: Class RK1, time-delay.

E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.

F. Primary Protection for Control Transformers: Class CC, time-delay.

2.3 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

H. Class L Fuses: Comply with UL 248-10.

I. Class CC Fuses: Comply with UL 248-4.

2.4 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet where indicated.

END OF SECTION

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SECTION 26 28 16.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 28 13 - Fuses.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

G. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

H. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
2. Include wiring diagrams showing all factory and field connections.
3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB/GE.

B. Eaton Corporation.

C. Schneider Electric; Square D Products.

D. Siemens Industry, Inc.

E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:
1. Minimum Ratings:
   a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
   b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

H. Provide with switch blade contact position that is visible when the cover is open.

I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

J. Conductor Terminations: Suitable for use with the conductors to be installed.

K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.

M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

N. Heavy Duty Switches:
1. Comply with NEMA KS 1.
2. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
   a. Provide means for locking handle in the ON position where indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 05 26.

H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

END OF SECTION

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SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:
   1. Magnetic motor starters.
   2. General purpose contactors.
   3. Manual motor starters.

B. Overcurrent protective devices for motor controllers, including overload relays.

C. Control accessories:
   1. Auxiliary contacts.
   2. Pilot devices.
   3. Control and timing relays.
   4. Control power transformers.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 28 13 - Fuses: Fuses for fusible switches.

1.3 REFERENCE STANDARDS

A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers 2016.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.

E. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
   3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.

4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
6. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of enclosed controllers and adjacent equipment with all required clearances indicated.
2. Include wiring diagrams showing all factory and field connections.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB/GE.

B. Eaton Corporation.

C. Schneider Electric; Square D Products.

D. Siemens Industry, Inc.

2.2 ENCLOSED CONTROLLERS

A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:
   1. Provide controllers and associated components suitable for operation under the following service conditions without derating:
      a. Altitude:
         1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
         2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
      b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
   2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:
   1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:
   1. Comply with NEMA ICS 6.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.
      b. Outdoor Locations: Type 3R or Type 4.
   3. Finish: Manufacturer's standard unless otherwise indicated.

H. Magnetic Motor Starters: Combination type unless otherwise indicated.
   1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
   2. Noncombination Magnetic Motor Starters: NEMA ICS 2, Class A noncombination motor controllers with magnetic contactor(s) and overload relay(s).
   3. Configuration: Full-voltage non-reversing unless otherwise indicated.
   4. Minimum Starter Size: NEMA Size 0.
   5. Use of non-standard starter sizes smaller than specified standard NEMA sizes is not permitted.
   6. Disconnects: Circuit breaker or disconnect switch type as indicated.
      a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
      b. Disconnect Switches: Fusible type unless otherwise indicated.
      c. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
      d. Provide auxiliary interlock for disconnection of external control power sources where applicable.
   7. Overload Relays: Bimetallic thermal type unless otherwise indicated.
   8. Pilot Devices Required:
      a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.

I. Manual Motor Starters:

1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).
2. Configuration: Non-reversing unless otherwise indicated.
3. Fractional-Horsepower Manual Motor Starters:
   a. Furnish with toggle operator.
   b. Overload Relays: Bimetallic or melting alloy thermal type.
   c. Provide means for locking operator in the OFF position.
   d. Furnish Red ON indicating light where not within sight of equipment.
4. Integral-Horsepower Manual Motor Starters:
   a. Furnish with toggle or pushbutton operator.
   b. Overload Relays: Bimetallic or melting alloy thermal type.
   c. Provide means for locking operator in the OFF position.
   d. Furnish Red ON indicating light where not within sight of equipment.
   e. Provide auxiliary contact where indicated; normally open (NO) or normally closed (NC) as indicated or as required.

J. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
3. Trip-free operation.
4. Visible trip indication.
5. Resettable.
   a. Employ manual reset unless otherwise indicated.
   b. Do not employ automatic reset with two-wire control.
6. Bimetallic Thermal Overload Relays:
   a. Interchangeable current elements/heaters.
   b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
   c. Trip test function.
7. Melting Alloy Thermal Overload Relays:
   a. Interchangeable current elements/heaters.

B. Fusible Disconnect Switches:
1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
2. Fuse Clips: As required to accept indicated fuses.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

C. Circuit Breakers:
1. Interrupting Capacity (not applicable to motor circuit protectors):
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

2. Motor Circuit Protectors:
   a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.
   b. Provide field-adjustable magnetic instantaneous trip setting.

2.4 CONTROL ACCESSORIES

A. Auxiliary Contacts:
   1. Comply with NEMA ICS 5.
   2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.

B. Pilot Devices:
   1. Comply with NEMA ICS 5; heavy-duty type.
   2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
   3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
   4. Indicating Lights: Push-to-test type unless otherwise indicated.
   5. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:
   1. Comply with NEMA ICS 5.
   2. Provide number and type of relays indicated or required to perform necessary functions.

D. Control Power Transformers:
   1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices.
   2. Include primary and secondary fuses.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install controllers in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install enclosed controllers plumb and level.

F. Provide grounding and bonding in accordance with Section 26 05 26.

G. Install all field-installed devices, components, and accessories.

H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

END OF SECTION