



SPECIFICATIONS AND CONTRACT DOCUMENTS

FOR THE RENOVATION OF THE

**HVAC IMPROVEMENTS
ADDISON ATHLETIC CLUB
3900 BELTWAY DRIVE, ADDISON TX 75001**

**TOWN OF ADDISON, TEXAS
INFRASTRUCTURE AND DEVELOPMENT SERVICES
BID NUMBER 18-224**

SEPTEMBER 17, 2018

PREPARED BY



**Reed, Wells, Benson & Company
Consulting Engineers**

Firm Registration #: F-2176

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TOWN OF ADDISON, TEXAS

MAYOR

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COUNCIL MEMBERS

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Paul Walden

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**ASSISTANT DIRECTOR OF INFRASTRUCTURE SERVICES AND
ENGINEERING**

Jason Shroyer, P.E.

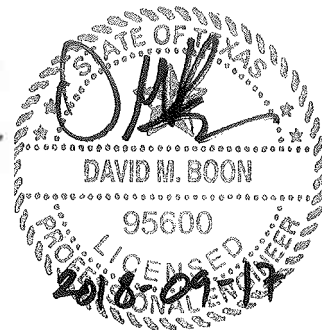
City of Addison Athletic Club

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SECTION AB

ADVERTISEMENT FOR BIDS

ADVERTISEMENT FOR BIDS

1. The Town of Addison is requesting bids for the Bid of the Addison Athletic Club HVAC Improvements. **Bids will be accepted until 2:00 p.m., Thursday, October 18, 2018** at the Finance Building, 5350 Belt Line Rd., Dallas, Texas 75254 – Attention Purchasing Department, at which time responders names and bids will be publicly read aloud. Late bids will not be considered. The plans, specifications, quantities, pre-bid time and date, and other information are available on www.bidsync.com. The plans, specifications, and quantities for the work to be done are also on file with Lisa A. Pyles, Director of Infrastructure and Development Services, Town of Addison, 16801 Westgrove Drive, Addison, Texas 75001, and such plans, specifications, and quantities may be examined without charge. The Town of Addison reserves the right to waive any formalities, to reject any and all bids, and to select the proposal deemed most advantageous to the Town of Addison.

2. The Contractor shall identify his bid on the outside of the envelope by writing the words **INFRASTRUCTURE AND DEVELOPMENT SERVICES BID NUMBER 18-224, ADDISON ATHLETIC CLUB HVAC IMPROVEMENTS**

PAPER BIDS SHALL BE REQUIRED.

3. Bids shall be accompanied by a bid bond in the same amount from a reliable surety company licensed by the State of Texas to act as a Surety and be listed on the current U.S. Treasury Listing of Approved Sureties, or a Binder of Insurance executed by a surety company licensed by the State of Texas to act as a surety or its authorized agent as a guarantee that the bidder will enter into a contract and execute a Performance Bond within ten (10) days after notice of award of contract to him.
4. Plans, specifications and bidding documents may be downloaded from www.bidsync.com. The Town of Addison is a "free buyer", meaning that prospective bidders need only a free registration to sign up for plan updates. Bidders assume all risk for acquiring specs and/or plans from third party sites and plan rooms, as only Bidsync.com will be directly updated by Addison.
5. The right is reserved by the Mayor and the City Council as the interests of the City may require to reject any or all bids and to waive any formality in bids received and to select the proposal deemed most advantageous to the City.
6. The Bidder (Proposer) must supply all the information required by the Proposal Form.
7. A Performance Bond, Labor and Material Payment Bond, and Maintenance Bond will be required by the Owner; each Bond shall be in the amount of 100% of the total contract amount. Bonds shall be issued by a surety company licensed by the State of Texas to act as a Surety and be listed on the current U.S. Treasury Listing of Approved Sureties.
8. The Bidder (Proposer) must supply all the information required by the Bidder Qualification Statement.
9. **An optional pre-bid meeting will be held on Tuesday, October 2, 2018 at 2:00pm at the Town of Addison Athletic Club, 2nd Floor Classroom, located at 3900 Beltway Drive, Addison, Texas 75001. A tour of the Addison Athletic Club will follow this meeting.**
10. For information on bidding or work to be performed, please submit all questions on Bidsync. **All questions must be received by 5:00 pm on Friday, October 12, 2018. All valid questions received by this deadline will be answered by 5:00 pm on Tuesday, October 16, 2018.**

11. The project consists of the replacement of existing package A/C units and related equipment; installation of a new packaged 200-ton air cooled chiller system with associated piping and components, new controls and thermostats; various ductwork improvements; added electrical service; installation of new high-volume, low-speed fans; and other related work.

SECTION IB

INSTRUCTIONS TO BIDDERS

INSTRUCTIONS TO BIDDERS

- A. PROJECT: ADDISON ATHLETIC CLUB HVAC IMPROVEMENTS** in the Town of Addison. The bids will be evaluated as stated in Section "N" of these Instructions to Bidders.
- B. PROJECT DESCRIPTION:** The project consists of the replacement of existing package A/C units and related equipment; installation of a new packaged 200-ton air cooled chiller system with associated piping and components, new controls and thermostats; various ductwork improvements; added electrical service; installation of new high-volume, low-speed fans; and other related work.
- C. PROPOSALS:** Proposals must be in accordance with these instructions in order to receive consideration.
- D. DOCUMENTS:** Bidding Documents include the Project Manual (consisting of the Advertisement for Bids, these Instructions to Bidders, Proposal Forms, Reference Form, Contract Agreement, Performance Bond, Payment Bond, Maintenance Bond, Contractor's Affidavit of Bills Paid, General Provisions, Special Provisions, Project Sign, and Technical Specifications), a Waiver of Lien, Drawings, and Addenda which may be issued by the Town of Addison during the bidding period. Bidding Documents may be viewed and/or obtained under the terms and conditions set forth in the Advertisement for Bids, Section AB of this Project Manual.
- E. EXAMINATION OF DOCUMENTS AND SITE:** Bidders shall carefully examine the Bidding Documents and the construction site to obtain firsthand knowledge of the scope and the conditions of the Work. Each Contractor, Subcontractor and Sub-subcontractor, by submitting a proposal to perform any portion of the Work, represents and warrants that he has examined the Drawings, Specifications (Project Manual) and the site of the Work, and from his own investigation has satisfied himself as to the scope, accessibility, nature and location of the Work; the character of the equipment and other facilities needed for the performance of the Work; the character and extent of other work to be performed; the local conditions; labor availability, practices and jurisdictions; and other circumstances that may affect the performance of the Work. Bidders shall contact Randy Rogers (Addison Athletic Club) at (972) 450-7048 for access to the site. No additional compensation will be allowed by the Owner for the failure of such Contractor, Subcontractor or Sub-subcontractor to inform himself as to conditions affecting the Work.
- F. INTERPRETATION OF DOCUMENTS:** If any person contemplating submitting a bid for the proposed Contract is in doubt as to the meaning of any part of the Drawings, Specifications (Project Manual) or other proposed Contract Documents, he may submit questions to the Town of Addison, no later than by 5:00 pm on Friday, October 12, 2018. All valid questions received by this deadline will be answered by 5:00 pm on Tuesday, October 16, 2018. Bidders should act promptly and allow sufficient time for a reply to reach them before preparing their bids. Any interpretation or clarification will be in the form of an Addendum duly issued. No alleged verbal interpretation or ruling will be held binding upon the Owner.

- G. SUBSTITUTIONS:** Conditions governing the submission of substitutions for specific materials, products, equipment and processes are in the Special Provisions. Requests for substitutions must be received by the Town of Addison seven (7) calendar days prior to the established bid date.
- H. ADDENDA:** Interpretations, clarifications, additions, deletions and modifications to the Documents during the bidding period will be issued in the form of Addenda and a copy of such Addenda will be released through www.bidsync.com. It will be the responsibility of each person who has been issued a set of bid documents to secure all Addenda from www.bidsync.com. Addenda will be a part of the Bidding Documents and the Contract Documents, and receipt of them shall be acknowledged in the Bid Form. All such interpretations and supplemental instructions will be in the form of written addenda to the contract documents which, if issued, will be released through www.bidsync.com not later than three (3) calendar days prior to the date fixed for the opening of bids. If any bidder fails to acknowledge the receipt of such addenda in the space provided in the bid form, his bid will nevertheless be construed as though the receipt of such addenda had been acknowledged.
- I. COMPLETION TIME:** The selected contractor shall use the time period between the awarding of the contract at City Council and the date of Notice to Proceed to submit materials and shop drawings for approval. The MEP Engineer shall review and return these submittals in the most expedient manner possible to accommodate immediate material ordering.
- a. Upon receiving Notice to Proceed, the selected contractor shall have **150 calendar days** to construct the project and achieve substantial completion. Substantial completion for this project includes the following items:
 - i. Preliminary Punchlist walk-through with the Town performed;
 - b. After substantial completion is reached, the contractor shall have an **additional 20 calendar days** to achieve 100% final completion. Final completion for this project shall include:
 - i. Punchlist items completed and approved by the Town;
 - ii. Site clean-up;
 - iii. Submittal of Record Drawings; and
 - iv. Execution of Maintenance Bond.
- J. PREPARATION OF BIDS:** Prices quoted shall include all items of cost, expense, taxes, fees and charges incurred by, or arising out of, the performance of the work to be performed under the Contract. Bids shall be submitted in duplicate and shall be signed in ink. Any bid on other than the required form will be considered informal and may be rejected. Erasures or other changes in a bid must be explained or noted over the initials of the bidder. Bids containing any conditions, omissions, unexplained erasures and alterations, or irregularities of any kind may be rejected as informal. The prices should be expressed in words and figures or they may be deemed informal and may be rejected. In case of discrepancy between the price written in the bid and that given in the figures, the price in writing will be considered as the bid. In the case of a discrepancy between a unit price and its extension, the unit price will govern. Failure to submit all requested information will make a bid irregular and subject to rejection. Bids shall be signed with name typed or printed below signature, and, if a partnership, give full name of all partners. Where bidder is a corporation, bids must be signed with the legal name of the

corporation followed by the name of the state of incorporation and the legal signature of an officer authorized to bind the corporation to a contract.

NOTE: AN ELECTRONIC SPREADSHEET IS POSTED ON BIDS SYNC FOR CONTRACTORS CONVENIENCE TITLED "BID SCHEDULE BID 18-224". THIS SPREADSHEET MAY BE USED IN LIEU OF THE MANUAL HANDWRITTEN PROPOSAL FORM IN THE SPECIFICATIONS AND SHALL BE ATTACHED TO THE PROPOSAL AND MADE PART OF THE CONTRACT DOCUMENTS. USING THE SPREADSHEET OPTION SHALL NOT AMEND OR MODIFY ANY WORDING IN THE PROPOSAL FORM OR THE PLANS AND THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONFIRMING THAT THE SPREADSHEET ADEQUATELY CONVEYS THEIR BID.

SUBMITTAL OF BIDS: Sealed proposals will be received at the time, date and place stated in the Advertisement for Bids. Proposals shall be made on unaltered Proposal Forms furnished by the Town of Addison. Bidders shall submit proposals in an opaque, sealed envelope addressed to the Owner and plainly mark on the outside of the envelope the name and address of the bidder. The envelopes shall also be marked with the following project description:

ADDISON ATHLETIC CLUB HVAC IMPROVEMENTS BID NUMBER 18-224

The Bid Bond must be completed and signed by each bidder and submitted with the bid. submit Bids by mail or in person prior to the time for receiving bids set forth in the Advertisement for Bids issued by the Town.

Electronic bidding on bidsync.com will not be considered for this project. The Town of Addison uses bidsync to distribute bids and proposals. There will be NO COST to the contractor for standard bids or proposals. Bid number 18-224 is considered a standard bid. For Cooperative Bids and Reverse Auctions ONLY, the successful contractor/supplier agrees to pay bidsync a transaction fee of one percent (1%) of the total amount of all contracts for goods and/or services. Cooperative Bids and Reverse Auctions will be clearly marked on the bid documents. To assure that all contractors/suppliers are treated fairly, the fee will be payable whether the bid/proposal is submitted electronically, or by paper means. Refer to www.bidsync.com for further information.

- K. MODIFICATION AND WITHDRAWAL OF BIDS:** Prior to the time set for bid opening, bids may be withdrawn or modified. Bids may be modified only on the official bid form and must be signed by a person legally empowered to bind the bidder. No bidder shall modify, withdraw, or cancel his bid or any part thereof for sixty (60) calendar days after the time agreed upon for the receipt of bids.
- L. DISQUALIFICATION:** The Owner reserves the right to disqualify proposals, before or after the opening, upon evidence of collusion with intent to defraud or other illegal practices relating to this proposal upon the part of the bidder.
- M. SUBMISSION OF POST-BID INFORMATION:** Upon notification of acceptance, the selected bidder shall, within twenty-four (24) hours, submit the following:
1. A designation of the portions of the Work proposed to be performed by the bidder with his own force.

2. A list of names of the Subcontractors or other persons or organizations, including those who are to furnish materials and equipment fabricated to a special design proposed for such portions of the Work as may be designated in the Bidding Documents or as may be requested by the Town of Addison. The bidder will be required to establish to the satisfaction of the Owner the reliability and responsibility of the proposed Subcontractors and suppliers to furnish and perform the Work.

3. Other information as required.

N. AWARD: The Owner reserves the right to accept any or to reject any bids without compensation to bidders and to waive irregularities and informalities. The Town of Addison Infrastructure Operations & Services Department, in making its recommendation, will consider the following elements:

1. Whether the bidder is a contractor with experience in the type of work involved.
2. Whether the bidder has adequate plant, equipment and personnel to perform the work properly and expeditiously.
3. Whether the bidder has a suitable financial status and reputation for meeting obligations incident to work of the kind specified.
4. Whether the bidder has complied with the terms and conditions.

Alternate items may or may not be awarded. Addition or deletion of other items or schedules will be governed by the *Standard Specifications for Public Works Construction – North Central Texas, 5th Edition*, (hereinafter called SSPWC), "Change or Modification of Contract".

O. EXECUTION OF THE CONTRACT: The successful bidder will be required to enter into a contract with the Owner within ten (10) days of notice by the Owner that his bid has been accepted. Failure to enter into a contract within the established time limit shall be considered grounds for forfeiture of the bid bond.

P. CONSTRUCTION SCHEDULE: It is the Owner's desire to have the project completed and operational in as short a time as possible. The number of calendar days for completion of the project will begin with the date specified in the Notice to Proceed. The Notice to Proceed will be issued in a manner to facilitate a smooth construction of the project. The Contractor shall begin construction within ten (10) calendar days of the issuance of the Notice to Proceed.

Q. COST PLUS TIME BIDDING: N/A

R. FORM OF CONTRACT: The contract for the construction of the project will be drawn up by the Owner. A sample form of agreement is included in the Contract Agreement Section.

S. BONDS: A Performance Bond, a Labor and Material Payment Bond and a Maintenance Bond will be required by the Owner. The Performance Bond and Payment Bond shall name the Town of Addison, and others as directed by the Town, as joint obligees. Sample forms have been included in the Performance Bond, Payment Bond, and Maintenance Bond sections. (Contractor shall confirm the legal names of obligees prior to execution of Bonds.)

T. BID SECURITY: Bids shall be accompanied by a bid bond in an amount not less than five percent (5%) of the total maximum bid price from a surety company licensed to do business in the State of Texas as a guarantee that the bidder will enter into a contract and execute a Performance Bond and Payment Bond within ten (10) calendar days after notice of award of contract to him.

U. RESOLUTIONS: If the bidder is a corporation, a copy of the resolution empowering the person submitting the bid to bind the bidder must be included with the bid.

V. CONSTRUCTION STAKING: N/A

W. FINAL PAYMENT: The general provisions for Final Payment shall be as stated in Item 109.5.4 of the SSPWC including all Amendments and Additions. Prior to final payment the Contractor shall provide the Owner with the following items:

1. A Contractor's Affidavit of Bills Paid in accordance with Section BP.
2. A Consent of Surety Company to Final Payment.
3. A complete set of record plans which indicate all construction variations from the original construction documents in accordance with the Special Provisions.
4. A one (1) year Maintenance Bond in accordance with Section MB.
5. Acknowledgement that the project has been reviewed and accepted by TDLR.

X. PREVAILING WAGE RATES: Wage rates paid on this project shall not be less than specified in the schedule of general prevailing rates of per diem wages as attached in the Special Provisions.

Y. PRIORITY OF CONTRACT DOCUMENTS: In case of conflict between contract documents, priority of interpretation shall be in the following order: signed agreement; performance and payment bonds; proposal; special provisions (or conditions); technical specifications; general provisions; advertisement for bids; project drawings; Town of Addison Standard Drawings. This priority list shall take precedence over Item 105.1.1 of the SSPWC.

SECTION PF-1

PROPOSAL FORM

PROPOSAL FORM

_____, 2018

TO: The Honorable Mayor and Town Council
Town of Addison, Texas

Gentlemen:

The undersigned bidder, having examined the plans, specifications and contract documents, and the location of the proposed work, and being fully advised as to the extent and character of the work, proposes to furnish all equipment and to perform labor and work necessary for completion of the work described by and in accordance with the Plans, Specifications and Contract for the following prices, to wit:

Signed by: _____

ACKNOWLEDGMENT OF ADDENDA:

The Bidder acknowledges receipt of the following addenda:

Addendum No. 1 _____

Addendum No. 2 _____

Addendum No. 3 _____

The following pages contain all bid items for:

BID SCHEDULE – ADDISON ATHLETIC CLUB HVAC IMPROVEMENTS.
BID NUMBER 18-224

- NOTES:
1. All items, labor, materials, equipment, facilities, incidentals and work required for construction of the project are to be provided and installed by the Contractor as part of the project and payment for the cost of such shall be included in the price bid for the construction of the project.
 2. Prices must be shown in words and figures for each item listed in the Proposal. In the event of discrepancy, the words shall control.
 3. Materials, which are "tax exempt", are those items which are physically incorporated into the facilities constructed for the Town of Addison, as set forth in the Special Provisions. Materials include, but are not limited to purchased items such as water pipe, sanitary sewer pipe, storm drain pipe, etc.

Services, which are "not tax exempt", are those items which are used by the Contractor but are not physically incorporated into the Town of Addison's facility and/or items which are consumed by construction, as set forth in the Special Provisions. Services include, but are not limited to, items such as supplies, tools, skill and labor, the purchase, rental or lease of equipment, etc.

Name of Person Signing Bid

Signature of Person Signing Bid

Address

Telephone No.

Fax No.

T.I.N. (Tax Identification or Employer's Number)

If BIDDER is:

AN INDIVIDUAL

By _____ (Individual's Name) (Seal)

doing business as _____

Business address: _____

Phone No. _____

A PARTNERSHIP

By _____ (Firm Name) (Seal)

(General Partner)

doing business as _____

Business address: _____

Phone No. _____

A CORPORATION

By _____
(Corporation Name)

(State of Incorporation)

By _____
(Name of Person Authorized to Sign)

(Title)

(Corporate Seal)

Attest _____
(Secretary)

Business address: _____

Phone No. _____

A JOINT VENTURE

By _____
(Name)

(Address)

By _____
(Name)

(Address)

(Each joint venture must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture should be in the manner indicated above.)

BID SCHEDULE
Addison Athletic Club HVAC Improvements
BID NUMBER 18-224

Cardio Wing Base Bid Demolition Scope

Item No.	Quantity	Unit	Description and Unit Price in Words	Unit Price in Figures	Total Amount
1.01	5	LS	Removal of five (5) existing package A/C units and associated ductwork, condensate drains, duct heaters, t-stats and electrical connections. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
1.02	1	LS	Removal of any landscaping including trees and lighting bollards. Provide new housekeeping pad for the new 200 ton chiller and associated pumps. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
1.03	1	LS	Removal all the existing supply grilles in the cardio spaces on the second floor. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
1.04	6	LS	Removal of all hanging circle grids below the lightings in each section of cardio space on the second floor. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
1.05	1	LS	Provide a new 480V/3 phase electrical service with a 800 amp switchboard to serve the new chiller and duct heaters. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
Subtotal					

Cardio Wing Base Bid New Scope

1.06	1	EA	<p>Provide a new packaged 200 ton air cooled chiller and associated inline chiller pumps, and 6" housekeeping pad. complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		
1.07	1	LS	<p>Provide six (6) new air handling units, associated supply/return ductwork, condensate drains, 1-1/4" CHS/R piping and electric duct heaters within the existing mechanical room on the ground floor. Provide new DCC controls and t-stats. Provide new 30/3/15 disconnect switch and reconnect to the existing panel. complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		
1.08	1	LS	<p>Provide one (1) new air handling unit suspended from the structure, associated CHS/R piping connections, and thermostats to serve the staff area. Provide new 30/3/15 disconnect switch and reconnect to the existing panel. complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		
1.09	1	LS	<p>Provide new 6" insulated CHS/R piping from the chiller routed to the ground floor to the new six (6) new AHU. The 6" CHS/R piping shall reduce to new 4" CHS/R after the staff area unit. The 4" CHS/R piping shall extend to the existing mechanical room in the original building and tie into the existing CHS/R piping. complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		
1.10	1	LS	<p>Provide new supply diffusers to replace the existing supply grilles that were removed within the demolition scope. complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		

1.11	6	EA	<p>Provide six (6) new high volume low speed fans in the middle of each cardio bay on the second floor. Provide new 2P25A circuit breakers from the existing electrical panel, conduit and motor thermal overload switch. Provide one recessed lockable panel for the main control panel operating the fans. (Work shall take place 45 days after notice to proceed) complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		
1.12	1	LS	<p>Repair gyp/lay in ceiling and walls damaged by the ceiling cassettes and construction. Match adjacent finishes and color. Paint the walls and ceiling in its entirety surface to avoid color matching issues. complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		
Subtotal					

Original Building Base Bid Demolition Scope

2.01	4	EA	<p>Remove four (4) air handling units and associated pneumatic thermostat located within the existing mechanical room or above the existing lay in ceiling. Disconnect the existing electrical connection, supply ductwork, and return ductwork for reconnection to the new air handling unit complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		
2.02	1	LS	<p>Disconnect the electrical connection and lock the circuit breakers to the existing chiller, cooling tower and associated pumps. Equipment shall be taken out of service. complete in place, the sum of</p> <p>_____ Dollars</p> <p>and _____ Cents per Unit.</p>		
Subtotal					

Original Building Base Bid New Scope

2.03	1	EA	Provide four (4) new air handling units and reconnect the supply ductwork, return ductwork, and electrical connections. Provide new DCC controls and t-stats. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
2.04	1	LS	Repair gyp/lay in ceiling and walls damaged by the air handling unit installation. Match adjacent finishes and color. Paint the walls and ceiling in its entirety surface to avoid color matching issues. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
SubTotal					
Base Bid Total					

Alternate Bid - Original Building Demolition Scope

Item No.	Quantity	Unit	Description and Unit Price in Words	Unit Price in Figures	Total Amount
3.01	6	EA	Remove five (5) air handling units and associated pneumatic thermostat located within the existing mechanical room or above the existing lay in ceiling. Disconnect the existing electrical connection, supply ductwork, and return ductwork for reconnection to the new air handling unit. Provide new DCC controls and t-stats. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
3.02	1	LS	Remove the existing ductwork and supply grilles serving the gymnasium. complete in place, the sum of _____ Dollars and _____ Cents per Unit.		
Subtotal					

Alternate Bid - Original Building New Scope

3.03	6	EA	<p>Provide five (5) new air handling unit and reconnect the supply ductwork, return ductwork, and electrical connections. complete in place, the sum of</p> <p>_____ Dollars and _____ Cents per Unit.</p>		
3.04	1	EA	<p>Provide new fabric duct and cabling system serving the gymnasium. complete in place, the sum of</p> <p>_____ Dollars and _____ Cents per Unit.</p>		
3.05	1	LS	<p>Replace the existing roof mounted relief air hood within the gymnasium and install a motorized damper at the roof opening to modulate as required to maintain the building pressurization. complete in place, the sum of</p> <p>_____ Dollars and _____ Cents per Unit.</p>		
3.06	1	LS	<p>Repair gyp/lay in ceiling and walls damaged by the air handling unit installation. Match adjacent finishes and color. Paint the walls and ceiling in its entirety surface to avoid color matching issues. complete in place, the sum of</p> <p>_____ Dollars and _____ Cents per Unit.</p>		
Subtotal					
Alternate Bid Total					
Total					

SECTION BB
BID BOND

BID BOND

Bidder shall submit a bid bond equal to five percent (5%) of the bid price. Failure to submit a bid bond when required may deem the bid non-responsive. Bid Bonds may be submitted electronically with the executed original provided immediately upon request.

SECTION BQS

BIDDER QUALIFICATION STATEMENT

SECTION BQS

ALL BIDDERS ARE NOTIFIED THAT THE FOLLOWING QUALIFICATION STATEMENT MUST BE COMPLETED AND SUBMITTED WITH THE BID PROPOSAL

CONTRACTOR'S QUALIFICATIONS

The Contractor shall show that he has experience with similar projects that require working on HVAC and electrical construction and/or replacement projects in confined quarters in a fully operational public facility which will require the Contractor to plan his work efforts and equipment needs with these limitations in mind. The Contractor shall submit a complete list of ALL Municipal and Similar Non-Municipal current and completed projects for the past three (3) years for review. This list shall include the names of supervisors and type of equipment used to perform this work.

BIDDERS QUALIFICATION STATEMENT

INFRASTRUCTURE AND DEVELOPMENT SERVICES BID NUMBER 18-224, ADDISON ATHLETIC CLUB HVAC IMPROVEMENTS

Contractor: _____

Indicate One: _____ Sole Proprietor _____ Partnership _____ Other
 _____ Corporation _____ Joint Venture

Name: _____ Partner: _____

Title: _____ Title: _____

Address: _____ Address: _____

City: _____ City: _____

State & Zip: _____ State & Zip: _____

Phone: _____ Phone: _____

State and Date of Incorporation, Partnership, Ownership, Etc. _____

Location of Principal Office: _____

Contact and Phone at Principal Office: _____

Liability Insurance Provider and Limits of Coverage: _____

Workers Compensation Insurance Provider: _____

Surety (Performance and Payment): _____

Address: _____

Contact and Phone: _____

Superintendent and Backup Superintendent: (Work Resume - attach additional sheets.) (Safety Record – attached additional sheets; if needed show all verified safety violations.) The superintendent shall be able to communicate in English and not operate any equipment and have not had any verified job safety violations in the past five years. Any variations shall be reviewed by the OWNER for approval or denial. A job site shall be shut down if proper supervision is not provided.

Superintendent Name

Backup Superintendent Name

Safety Record – List ALL Verified Violations for Superintendent and Backup Superintendent with explanation, date and action taken to correct future safety violations:

Superintendent

Backup Superintendent

Total Number of Employees to be Associated with this Job: _____

Managerial _____ Administrative _____ Professional _____

Skilled _____ Semi-Skilled _____ Other _____

Percentage of work to be done by Bidder's Employees (Based on Dollars Bid): _____

Type(s) of work to be done by Bidder's Employees (examples: chiller installation, ductwork fabrication and installation, fan installation, structural steel, electrical work, etc.)

Access to Tools and Equipment: Percent Owned____ Percent Rented____

Number of Years in Business as a Contractor on Above Types of Works:_____

Type(s) of Work to be done by Sub-Contractors

Include Name, Address, and Phone Number of Sub-Contractor.

Use additional sheets if needed.

Type of Work

Sub-Contractor

List Equipment to be used on this project (Make/Model/Age of Major Equipment) Any Equipment not listed shall be reviewed by the OWNER for approval or rejection prior to use of Equipment on this project. (Use additional sheets if necessary)

Type of Equipment

Make

Model

Age (years)

List of ALL Municipal and Similar Non-Municipal current and completed projects for the past three (3) years. (Use additional sheets if necessary.)

1. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

2. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

3. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

4. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

5. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

6. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

7. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

8. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

9. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

10. Project: _____

Current Status: _____

Any Litigation Issues: Yes or No (Circle One) If Yes, explain: _____

Any Verified Safety Violations: Yes or No (Circle One) If Yes, explain: _____

Project Description: _____

Owner/Agency: _____

Year Built: _____ Contract Price: _____

Contact Person: _____ Phone: _____

Trade references (List Company, Address, Contact Person, and Phone):

Bank References (List Institution, Address, Contact Person, and Phone)

Claims and Suits (if the answer to any of the following questions is yes, please attached details):

1. Has your organization ever failed to complete any work awarded to it? _____
2. Are there any judgments, claims, arbitration proceedings, or suits pending or outstanding against your organization or officers? _____
3. Has your organization filed any lawsuits or requested arbitration with regard to construction contracts within the last five years? _____
4. Within the last five (5) years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract? _____

I, _____, being duly sworn deposes and says that the information provided herein is true and sufficiently complete so as not to be misleading.

Date this _____ day of _____, 20____.

Name of

Organization: _____

By: _____

Title: _____

STATE OF TEXAS

COUNTY OF DALLAS

BEFORE ME the undersigned authority, on this day personally appeared _____, known to me to be the person whose name subscribed to the foregoing instrument, and acknowledged to me that he executed the same for the purposes and considerations therein expressed.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this ____ day of _____ 20____.

Notary Public in and for _____ County, Texas

SECTION CA

CONTRACT AGREEMENT

CONTRACT AGREEMENT

STATE OF TEXAS

COUNTY OF DALLAS

THIS AGREEMENT is made and entered into this _____ day of _____, 2018, by and between the Town of Addison, of the County of Dallas and State of Texas, acting through its City Manager, thereunto duly authorized so to do, Party of the First Part, hereinafter termed the OWNER, and _____, of the City of _____, County of _____, State of _____, Party of the Second Part, hereinafter termed CONTRACTOR.

WITNESSETH: That for and in consideration of the payment and agreement hereinafter mentioned, to be made and performed by the OWNER, the said CONTRACTOR hereby agrees with the said OWNER to commence and complete construction of certain improvements as follows:

ADDISON ATHLETIC CLUB HVAC IMPROVEMENTS

INFRASTRUCTURE AND DEVELOPMENT SERVICES BID NUMBER 18-224

and all extra work in connection therewith, under the terms as stated in the General and Specific Conditions of the AGREEMENT; and at his own proper cost and expense to furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor, insurance and other accessories and services necessary to complete the said construction, in accordance with the conditions and prices stated in the Proposal attached hereto and in accordance with the Advertisement for Bids, Instructions to Bidders, General Provisions, Special Provisions, Plans, and other drawings and printed or written explanatory matter thereof, and the Technical Specifications and Addenda thereto, as prepared by the OWNER, each of which has been identified by the endorsement of the CONTRACTOR and the OWNER thereon, together with the CONTRACTOR's written Proposal and the General Provisions, all of which are made a part hereof and collectively evidence and constitute the entire AGREEMENT.

The CONTRACTOR hereby agrees to commence work within ten (10) calendar days after the date of written notice to do so shall have been given to him, to complete the work within one hundred and fifty **(150)** calendar days, after he commences work, subject to such extensions of time as are provided by the General Provisions.

The OWNER agrees to pay the CONTRACTOR _____ Dollars (\$_____) in current funds for the performance of the Contract in accordance with the Proposal submitted thereof, subject to additions and deductions, as provided in the General Provisions, and to make payments of account thereof as provided therein.

IN WITNESS WHEREOF, the parties of these presents have executed this AGREEMENT in the year and day first above written.

TOWN OF ADDISON, TEXAS (OWNER)

ATTEST:

By: _____
City Manager

By: _____

(CONTRACTOR)

ATTEST:

By: _____

By: _____

The following to be executed if the CONTRACTOR is a corporation:

I, _____ certify that I am the secretary of the corporation named as CONTRACTOR herein; that _____, who signed this Contract on behalf of the CONTRACTOR is the _____ (official title) of said corporation; that said Contract was duly signed for and in behalf of said corporation by authority of its governing body, and is within the scope of its corporate powers.

Signed: _____

Corporate Seal

SECTION PrB
PERFORMANCE BOND

PERFORMANCE BOND

STATE OF TEXAS }
COUNTY OF DALLAS }

WHEREAS, _____ as principal ("Contractor") and _____, a corporation organized under the laws of _____ and being duly authorized to do business in the State of Texas, as surety ("Surety") (whether one or more), do hereby expressly acknowledge themselves to be held and bound to pay to the Town of Addison, Texas, a home-rule municipality organized and operating under the Constitution and laws of the State of Texas (the "Town"), its successors and assigns, and to all persons, firms, subcontractors and corporations who may furnish materials or labor under the contract as more fully described below, the sum of _____ Dollars in the lawful currency of the United States of America (\$) for the payment of which Contractor and Surety are liable to the Town, jointly and severally; and

WHEREAS, Contractor has this day entered into a written contract with the Town to build and construct _____

_____ which contract and the plans and specifications therein mentioned (collectively referred to hereinafter as the "Contract") are hereby expressly incorporated into and made a part hereof as though set forth at length; and

WHEREAS, this bond is given pursuant to Chapter 2253 of the Texas Government Code;

NOW, THEREFORE, if Contractor shall well, truly and faithfully perform all of the undertakings, duties, terms, conditions and agreements of the Contract; shall satisfy all claims and demands incurred under the Contract; shall fully indemnify and hold the Town harmless; shall reimburse and repay the Town for any outlay or expense which the Town may incur in making good any default, and shall promptly make payment to all persons, firms, subcontractors and corporations who may furnish materials or labor under the Contract, then this obligation shall be void; otherwise to remain in full force and effect. The obligations of Contractor and Surety under this bond apply both to the original Contract and to any extension or modification of the Contract and Surety agrees that no change, extension of time, addition, expansion or other modification of the Contract, the work to be done under the Contract, or the plans and specifications which are a part of the Contract shall in any manner affect the obligations of Surety under this bond, and Surety waives notice of any such change, extension of time, addition, expansion or other modification. The obligations of Contractor and Surety under this bond are performable and payable in Dallas County, Texas such that exclusive venue for any legal action pertaining to this bond shall lie in Dallas County, Texas. By their signatures below, the persons signing this bond warrant and represent that they are, respectively, duly authorized to sign on behalf of Contractor and Surety.

EXECUTED this the ____ day of _____, 2018.

CONTRACTOR:

SURETY: 1

By: _____

By: _____

Title: _____

Title: _____

ACKNOWLEDGMENTS
[Contractor]

STATE OF TEXAS }
COUNTY OF DALLAS }

Before me _____ (insert the name of the officer) on this day _____ personally appeared _____ known to me (or proved to me on the oath of _____) or through _____ (description of identity card or other document) to be the person whose name is subscribed to the forgoing instrument and acknowledged to me that he/she executed the same for the purpose and consideration therein expressed.

Given under my hand and seal of office this _____ day of _____, 2_____.

Notary Public in and for the State of Texas
My Commission Expires: _____

Typed or Printed Name of Notary

[Surety]

STATE OF TEXAS }
COUNTY OF DALLAS }

This instrument was acknowledged before me on the ____ day of _____, 2_____ by _____ who is the _____ of the Surety, on behalf of Surety.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the ____ day of _____, 2_____.

Notary Public in and for the State of Texas

Typed or Printed Name of Notary

My Commission Expires: _____

1 Please see attached contact sheet for Surety and the Texas Department of Insurance.

Payment and Performance Bond Contact Sheet

(1) Claims:

All notices of claims shall be sent to the surety at the following address:

(Name of surety)

(Mailing address)

(Physical address)

(Phone number)

(2) Texas Department of Insurance Contact Number:

The address and contact information of the surety may otherwise be obtained by contacting the Texas Department of Insurance at the following toll free telephone number:

1-800-252-3439.

SECTION PyB
PAYMENT BOND

PAYMENT BOND

STATE OF TEXAS }
COUNTY OF DALLAS }

WHEREAS, _____, as principal ("Contractor") and _____, a corporation organized under the laws of _____ and being duly authorized to do business in the State of Texas, as surety ("Surety") (whether one or more), do hereby expressly acknowledge themselves to be held and bound to pay to the Town of Addison, Texas, a home-rule municipality organized and operating under the Constitution and laws of the State of Texas (the "Town"), its successors and assigns, and to all persons, firms, subcontractors and corporations who may furnish materials or labor under the contract as more fully described below, the sum of _____ Dollars in the lawful currency of the United States of America (\$) for the payment of which Contractor and Surety are liable to the Town, jointly and severally; and

WHEREAS, Contractor has this day entered into a written contract with the Town to build and construct _____

which contract and the plans and specifications therein mentioned (collectively referred to hereinafter as the "Contract") are hereby expressly incorporated into and made a part hereof as though set forth at length; and

WHEREAS, this bond is given pursuant to Chapter 2253 of the Texas Government Code;

NOW, THEREFORE, if Contractor shall promptly make payment to all persons, firms, subcontractors and corporations who may furnish materials or labor under the Contract, then this obligation shall be void; otherwise to remain in full force and effect. The obligations of Contractor and Surety under this bond apply both to the original Contract and to any extension of time or modification of the Contract and Surety agrees that no change, extension of time, addition, expansion or other modification of the Contract, the work to be done under the Contract, or the plans and specifications which are a part of the Contract shall in any manner affect the obligations of Surety under this bond, and Surety waives notice of any such change, extension of time, addition, expansion or other modification. The obligations of Contractor and Surety under this bond are performable and payable in Dallas County, Texas such that exclusive venue for any legal action pertaining to this bond shall lie in Dallas County, Texas. By their signatures below, the persons signing this bond warrant and represent that they are, respectively, duly authorized to sign on behalf of Contractor and Surety.

EXECUTED this the _____ day of _____, 2_____.

CONTRACTOR:

SURETY: ¹

By: _____

By: _____

Title: _____

Title: _____

ACKNOWLEDGMENTS
[Contractor]

STATE OF TEXAS }
COUNTY OF DALLAS }

Before me _____ (insert the name of the officer) on this day _____ personally appeared _____ known to me (or proved to me on the oath of _____) or through _____ (description of identity card or other document) to be the person whose name is subscribed to the forgoing instrument and acknowledged to me that he/she executed the same for the purpose and consideration therein expressed.

Given under my hand and seal of office this _____ day of _____, 2_____.

Notary Public in and for the State of Texas
My Commission Expires: _____

Typed or Printed Name of Notary

[Surety]

STATE OF TEXAS }
COUNTY OF DALLAS }

This instrument was acknowledged before me on the _____ day of _____, 2_____ by _____ who is the _____ of the Surety, on behalf of Surety.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the _____ day of _____, 2_____.

Notary Public in and for the State of Texas
My Commission Expires: _____

Typed or Printed Name of Notary

¹ Please see attached contact sheet for Surety and the Texas Department of Insurance

Payment and Performance Bond Contact Sheet

(1) Claims:

All notices of claims shall be sent to the surety at the following address:

(Name of surety)

(Mailing address)

(Physical address)

(Phone number)

(2) Texas Department of Insurance Contact Number:

The address and contact information of the surety may otherwise be obtained by contacting the Texas Department of Insurance at the following toll free telephone number:

1-800-252-3439.

SECTION MB

MAINTENANCE BOND

MB 1

MAINTENANCE BOND – TWO YEAR

STATE OF TEXAS ,

COUNTY OF DALLAS ,

WHEREAS, _____, as principal ("Contractor") and _____, a corporation organized under the laws of _____ and being duly authorized to do business in the State of Texas, as surety ("Surety")(whether one or more), do hereby expressly acknowledge themselves to be held and bound to pay to the Town of Addison, Texas, a home-rule municipality organized and operating under the Constitution and laws of the State of Texas (the "Town"), its successors and assigns the sum of _____ Dollars in the lawful currency of the United States of America (\$) for the payment of which Contractor and Surety are liable to the Town, jointly and severally; and

WHEREAS, Contractor has this day entered into a written contract with the Town to build and construct which contract and the plans and specifications therein mentioned (collectively referred to hereinafter as the "Contract") are hereby expressly incorporated into and made a part hereof as though set forth at length; and

WHEREAS, under the Contract it is provided that the Contractor will maintain and keep in good repair all work to be performed and done under the Contract for a period of **one (1) year** from the date of acceptance of the completed work by the Town, and to do and perform all necessary work and repair any defective condition, it being understood that the purpose of this maintenance bond is to insure all warranties, express or implied, made or given by the Contractor to the Town and to cover all defective, inadequate or non-conforming conditions arising by reason of any materials or labor installed, provided, constructed or performed by the Contractor and in case the Contractor shall fail to correct any such conditions it is agreed that the Town may make such corrections and charge the cost of making those corrections against the Contractor and the Surety on this obligation, and the Contractor and Surety shall be subject to the liquidated damages provided in the contract, the plans and the specifications for each day's failure on its part to comply with the terms and provisions of the Contract;

NOW, THEREFORE, if the Contractor shall keep and perform its obligation to maintain the work and keep the work in repair for the full maintenance period of two (2) year as herein provided, then these presents shall be null and void and have no further effect, but if default shall be made by Contractor in the performance of its obligations, then these presents shall have full force and effect, and the Town shall have and recover from the Contractor and its Surety damages in the premises as provided and it is further understood and agreed that this obligation shall be a continuing one against the Contractor and the Surety and that successive recoveries may be had hereon for successive breaches until the full amount of this bond shall have been exhausted; and it is further understood that the obligation under this bond to maintain the work shall continue throughout the maintenance period and shall not be changed, diminished, or in any other manner affected during the term of this bond. The obligations of Contractor and Surety under this bond apply both to the original Contract and to any extension or modification of the Contract and Surety agrees that no change, extension of time, addition, expansion or other modification of the Contract, the work to be done under the Contract, or the plans and specifications which are a part of the Contract shall in any manner affect the obligations of Surety under this bond, and Surety waives notice of any such change, extension of time, addition, expansion or other modification. The obligations of Contractor and Surety under this bond are performable and payable in Dallas County, Texas such that exclusive venue for any legal action pertaining to this bond shall lie in Dallas County, Texas. By their signatures below, the persons signing this bond warrant and represent that they are, respectively, duly authorized to sign on behalf of Contractor and Surety.

EXECUTED this the _____ day of _____, 2_____.
CONTRACTOR: _____ SURETY: _____

By: _____ By: _____
Printed Name: _____ Printed Name: _____
Title: _____ Title: _____

Address of Principal: _____ Address of Surety: _____

ACKNOWLEDGMENTS
[Contractor]

STATE OF TEXAS ,
COUNTY OF DALLAS ,

Before me _____ (insert the name of the officer) on this day _____ personally appeared _____ known to me (or proved to me on the oath of _____) or through _____ (description of identity card or other document) to be the person whose name is subscribed to the forgoing instrument and acknowledged to me that he/she executed the same for the purpose and consideration therein expressed.

Given under my hand and seal of office this _____ day of _____, 2_____.

Notary Public in and for the State of Texas _____ Typed or Printed Name of Notary
My Commission Expires: _____
[Surety]

STATE OF TEXAS ,
COUNTY OF DALLAS ,

This instrument was acknowledged before me on the ____ day of _____, 2____ by _____ who is the _____ of the Surety, on behalf of Surety.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the _____ day of _____, 2_____.

Notary Public in and for the State of Texas _____ Typed or Printed Name of Notary
2-4-13 2 yr

SECTION BP

CONTRACTOR'S AFFIDAVIT OF BILLS PAID

CONTRACTOR'S AFFIDAVIT OF BILLS PAID

STATE OF TEXAS

COUNTY OF DALLAS

Personally, before me the undersigned authority, on this day appeared _____ who, being
duly sworn, on oath, says that he is a legal representative of _____
(full name of Contractor as in contract)

and that the contract for the construction of the project, designated as

ADDISON ATHLETIC CLUB HVAC IMPROVEMENTS

INFRASTRUCTURE AND DEVELOPMENT SERVICES BID NUMBER 18-224

has been satisfactorily completed and that all bills for materials, apparatus, fixtures, machinery and labor
used in connection with the construction of this project have, to the best of my knowledge and belief, been
fully paid.

Signature

Title

Sworn to and subscribed before me this _____ day of _____, 201_.

Notary Public in and for

County, Texas

Instructions:

If the contractor is an individual, he shall sign the affidavit. If the contractor is a partnership, any partner may sign the affidavit. If the contractor is a corporation, a person authorized by the by-laws or by the Board of Directors shall sign the affidavit. If the Contractor is a joint-venture of individuals, any of the individuals may sign the affidavit. If the Contractor is a joint-venture of partnerships, or of individuals and partnerships, the affidavit may be signed by the individual or any partner of any partnership. If the contractor is a joint-venture in which a corporation is a party, separate affidavits must be executed in the name of the joint-venture: one by each corporation and one by each individual or partnership. Signatures for corporations should be by a duly authorized officer. If signature is by another, a showing of authority to sign must accompany the affidavit.

SECTION GP

GENERAL PROVISIONS

GENERAL PROVISIONS

The General Provisions of the Contract shall be as stated in the *Standard Specifications for Public Works Construction – North Central Texas, 5th Edition (2017)*, under Division 100, "General Provisions", as amended or supplemented and except as modified by the Special Provisions or Instructions to Bidders.

SECTION SP
SPECIAL PROVISIONS

SPECIAL PROVISIONS

1. **SCOPE OF WORK:** The Work to be performed under the provisions of these Contract Documents shall consist of furnishing all materials, labor, equipment, supplies and appurtenances; providing all construction, plant, equipment and tools; performing all necessary labor and supervision; and the construction complete, including all Work appurtenant thereto, the proposed improvements for: Addison Athletic Club HVAC Improvements ("Project").
2. **GENERAL:** This Work shall conform to the requirements of the Specifications and the details as shown on the Plans. These Contract Documents are intended to be complementary. The Contractor shall do all work as provided in the plans, specifications, special provisions, bid and contract, and shall do such additional Extra work as may be considered necessary to complete the work in a satisfactory and acceptable manner. The Contractor shall furnish all labor, tools, materials, machinery, equipment, and incidentals necessary to the satisfactory prosecution and completion of the Work. Requirements of any of the Contract Documents are as binding as if called for by all. In the event of conflict between the Plans and the Specifications, the Contractor will be deemed to have assumed the more expensive way of doing the Work unless, before submitting a bid, the Contractor shall have asked for and obtained (by addendum) a written decision as to which method or material is intended.

In cases of discrepancies, calculated dimensions shall govern over scaled dimensions; Special Provisions and special Specifications shall govern over both General Provisions and standard Specifications; and quantities shown on the Plans shall govern over those shown in the proposal.

3. **EXAMINATION OF SITE:** The Contractor acknowledges that he has investigated and satisfied itself as to the conditions affecting the Work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, or similar physical conditions at the site, conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the Work. The Contractor acknowledges that he has inspected the site of the Work and is familiar with the soil conditions to be encountered. Any failure by the Contractor to acquaint himself with the available information will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the Work. The Town of Addison assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the Town and the Engineer.
4. **SPECIFICATIONS:** Construction improvements shall be governed by the following published specifications and details (except as modified by these Special Provisions):

Standard Specifications for Public Works Construction, North Central Texas - North Central Texas Council of Governments (latest edition);

Addison Athletic Club HVAC Improvements

Town of Addison Standard Construction Details;

The Contractor shall keep copies of applicable Specifications on the Project site at all times.

Where reference is made to specifications compiled by other agencies, organizations or departments, such referenced specifications are hereby made a part of the Project Specifications.

5. **SUBSURFACE INVESTIGATION:** Subsurface exploration to ascertain the nature of soils, including the amount of rock, if any, is the responsibility of any and all prospective Bidders. It shall be the responsibility of the Bidders to make such subsurface investigations as he deems necessary to determine the nature of the material to be encountered. Some preliminary subsurface exploration has been performed by the Town of Addison and the Engineer, and is provided to the Contractor in the Contract Documents. This information is provided only as preliminary and all bids shall be based on information obtained by the Contractor. The Town of Addison and the Engineer disclaim any responsibility for the accuracy, true location and extent of the soils information that has been prepared by others. They further disclaim responsibility for interpretation of that data by Bidders, as in projecting soil bearing values, rock profiles, soils stability and the presence, level and extent of underground water.
6. **HISTORICAL, SCIENTIFIC AND ARCHAEOLOGICAL DISCOVERIES:** Contractor shall immediately give an oral and written report to the Town of Addison of the discovery of any articles of historical, scientific, or archaeological significance. Contractor shall take all necessary steps to preserve the article and shall cease operations, which would affect the find until otherwise directed by the Town of Addison but continue with all other unaffected operations. The future operations of Contractor with respect to the discovery, including disposition of the articles, shall be decided by the Town of Addison. The Town of Addison shall have sole and exclusive title to any discovered articles.

The Town of Addison shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in Contractor's cost of, or the time required for performing any part of the work under the Contract, whether or not changed as a result of conditions, an equitable adjustment will be made and the Contract modified in writing accordingly.

No request by Contractor for an equitable adjustment to the Contract under this Section shall be allowed unless Contractor has given the written notice required. No request by Contractor for an equitable adjustment of the Contract for differing site conditions will be allowed or shall be made after final payment under the Contract.

ENVIRONMENTAL REQUIREMENTS: In addition to requirements set forth in other sections of the Contract, including the Plans and Specifications, Contractor shall ensure that the requirements of this Section are fulfilled and incorporated into its procedures and processes as well as those of any Subcontractors. All materials utilized

Addison Athletic Club HVAC Improvements

by Contractor on the Project shall comply with all applicable local, state and federal laws and regulations.

A. Contractor is responsible for compliance with any requirements included in the Contract Documents regarding Hazardous Materials. If Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by Contractor, Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Town of Addison in writing.

1. The term “Hazardous Materials” means any substance or compound, whether solid, liquid or gaseous: (i) which is listed, defined or regulated as a “hazardous substance”, “hazardous waste”, “extremely hazardous waste”, “solid waste”, “toxic substance”, “hazardous substance”, “hazardous material” or “regulated substance” or otherwise classified as hazardous or toxic, in or pursuant to any Environmental Law; or (ii) which is or contains asbestos, radon, any polychlorinated biphenyl, urea formaldehyde foam insulation, explosive or radioactive material, lead, or motor fuel or other volatile organic compounds; or (iii) which causes or poses a threat to cause a contamination or nuisance on the Project Site or any adjacent property, or (iv) which causes or poses a threat to cause a hazard to the environment or to the health, safety or welfare of persons on or about the Project Site.

2. The term “Environmental Law” means any federal, state or local law, statute, guidance or policy statement, ordinance, code, rule, regulation, license, authorization, decision, order, injunction or decree, which pertains to health, safety or the environment (including, but not limited to, ground, air, water or noise pollution or contamination, and underground or aboveground tanks) and shall include without limitation, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, the Resource Conservation and Recovery Act of 1976, as amended, the Occupational Health and Safety Act, the Toxic Substances Control Act, the Texas Water Code and the Texas Solid Waste Disposal Act and any other state or federal environmental statutes.

B. If the material or substance was on the site prior to the issuance of the Notice to Proceed, the Town of Addison shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by Contractor and, in the event such material or substance is found to be present, to verify that it has been remediated to levels required by the Texas Commission on Environmental Quality. When the material or substance has been remediated, Work in the affected area shall resume upon written direction of the Town of Addison.

C. Except as provided in Subparagraph B., Contractor (with the Town of Addison’s prior written approval of the laboratory) shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by Contractor and, in the event such material or substance is found to be present, the Town of Addison shall

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determine whether Contractor or the Town of Addison shall have the substance remediated to levels required by the Texas Commission on Environmental Quality. When the material or substance has been remediated, Work in the affected area shall resume upon written direction of the Town of Addison. The Contract time shall be not be extended and the Contract Price shall not be increased, unless the material or substance to be remediated were not introduced to the Work Site by Contractor, and Contractor shall then pay for (or reimburse the Town of Addison for) the testing and remediation.

D. The Town of Addison shall not be responsible under this Section for materials or substances Contractor brings or introduces to the Project Site. Contractor shall be responsible for the fault or negligence in the use and handling of materials or substances of Contractor, Subcontractor, Sub-subcontractor, or anyone directly or indirectly employed by any of them.

E. Contractor shall indemnify the Town of Addison and its affiliates for any and all damages incurred by the Town of Addison as a result of Contractor's actions with respect to all applicable state and federal environmental laws related to materials or substances Contractor brings to the Project Site, including but not limited to fines, penalties, costs of remediation and reasonable attorney's fees. No time extension shall be granted for breach of this provision.

F. Contractor agrees that it shall not transport to, use, generate, dispose of, or install at the Project Site any Hazardous Materials, except in accordance with applicable environmental laws. Further, in performing the Work, Contractor shall not cause any release of Hazardous Materials into, or contamination of, the environment, including the soil, the atmosphere, any water course or ground water unless required by the Contract Documents. In the event Contractor engages in any of the activities prohibited in this Section or fails to stop Work as provided in this Section, to the fullest extent permitted by law, Contractor hereby indemnifies and holds the Town of Addison, its affiliates and their respective officers, agents, employees and tenants harmless from and against any and all claims, damages, losses, causes of action, suits and liabilities of every kind, including but not limited to, expenses of litigation, court costs, punitive damages and attorneys' fees, arising out of, incidental to or resulting from the activities prohibited in this Section or Contractor's failure to stop Work as required. Contractor shall obtain from manufacturers and furnish to the Town of Addison Materials Safety Data Sheets (OSHA Form 20) for all materials incorporated into the Project by Contractor. The Town of Addison hereby agrees that, as between the Town of Addison and Contractor, the Town of Addison will be responsible for Hazardous Materials on site which existed prior to Contractor performing Work on the Project Site or which are introduced to the Project Site by the Town of Addison, except as provided in this Section. Contractor will not be considered the generator of Hazardous Materials on site which existed prior to Contractor performing Work on the Work Site or which are introduced to the Project Site by the Town of Addison. If the Hazardous Materials were on the Project Site prior to Contractor's presence on the Project Site or were introduced to the Project Site by the Town of Addison, then, if appropriate, the Town of Addison will make an equitable adjustment to the Contract.

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G. Include in all construction subcontracts exceeding \$100,000, the following requirement: "Contractor is responsible for compliance with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act, Section 505 of the Clean Water Act, Executive Order 11738, and Environmental Protection Agency regulations."

H. No request by Contractor for an equitable adjustment to the Contract under this Section shall be allowed unless Contractor has given the written notice required.

I. No request by Contractor for an equitable adjustment of the Contract for Hazardous Materials will be allowed or shall be made after final payment under the Contract.

7. **COMPLIANCE WITH LAWS:** The Contractor shall familiarize himself with the nature and extent of the Specifications, Plans, Project Site conditions, traffic and safety requirements, and shall fully comply with all local, state and federal laws, including all codes, ordinances, rules and regulations applicable to this Contract and the Work to be done hereunder, which exist or which may be enacted later by governmental bodies having jurisdiction or authority for such enactment. The Contractor shall comply with all federal, state and local laws, rules and regulations of every kind and nature applicable to the performance of its Work hereunder, and shall hold the Town of Addison and the Engineer harmless therefrom. No plea of ignorance or misunderstanding thereof will be considered.
8. **PERMITS, LICENSES. AND REGULATIONS:** Permits and licenses for the prosecution of the Work shall be secured and paid for by the Contractor. Any required permit fees will still be paid by the Contractor. Wherever the Work under this contract requires the obtaining of permits from the Town of Addison or other public authorities, duplicate copies of such permits shall be furnished to the Engineer by the Contractor hereunder before the Work covered thereby is started. **NO WORK WILL BE ALLOWED TO PROCEED BEFORE SUCH PERMITS ARE OBTAINED.**
9. **RIGHTS-OF-WAY AND EASEMENTS:** Rights-of-way and permanent easements, dedicated to the Town of Addison, will be secured for this Project and made a part of thereto. The Contractor shall obtain a right-of-way permit from the Town of Addison prior to beginning Work. When working within the public rights-of-way and easements, the Contractor shall at all times observe and comply with all Federal and State Laws, and Town of Addison ordinances and regulations which in any way affect the conduct of the Work or its operations, and shall observe and comply with all orders, laws, ordinances and regulations which exist or which may be enacted later by bodies having jurisdiction or authority for such enactment. No plea of misunderstanding or ignorance thereof will be considered. The Contractor and his Sureties shall indemnify and save harmless the Town of Addison, the Engineer and all of their officers, agents, and employees against any and all claims or liability arising from or based on the violation of any such law, ordinance, regulation, or order, whether it be by itself or its employees.

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It shall be the responsibility of the Contractor, prior to the initiation of construction on easements through private property, to inform the property owner of its intent to begin construction. Before beginning construction in areas of public dedication, the Contractor shall inform the agency having jurisdiction in the area forty-eight (48) hours prior to initiation of the Work. All easements shall be cleaned up after use and restored to their original conditions or better.

10. **RESTRICTED WORK HOURS:** Per the Town of Addison Building Regulations, “It shall be unlawful for a person, firm or corporation to excavate, erect, build, construct, alter, repair or demolish any building or structure which has been issued or which is required to be issued a building permit by the Town of Addison between the hours of 7:00 p.m. and 7:00 a.m. Monday through Friday, and between the hours of 7:00 p.m. and 8:00 a.m. on Saturday and Sunday, if such activity is performed within a residential, apartment, or townhouse zoned area, or within three hundred (300) feet of an occupied residence, except in cases of urgent necessity or in the interest of public safety and convenience, and then only by permit of the City Manager.”

It is in the interest of the public safety and convenience for the Work under this Project to occur outside the standard Work hours. However, the contractor will must present a detailed Work schedule and obtain written approval from the Town.

11. **COMPLIANCE WITH IMMIGRATION LAWS:** Contractor shall take all steps necessary to ensure that all of the Contractor’s employees are authorized to work in the United States as required by the Immigration Reform and Control Act of 1986.
12. **NON-DISCRIMINATION POLICY:** It is the policy of the Town of Addison to afford all people an equal opportunity to bid on any contract being let by the Town. The Town of Addison has a policy that prohibits discrimination against any person because of race, color, sex, or national origin, in the award or performance of any contract. The Town of Addison will require its employees, agents, and Contractors to adhere to this policy.
13. **ANTITRUST LAWS:** The Contractor hereby assigns to the Town of Addison any and all claims for overcharges associated with this contract which arise under the antitrust laws of the United States 15 U.S.C.A. Sec. 1, et seq. (1973).
14. **ABANDONMENT:** The Town of Addison reserves the right to abandon, without obligation to the Contractor, any part of the Project, or the entire Project, at any time before the Contractor begins any construction Work authorized by the Town of Addison. In case of total abandonment of the Project, the Contract becomes void. The Town of Addison may abandon portions of the Project at any time during the Project duration. In case of such partial abandonment, the Contractor shall not be due any payment for lost or unrealized profits on the abandoned portions of the Project.
15. **DISCREPANCIES:** If the Contractor, in the course of the Work, finds any discrepancy between the Contract Documents and the physical conditions of the Project, or any errors or omissions in Plans or in the layout as given by survey points and instructions, or if it appears that any Plan, Specification or other Contract Document is or may not be in

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compliance with any building code or other requirement of any governmental body, he shall immediately inform the Town of Addison and the Engineer in writing, and the Town of Addison and the Engineer shall promptly verify the same. Any Work done after such discovery, until authorized, will be done at the Contractor's risk.

16. **PREPARATION OF STORM WATER POLLUTION PREVENTION PLAN:** A Storm Water Pollution Prevention Plan (SW3P) will not be required for this project.

This specification is not all inclusive of the requirements for an SW3P. The Contractor shall comply with all requirements of the TCEQ TPDES permit and the local authorities' storm water ordinance and/or regulations.

17. **ADDENDA:** Bidders desiring further information, or interpretation of the Plans and Specifications, must make written request for such information to the Engineer (not later than four (4) working days prior to the date set for the Bid opening. The ability to ask questions will close at **5:00 PM, Friday, October 12, 2018**. Answers to all such requests will be issued in the form of Addenda and a copy of such Addenda will be released through www.bidsync.com. It will be the responsibility of each person who has been issued as set of Bidding Documents to secure all Addenda from www.bidsync.com. Addenda will be bound with and made a part of the Contract Documents. No other explanation or interpretation will be considered official or binding. Should a Bidder find discrepancies in, or omissions from, the Plans, Specifications or Contract Documents, or should it be in doubt as to their meaning, it shall at once notify the Engineer in writing in order that a written addendum may be sent to all Bidders.
18. **PAY ITEMS:** Pay items provided are intended to be all-inclusive of the Work required on this Project. Work required by the Plans or Specifications but not provided with a specific pay item shall be considered incidental to other items of Work. Final payment to the construction Contractor shall not be made until all Work has been finally completed and verified in accordance with the construction contract, Plans and Specifications and have been finally accepted by the Town of Addison.

See bid item descriptions/reference specifications for details.

19. **INCREASE OR DECREASE IN QUANTITIES:** The quantities shown in the proposal are approximate. Final payment will be based on quantities determined by measurement methods described for each Work item.

When the quantity of Work to be done or materials to be furnished under any major pay item or contract is more than 125% of the quantity stated in the contract, whether stated by Town of Addison or by Contractor, then either party to the contract, upon demand, shall be entitled to negotiate for revised consideration on the portion of Work above 125% of the quantity stated in the contract.

When the quantity of the Work to be done or materials to be furnished under any major pay item of the contract is less than 75% of the quantity stated in the contract, whether stated by Town of Addison or by Contractor, then either party to the contract, upon demand, shall be entitled to negotiate for revised consideration on the portion of Work

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below 75% of the quantity stated in the contract. This paragraph shall not apply in the event Town of Addison deletes a pay item in its entirety from this contract.

20. **SUBSIDIARY WORK:** Any and all Work specifically governed by documentary requirements for the Project, such as conditions imposed by the Plans or these Special Provisions, in which no specific item for bid has been provided for in the Proposal, shall be considered as a subsidiary item of Work, the cost of which shall be included in the various bid items in the Proposal. Costs of permits, inspection fees, traffic control, construction staking, surface restoration and cleanup are general items of Work which fall in the category of subsidiary Work. Any repairs or replacement of items damaged during demolition or as a result of new construction will be considered subsidiary. Limits of all Work requiring repair will be determined by the Town of Addison staff or the inspector. Extreme care should be taken during all demolition and construction operations.
21. **QUALIFICATION OF BIDS:** The Town of Addison reserves the right to reject any and all Bids, to waive any and all informalities not involving price, time or changes in the Work, and the right to disregard all nonconforming, non-responsive, unbalanced, or conditional Bids. The Town reserves the right to reject the Bid of any Bidder if the Town believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the Town. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolve in favor of the correct sum.

To be considered responsive, the apparent three lowest Bidders are required to submit the Statement of Experience per Section BQS “Bidder Qualification Statement” within 5 days.

The apparent low three Bidders will be notified by the Engineer to request the information.

AWARD AND EXECUTION OF CONTRACT: For the purpose of award, each bid submitted shall consist of three parts with the correct summation of the products of the estimated quantities shown in the proposal multiplied by their bid unit prices.

Bidders must fill bid proposal for all base bids and all additive alternates. The method of Award will be based on the lowest qualified bidder for all base bids plus any combination of the additive alternates depending on the availability of funds.

The Town reserves the right to accept whichever bid is determined to be in the best interest of the public and to reject all bids.

All payments will be based on actual quantities and bid unit prices.

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22. **EXPLANATION OF CONTRACT TIME:** The term “Contract Time” as used in this Provision will mean calendar days for completion of the Work of the Contract from the date the Contract was executed. The term “calendar day” as used in this Article will mean every day shown on the calendar. Calendar days will be consecutively counted from commencement of Contract Time regardless of weather, weekends, holidays, suspensions of Contractor’s operations, delays or other events as described herein.

In the event of a catastrophic event (i.e., war, invasion, riot, declared state of emergency, national strike, or other situations as declared by the Town of Addison) directly and substantially affecting the Contractor’s operations on the Contract, the Contractor and the Town shall agree as to the number of calendar days to extend the Contract Time. In the event the Contractor and Town are unable to agree to the number of calendar days to extend the Contract Time, the Town shall unilaterally determine the number of calendar days to extend the Contract Time reasonably necessary and due solely to such catastrophic event and the Contractor shall have no right whatsoever to contest such determination, save and except that the Contractor establishes that the number of calendar days determined by the Town were arbitrary or without any reasonable basis.

Should the Contractor fail to complete the Contract on or before expiration of the Allowable Contract Time, as adjusted in accordance with the provisions above, the Town shall deduct from the moneys due the Contractor the Daily Value as shown in provision 78 for each calendar day completion exceeds the Allowable Contract Time. The term “Allowable Contract Time” as used in this Article shall mean the Original Contract Time plus adjustments pursuant to the statements above. This deduction shall be the disincentive for the Contractor’s failing to timely complete the Contract. **This shall be strictly enforced.**

23. **COPIES OF PLANS FURNISHED:** One (1) full-size copy and one (1) electronic copy of the Plans shall be furnished to the successful Contractor, at no charge, for construction purposes. Additional copies may be obtained at cost of \$150.00 per set upon request.
24. **PRE-CONSTRUCTION CONFERENCE:** The successful Contractor, Engineer, and Town of Addison shall meet for a pre-construction conference before any of the Work begins on this Project. At this time, details of sequencing of the Work, contact individuals for each party, testing requirements, submittals, and pay requests will be covered. Prior to the meeting, the Contractor shall prepare schedules showing the sequencing and progress of their Work and its effect on others. A final composite schedule will be prepared during this conference to allow an orderly sequence of Project construction.
25. **MOBILIZATION:** See specification SS-120 included in the technical specifications.
26. **GENERAL SEQUENCE OF CONSTRUCTION:** Prior to the start of Work, the Contractor shall develop a detailed construction and sequence of construction schedule using the critical path method (CPM) and submit to the Town of Addison and Engineer for approval. The CPM shall reflect all definable features of Work and activities that shall cause minimum interference with traffic along, across and adjacent to the Project

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during construction. If the schedule or sequence becomes unworkable or unsatisfactory as Work proceeds, adjustments shall be made. During all phases of construction access to all existing businesses must be maintained at all times unless otherwise authorized in writing by the Town of Addison or Addison Airport. Erosion control devices must be properly installed and maintained during all stages of construction.

The Contractor must comply with all work area restrictions as indicated in the Plans unless specifically authorized in writing by the Town of Addison.

The general intent is for the contractor to begin within one area and steadily progress limiting the area of construction to minimize disruptions to aircraft operations and businesses along the route.

27. **PROJECT REPRESENTATIVE:** The Town of Addison, the Engineer, the Contractor(s), and any applicable public utilities shall designate a single individual within their organization to act as liaison for the Project. This individual shall be aware of the day to day activities on the Project, have authority to make decisions binding on the party, and serve as single point for coordination of activities with the other team members. The Contractor's representative must be available to meet and discuss construction related issues on site or at the Town's offices within 20 minutes of a request during working hours and throughout the entire construction period. Upon repeated failure of attendance at requested meetings, Contractor will be required to have a Project representative on-site at all times.
28. **COORDINATION WITH OTHERS:** In the event that other Contractors are doing Work in the same area simultaneously with this Project, the Contractor shall coordinate his proposed construction with that of the other Contractors. The Town of Addison and/or the Engineer shall mediate any disputes, and the Contractors shall comply with their decisions.
29. **INSURANCE:** Each insurance policy that the Contractor must furnish in accordance with these contract documents shall name the Town of Addison and the Engineer as additional insured. Contractor shall include in their bid package, a copy of their certificate of insurance showing compliance to the limits established by the Town of Addison.

1.0 The Contractor shall agree to furnish and maintain continuously during the period of this agreement, any renewals or extension, insurance coverage meeting all of the following requirements:

1.1 Commercial General Liability Insurance at minimum combined single limits of \$1,000,000 per occurrence and \$2,000,000 general aggregate for Bodily Injury and Property Damage, which coverage shall include Products/Completed Operations, and XCU Hazards. Coverage for product/completed operations must be maintained for at least two (2) years after the construction Work has been completed. Coverage must be amended to provide for an each-project aggregate limit of insurance. Contractual Liability must be included.

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1.2 Workers Compensation Insurance at statutory limits, including employer's liability coverage at minimum limits of \$1,000,000 each occurrence-each accident, \$1,000,000 by disease-each occurrence and \$1,000,000 by disease aggregate

1.3 Commercial Automobile Liability Insurance at minimum combined single limits of \$1,000,000 per occurrence for bodily injury and property damage, including owned, non-owned, and hired car coverage.

1.4 Umbrella Liability at minimum limits of \$1,000,000 each-occurrence \$4,000,000 aggregate with respect to primary commercial general liability, automobile liability and employer's liability policies.

1.5 Any Subcontractor(s) hired by the Contractor shall maintain insurance coverage equal to that required by the Contractor. It is the responsibility of the Contractor to assure compliance with this provision. The Town accepts no responsibility arising from the conduct, or lack of conduct, of the Subcontractor.

1.6 A comprehensive general liability insurance form may be used in lieu of a commercial general liability form. In this event, coverage must be written on an occurrence basis, at limits of \$1,000,000 each-occurrence, combined single limit and coverage must include a broad form comprehensive general liability endorsement, products/completed operations, XCU hazards and contractual liability.

2.0 With reference to the foregoing insurance requirements, Contractor shall specifically endorse applicable insurance policies as follows:

2.1 The Town shall be named as an additional insured with respect to general liability and automobile liability.

2.2 All liability policies shall contain no cross liability exclusions or insured versus insured restrictions.

2.3 A waiver of subrogation in favor of the Town of Addison shall be contained in the workers compensation and all liability policies.

2.4 All insurance policies shall be endorsed to require the insured to immediately notify the Town of Addison of any material changes in the insurance coverage.

2.5 All insurance policies shall be endorsed to the effect that the Town will receive at least thirty (30) days notice prior to cancellation or non-renewal of the insurance.

2.6 All certificates shall be mailed to Town of Addison, Purchasing Dept., P.O. Box 9010, Addison, Texas 75001 or emailed to purchasing@addisontx.gov.

2.7 All insurance policies, which name the Town as an additional insured, must be endorsed to read as primary coverage regardless of the application of other insurance.

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2.8 Required limits may be satisfied by any combination of primary and umbrella liability insurances.

2.9 Contractor may maintain reasonable and customary deductibles, subject to approval by the Town.

3.0 All insurance shall be purchased from an insurance company who meets the following requirements:

3.1 Must be issued by a carrier, which is rated “A-” VII or better by A.M. Best’s Key Rating Guide.

3.2 Licensed and admitted to do business in the State of Texas and is a subscriber to the Texas Guaranty Fund.

4.0 All insurance must be written on forms filed with and approved by the Texas State Board of Insurance. Certificates of insurance shall be prepared and executed by the insurance company or its authorized agent and shall contain provisions representing and warranting the following:

4.1 Set forth all endorsements and insurance coverages according to requirements and instruction contained herein.

4.2 Shall specifically set forth the notice-of-cancellation or termination provisions to the Town.

5.0 Upon request, Contractor shall furnish the Town of Addison with certified copies of all insurance policies.

WORKERS’ COMPENSATION INSURANCE COVERAGE:

A. Definitions.

Certificate of Coverage (“certificate”) - A copy of a certificate of insurance, a certificate of authority to self insure issued by the Texas Workers’ Compensation Commission (the “TWCC”), or a coverage agreement (TWCC-81, TWCC-82, TWCC-83 or TWCC-84), showing statutory workers’ compensation insurance coverage for the person’s or entity’s employees providing services on a Project, for the duration of the Project.

Duration of the Project - includes the time from the beginning of the Work on the Project until the Contractor’s/person’s Work on the Project has been completed and accepted by the governmental entity.

Persons Providing Services on the Project (“Subcontractor” in Section 406.096 of the Texas Labor Code) - includes all persons or entities performing all or part of the services the Contractor has undertaken to perform on the Project, regardless of whether that person contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent Contractors, Subcontractors,

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leasing companies, motor carriers, Town-operators, employees of any such entity or employees of any entity which furnishes persons to provide services on the Project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a Project. "Services" does not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

B. The Contractor shall provide coverage, based on property reporting of classification codes and payroll amounts and filing of any coverage agreement, which meets the statutory requirements of Texas Labor Code, 401.011(44) for all employees of the Contractor providing services on the Project, for the duration of the Project.

C. The Contractor must provide a certificate of coverage to the Town of Addison prior to being awarded the contract.

D. If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the Project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the Town of Addison, showing that the coverage has been extended.

E. The Contractor shall obtain from each person providing services on the Project, and provide to the Town of Addison:

(1) a certificate of coverage, prior to that person beginning Work on the Project, so that the Town of Addison will have on file certificates of coverage showing coverage for all persons providing services on the Project; and,

(2) no later than seven days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;

F. The Contractor shall retain all required certificates of coverage on file for the duration of the Project and for one year thereafter.

G. The Contractor shall notify the Town of Addison in writing by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project.

H. The Contractor shall post on each Project site a notice, in the text, form and manner prescribed by the TWCC, informing all persons providing services on the Project that they are required to be covered, and stating how a person may verify current coverage and report failure to provide coverage.

I. The Contractor shall contractually require each person with whom it contracts to provide Services on a Project to:

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- (1) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Codes 401.011 (44) for all its employees providing services on the Project, for the duration of the Project;
- (2) provide to the Contractor, prior to that person beginning Work on the Project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project, for the duration of the Project;
- (3) provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
- (4) obtain from each person with whom it contracts, and provide to the Contractor;
 - a. a certificate of coverage, prior to the other person beginning Work on the Project; and,
 - b. a new certificate of coverage showing extension of the coverage period, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the Project.
- (5) retain all required certificates of coverage on file for the duration of the Project and for one year thereafter;
- (6) notify the Town of Addison in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project; and
- (7) contractually require each other person with whom it contracts to perform as required by paragraphs (1) - (7) with the certificate of coverage to be provided to the person for whom they are providing services.

J. By signing this contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the Town of Addison that all employees of the Contractor who will provide services on the Project will be covered by worker's compensation coverage for the duration of the Project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the TWCC's Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties or other civil actions.

K. The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the Town of Addison to declare the contract void if the Contractor does not remedy the breach within ten days after receipt of notice of breach from the Town.

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The following is the form of notice of workers' compensation coverage prescribed by the TWCC. Pursuant to Section 110.110 (d) (7), this notice must be printed with a title in at least 30-point bold type, and text in at least 19-point nominal type, and shall be in both English and Spanish and any other language common to the worker population.

REQUIRED WORKERS' COMPENSATION COVERAGE

"The law requires that each person working on this site or providing services related to this construction Project must be covered by workers' compensation insurance. This includes persons providing, hauling or delivering equipment or materials, or providing labor or transportation or other service related to the Project, regardless of the identity of their employer or status as an employee.

"Call the Texas Workers' Compensation Commission (TWCC) at (512) 440-3789 to receive further information on the legal requirements for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

30. **RESOLUTION OF DISPUTES:** The parties hereby covenant and agree that in the event of any controversy, dispute, or claim, of whatever nature arising out of, in connection with or in relation to the interpretation, performance or breach of this Contract, including but not limited to any claims based on contract, tort or statute, before filing a lawsuit, the parties agree to submit the matter to Alternative Dispute Resolution pursuant to the laws of the State of Texas. The parties shall select a third party arbitrator or mediator from the current list of neutrals on file with the Alternative Dispute Resolution Administrator of the Dallas County District Courts or other mutually agreeable mediator or arbitrator. All forms of Alternative Dispute Resolution may be used except binding arbitration. The proceedings shall be conducted in accordance with the laws of the State of Texas.
31. **SHOP DRAWINGS:** The Contractor shall provide, review, approve and submit all shop drawings, product data and samples required by the Town of Addison, the Architect/Engineer and the Contract Documents in accordance with Item 1.28 of the Standard Specifications for Public Works Construction, North Central Texas Council of Governments. The Contractor shall furnish shop drawings in PDF format for review by the Architect/Engineer, who will review, approve and forward to the Town of Addison for acceptance. Shop drawings shall include all items to be installed in the Project.
32. **PROJECT VIDEO:** Prior to the start of construction, Contractor shall video the construction area and property adjacent to construction in the presence of the City Inspector. The format shall be DVD. The video shall be narrated. The Contractor shall furnish the Town of Addison a copy of the video in DVD format prior to commencement of Project. This shall be subsidiary to Project.
33. **SAMPLES AND TESTS OF MATERIALS:** The Town of Addison shall designate and pay an independent testing laboratory to furnish testing for this Project. Random testing

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will be provided by the independent lab as necessary for compliance with the Specifications. The Contractor shall coordinate construction with the testing lab and the Town of Addison, and shall provide assistance to the testing labs by providing excavation, access, trench safety, materials for testing and any other Work required to insure all testing requirements are met. Work performed to accommodate testing will be a subsidiary item and no extra payment will be authorized. All costs for the field quality control testing shall be paid for by the Town of Addison, except for any and all re-testing, which shall be paid by the Contractor and such cost shall be deducted from monthly pay requests. As a guide, the Contractor shall be responsible for providing any test required by the Specifications.

All samples and tests shall be performed in accordance with the Standard Specifications for Public Works Construction, North Central Texas Council of Governments (Latest Edition) as amended or supplemented.

34. **INSPECTION:** The Town of Addison and the Engineer reserve the right to inspect, test, measure or verify the construction Work for this Project as they deem necessary to ascertain that the Work is being accomplished in accordance with the standards and requirements set forth in the Contract Documents. Notwithstanding such reviews, the Contractor will be held responsible for the finished Work and any acceptance of the Work by the Town or governmental agencies will not relieve the Contractor from responsibility for the Work. The Town reserves the right to place full-time construction inspectors at the site of the Work. Costs for inspection services will be paid by the Town of Addison. The Contractor shall provide assistance to the Town of Addison and the Engineer by providing excavation, trench safety, or other Work necessary to facilitate inspection activities, and shall give sufficient notice well in advance of pending construction activities for scheduling of inspection services.

If the Specifications, the Town's instructions, laws, ordinances, or any public authority require any Work to be specially tested, the Contractor shall give the Town timely notice of its readiness for testing, and if the testing is by an authority other than the Town, of the date fixed for such testing. Tests by the Town shall be made promptly, and where practicable at the source of supply.

35. **ACCESS ROUTES, STAGING AREAS AND STORAGE AREAS:** All haul roads and access routes and the location of job site trailers, staging areas, and storage areas shall be subject to the approval of the Town and the Engineer. The Contractor shall be responsible for maintaining and repairing all roads and other facilities used during construction. Upon completion of the Project all existing roads and other disturbed areas shall be left in a condition equal to that at the time the Contractor commences Work on this Project.
36. **PROPERTY ACCESS:** Access to all public areas of the building shall be maintained at all times unless otherwise directed by the Architect/Engineer and/or Town of Addison.
37. **PLANT, PROCEDURES, METHODS AND EQUIPMENT:** The Contractor shall determine the methods to be employed, the procedures to be followed, and equipment to

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be used on the Work under this contract, subject to the requirements of these Specifications and approval of the Engineer and Town of Addison. Only adequate and safe procedures, methods and equipment shall be used.

The Contractor shall so arrange his Work and provide such plant and equipment as is necessary in order to meet the progress requirements of the approved time schedule and to complete the Work within the period of time as specified in the Contract. Only such materials and equipment as are necessary for the construction of the Work under this contract shall be placed, stored or allowed to occupy any space at the site of the Work.

It is expressly agreed that the acceptance or approval of any order of procedure, methods or equipment submitted or employed by the Contractor shall not in any manner relieve the Contractor of responsibility for the safety, maintenance and repairs of any Work, or for the construction maintenance and safety of the Work hereunder, or from any liability whatsoever on account of any procedure or method employed by the Contractor.

Where the Work under this contract requires permits from the Town of Addison, the State of Texas, or other public authorities, duplicate copies of such permits shall be furnished to the Engineer by the Contractor before the Work covered thereby is started. **NO WORK WILL BE ALLOWED TO PROCEED BEFORE REQUIRED PERMITS ARE OBTAINED AND DISTRIBUTED.**

38. **PARKING OF CONSTRUCTION EQUIPMENT:** At night and during all other periods of time when equipment is not being actively used on the construction Work, the Contractor shall park the equipment at locations which are approved by the Town of Addison. The Contractor shall provide adequate barricades, markers and lights to protect the Town of Addison, the Engineer, the public and other Work. All barricades, lights, and markers must meet the requirements of the Town of Addison, State and Federal regulations.
39. **ZONING REQUIREMENTS:** During the construction of this Project, the Contractor shall comply with the present zoning requirements of the Town of Addison in the use of vacant property for storage purposes.
40. **IN PUBLIC ROADS AND PRIVATE DRIVES:** No public road shall be entirely closed overnight. It shall be the responsibility of the Contractor to build and maintain all weather bypasses and detours, if necessary, and to properly light, barricade and mark all bypasses and detours that might be required on and across the roads involved in the Work included in this Contract.

The Contractor shall make every effort to complete construction and allow immediate access to adjacent property at driveway entrances located along the roadways. Towns or tenants of improvements where access and/or entrance drives are located shall be notified at least twenty-four (24) hours prior to the time the construction will be started at their driveways or entrances and informed as to the length of time driveways will be closed. Contractor shall at all times maintain at least one point of access into all properties,

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unless obtaining written permission from property Town to do otherwise with such written permission being provided to the Town's inspector.

The Contractor shall be responsible for all road and entrance reconstruction and repairs and maintenance of same for a period of two years from the date of Town of Addison's acceptance of the Work. In the event the repairs and maintenance are not made immediately to the satisfaction of the Town, and it becomes necessary for the Town to make such repairs, the Contractor shall reimburse the Town for the cost of such repairs.

The Contractor shall, at all times, keep a sufficient width of the roadway clear of dirt and other material to allow the free flow of traffic. The Contractor shall assume any and all responsibility for damage, personal or otherwise, that may be caused by the construction along roads and private drives.

41. **HAULING ON TOWN OF ADDISON STREETS:** The Contractor shall receive approval of its haul routes and type of equipment to be used prior to beginning construction. The Contractor shall be responsible for maintaining the cleanliness of existing paved roadways and shall provide equipment and manpower for that purpose.
42. **EXISTING POWER POLES & GUY WIRES:** The Contractor shall have the responsibility of coordinating with the proper authorities for the bracing, replacing or relocating of all utility poles and guy wires which interfere with the Work on this Project prior to beginning its construction operations. The Contractor will also be responsible for all damage to poles, guy wires, etc. that are damaged or destroyed by Contractor's operations.
43. **SAFETY RESTRICTIONS - WORK NEAR HIGH VOLTAGE LINES:** The following procedures shall be followed for Work near high voltage lines on this contract:
 - a. A warning sign not less than five (5) inches by seven (7) inches, painted yellow with black letters that are legible at twelve (12) feet shall be placed inside and outside vehicles such as cranes, derricks, power shovels, drilling rigs, pile driver, hoisting equipment or similar apparatus. The warning sign shall read as follows: "Warning - Unlawful to Operate This Equipment Within Six Feet of High Voltage Lines."
 - b. Equipment that may be operated within ten (10) feet of high voltage lines shall have an insulating cage guard protecting the boom or arm, except backhoes or dippers, and insulator links on lift hook connections.
 - c. When necessary to Work within six (6) feet of high voltage electric lines, notify the power company who will erect temporary mechanical barriers, de-energize the line, or raise or lower the line. All such Work done by the power company shall be at the expense of the Contractor. The Contractor shall maintain an accurate log of all such calls to the power company.
 - d. The Contractor is required to make arrangements with the power company for the temporary relocation or raising of high voltage lines at the Contractor's sole expense.

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- e. No person shall Work within six (6) feet of high voltage lines without protection measures having been taken as outlined in Paragraph c.
44. **PROTECTION OF EXISTING UTILITIES AND STRUCTURES:** The location and dimensions shown on the Plans relative to existing utilities and subsurface structures are based on the best records and/or field information available and are not guaranteed by the Town of Addison or the Engineer to be accurate as to location and depth. It shall be the Contractor's responsibility to verify locations of adjacent and conflicting utilities sufficiently in advance of its activities in order that he may negotiate such restrictive locations with the Town of Addison of the conflicting utility and/or make local adjustments to provide adequate clearances. The Contractor shall take all necessary precautions in order to protect all utilities and services encountered, whether or not they are indicated on the Plans. All damage to utilities resulting from Contractor's operations shall be restored at its expense. The Town of Addison and the Engineer assume no responsibility for failure to show any or all of these utilities or structures on the Plans, or to show them in their exact locations. It is mutually agreed that such failure shall not be considered sufficient basis for claims for additional compensation for Extra Work or for increasing the pay quantities in any manner whatsoever, unless the obstruction encountered is such as to necessitate changes in the lines or grades, or requires the building of special Work, provisions for which are not made in the Plans, in which case, provisions in these Specifications for Extra Work shall apply.
45. **PUBLIC UTILITIES AND OTHER PROPERTY TO BE CHANGED:** In case it is necessary to change or move the property of a public utility, such property shall not be moved or interfered with until authorized by the Town of Addison or the Engineer. The right is reserved for the Owner of public utilities to enter upon the limits of the Project for the purpose of making such changes or repairs of their property that may be made necessary by performance of the Contract. The Contractor shall be responsible for coordination with the Town of Addison and the Engineer, and all utility companies whose utility lines or streets may be affected by the proposed improvements. The Contractor shall observe the following:
- a. Prior to any excavation, the Contractor shall determine the locations of all existing water, gas, sewer, electric, telephone, telegraph, television, pipelines and other underground utilities and structures.
 - b. After commencing Work, the Contractor shall use every precaution to avoid interference with existing underground and surface utilities and structures, and protect them from damage.
 - c. Where the locations of existing underground and surface utilities and structures are indicated, these locations are generally approximate, and all items which may be encountered during the Work are not necessarily indicated. The Contractor shall determine the exact locations of all items indicated, and the existence and locations of all items not indicated.

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- d. The Contractor shall repair or pay for all damage caused by its operations to all existing utility lines, public property, and private property, whether it is below ground or above ground, and he shall defend and settle in total the cost of all lawsuits which may arise as a result of its operations.
 - e. To avoid unnecessary interferences or delays, the Contractor shall coordinate all utility removals, replacements and construction with the appropriate utility company, and then request written authorization from the Town of Addison or the Engineer. The Town of Addison and the Engineer will not be liable for damages due to delay as a result of the above.
46. **MAINTENANCE AND REPAIRS:** The Contractor shall maintain and keep in good repair all Work contemplated under these Plans, Specifications, and Plans which shall include the maintenance and repair of all existing streets, storm sewer crossings, utility crossings, temporary crossings for access to adjacent property, barricades, lights, and danger signals, and all Work which is necessary for the well being of the general public. In the event the Contractor fails in its obligations to properly maintain the Work, the Town of Addison shall make such repairs as are necessary and the cost of such repairs shall be deducted from payment due the Contractor.
47. **PROTECTION OF WORK:** During performance and up to date of final acceptance, the Contractor shall be under the absolute obligation to protect the finished Work against damage, loss or injury. In the event of damage, loss or injury, the Contractor shall promptly replace or repair such Work, whichever the Town of Addison shall determine to be preferable. The obligation to deliver finished Work in strict accordance with the contract prior to final acceptance shall be absolute and shall not be affected by the Town of Addison's approval of or failure to prohibit means and methods of construction used by the Contractor. All risk of loss or damage to the Work shall be borne solely by the Contractor until final acceptance of all Work by the Town of Addison, as evidenced by the Town of Addison's issuance of a certificate of acceptance.
48. **PUBLIC CONVENIENCE AND SAFETY:** In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for conditions of the Project site, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and not be limited to normal Work hours.

Materials stored about the Work site shall be so placed, and the Work shall at all times be so conducted, as to cause no greater obstruction to the traveling public than is considered necessary by the Town of Addison. The materials excavated shall be placed so as not to endanger the Work or prevent free access to all fire hydrants, water valves, gas valves, manholes (telephone, telegraph or electrical conduits, and sanitary sewers) and fire alarm or police call boxes in the vicinity.

The Town of Addison reserves the right to remedy any neglect on the part of the Contractor as regards to the public convenience and safety which may come to the Town

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of Addison's attention, after 24 hours notice in writing to the Contractor, save in cases of emergency, when the Town of Addison shall have the right to remedy any neglect without notice; and, in either case, the cost of such Work done by the Town of Addison shall be deducted from the monies due or to become due the Contractor. The Contractor shall notify the Town of Addison and the Engineer when any street is to be closed or obstructed. The Contractor shall provide for emergency vehicle access at all times.

Where the Work passes over or through private property, the Town of Addison shall provide such right-of-way. The Contractor shall notify the proper representatives of any public utility, corporation, company or individual, not less than 48 hours in advance of Work which might damage or interfere with the operation of their property along or adjacent to the Work. The Contractor shall be responsible for all damage or injury to property of any character (except such as may be required by the provisions of the Contract Documents, or caused by agents or employees or the Town of Addison) by reason of any negligent act or omission on the part of the Contractor, its employees, agents or Subcontractors, or at any time due to defective Work or materials, or due to its failure to reasonably or properly prosecute the Work, and said responsibility shall not be released by the fact that the Work shall have been completed and accepted.

When and where any such damage or injury is done to public or private property on the part of the Contractor, he shall restore or have restored at its own cost and expense such property to a condition similar or equal to that existing before such damage was done, by repairing, rebuilding or otherwise restoring as he may be directed, or he shall make good such damage or injury in a manner acceptable to the property Town of Addison and the Engineer. In case of failure on the part of the Contractor to restore such property or make good such damage or injury, the Town of Addison may, upon 48 hour written notice under ordinary circumstances, and without notice when a nuisance or hazardous condition results, proceed to repair, rebuild or otherwise restore such property as may be determined necessary, and the cost thereof shall be deducted from any monies due or to become due to the Contractor under this contract; or where sufficient contract funds are unavailable for this purpose, the Contractor or its surety shall reimburse the Town of Addison for all such costs.

49. **PROTECTION OF PERSONS AND PROPERTY:** The Contractor shall have the responsibility to provide and maintain all warning devices and take all precautionary measures required by law or otherwise necessary to protect the Work and persons and property while said persons or property are approaching, leaving or within the Work site or any area adjacent to said Work site. No separate compensation shall be paid to the Contractor for the installation or maintenance of any protective measures, warning devices, barricades, lights, signs, or any other precautionary measures required by law or otherwise necessary for the protection of persons or property.

The Contractor shall assume all responsibilities to the general public in connection with the general public's immediate approach to and travel through the Work site and the area adjacent to said Work site.

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Where the Work is in or adjacent to any street, alley, sidewalk, public right-of-way or public place, the Contractor shall at its own cost and expense provide such flagmen and watchmen and furnish, erect and maintain such warning devices, barricades, lights, signs, and other precautionary measures for the protection of persons or property as may be prudent or necessary, or as required by law. The Contractor's responsibility for providing and maintaining flagmen, watchmen, warning devices, barricades, signs and lights and other precautionary measures shall not cease until the Project shall have been completed and accepted by the Town of Addison, and shall cease when the Town of Addison notifies the Contractor in writing of final Project acceptance.

If the Town of Addison discovers that the Contractor has failed to comply with applicable federal or state laws (by failing to furnish the necessary flagmen, warning devices, barricades, lights, signs or other precautionary measures for the protection of persons or property), the Town of Addison may order the Contractor to take such additional precautionary measures as required by law to protect persons and property. In addition, the Contractor shall be held responsible for all damages to the Work and other public or private property due to the failure of warning devices, barricades, signs, lights or other precautionary measures in protecting said property; and whenever evidence is found of such damage, the Town of Addison may order the damaged portion immediately removed and replaced by and at the cost and expense of the Contractor.

- 50. TRAFFIC CONTROL:** It shall be the responsibility of the Contractor to provide traffic control during the construction as required by the State of Texas, the Town of Addison, and in accordance with the following additional requirements:
- a. The Contractor shall be required to furnish barricades, flares, flagmen, etc., for the protection of the public, employees and the Work.
 - b. The Contractor shall prosecute its Work in such a manner as to create a minimum of interruption to traffic along adjacent roadways.
 - c. The unit price bid under the appropriate bid item of the proposal shall cover all cost for providing signage, markings, lighting, barricades, flagmen and other devices and personnel required for traffic control during construction of the Project.
 - d. The Contractor shall not remove any regulatory sign, instructional sign, warning sign, street name sign or any other sign or signal which currently exists.
 - e. The Contractor shall provide a comprehensive Traffic Control Plan to the Town of Addison and Engineer for review, comment, and approval in the event the planned sequence of work is different in any way from that sequence of work provided for in the plans or where additional details are required. The Traffic Control Plan shall be designed in accordance with established standards and regulations and signed and sealed by a professional engineer, registered in the State of Texas. The plan should reflect the Contractor's proposed construction phasing and methodology and include the design layout for all proposed detour and traffic situations.

51. **BARRICADES, WARNING SIGNS, DETOURS AND SEQUENCE OF CONSTRUCTION:** Throughout the construction operations, streets and intersections will remain open to traffic by constructing the Work in stages. All streets, driveways, adjacent business and alleys shall remain open to traffic as far as is practicable.

A. General Construction: The Contractor shall plan its Work sequence in a manner that will cause minimum interference with aircraft operations during construction operations. Before beginning Work on this Project, the Contractor shall submit, for approval by the Town of Addison, a plan of construction operations outlining in detail a sequence of Work to be followed; setting out the method of handling traffic on streets, roads and driveways along, across and adjacent to the Work. If at any time during the construction, the Contractor's proposed plan of operation for handling traffic does not provide for safe comfortable movement, the Contractor shall immediately change its operations to correct the unsatisfactory conditions.

Ditches across the traffic lanes will be kept covered with a portable traffic-bearing surface at all times unless Work in the ditch is in progress. Only one lane of traffic may be closed at a time when Work is in progress in a ditch.

B. Safety: The Contractor shall provide, construct and maintain barricades and signs at locations set out in the Plans and in the Special Provisions in accordance with the Texas Manual on "Uniform Traffic Control Devices for Streets and Highways". In addition, he shall provide and maintain such other barricades and signs as deemed necessary by the Town or the Engineer, and provide and maintain, between sunset and sunrise, a sufficient number of lights at barricades and points of danger for the protection of vehicular and pedestrian traffic.

Barricades shall be placed in such a manner as not to interfere with the sight distance of drivers entering the street from side streets.

The Contractor shall keep traveled surfaces used in its hauling operation clear and free of dirt or other material.

The Contractor shall provide and maintain qualified flagmen at such points and for such periods of time as may be required to provide for the safety and convenience of public travel and Contractor's personnel.

52. **EXCAVATION SAFETY SYSTEMS:**

The Work performed under this section of the Specifications consists of providing trench safety systems consisting of shoring, sheeting, trench shield, and/or laid back slopes to meet the trench safety requirements of the Occupational Safety and Health Administration (O.S.H.A.), as required for this Project and specified herein.

A. General: Trench safety systems shall be provided by the Contractor as provided in Subpart P - Excavation, Trenching and Shoring, Part 1926 of the Code of Federal Regulations which describes safety and health regulations as administered by the U.S.

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Department of Labor Occupational Safety and Health Administration (O.S.H.A.). The standards specified by the O.S.H.A. Regulations shall be the minimum allowed on this Project. It shall be the responsibility of the Contractor to design and install adequate trench safety systems for all trenches excavated on this Project.

The Contractor shall furnish to the Town for review, prior to beginning construction activity, a Trench Safety Plan for the entire Project. The trench safety plan must be prepared and sealed by a Professional Engineer registered in the State of Texas. In addition, all trench safety systems utilized in this Project must be designed by a Professional Engineer registered in the State of Texas. The Contractor shall be totally responsible for the safety of all persons involved in the construction of this Project.

B. Core Borings: Any core borings and soil data furnished by the Town are for the convenience of the Contractor. The Contractor shall be responsible for any additional soil or geotechnical information required. The Contractor shall be responsible for properly designed trench safety systems to be utilized for any type of subsurface condition found on this Project. The furnishing of soil information by the Town of Addison in no way relieves the Contractor of this obligation. If no core borings or soil data are furnished by the Town, it shall be the Contractor's responsibility to obtain whatever geotechnical information required for preparation of trench safety systems.

C. Inspections: In addition to the inspections of the trench and trench safety systems required of the Contractor by the O.S.H.A. Regulations, the Town may further inspect the Work. The Town shall have the right to reject any trench safety systems which he finds to be inadequate, and the Contractor shall immediately improve the system to comply with this specification.

D. Measurement and Payment: Measurement and payment of Trench Safety Systems shall be based on the actual linear footage of the pipe installed on the Project. The payment shall be full compensation for all planning, engineering, materials, equipment, fabrications, installation, recovery and all incidental Work required. All excavation and backfill in addition to that specified elsewhere in these Specifications shall be considered subsidiary to this bid item.

- 53. TRENCH EXCAVATION, BACKFILL AND COMPACTION**: Trench excavation, backfill and compaction of storm drain and utility trenches shall be in accordance with Town of Addison Standards and with details shown on the Construction Plans.

A. Trench Excavation: If the stated maximum trench widths are exceeded, either through accident or otherwise, and if the Engineer determines that the design loadings of the pipe will be exceeded, the Contractor will be required to support the pipe with an improved trench bottom. The expense of such remedial measures shall be entirely the Contractor's own. All trenching operations shall be confined to the width of permanent rights-of-way, permanent easements and any temporary construction easements. All excavation shall be in strict compliance with the Trench Safety Systems Special Condition of this document.

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B. Trench Backfill: Trenches shall be backfilled above the top of the embedment material with approved backfill material per Town of Addison Standards for the appropriate pipe size, pipe material, depth, and soil condition.

C. Compaction: All trenches under proposed or existing pavement shall be compacted to within a range of 95% to 100% Standard Proctor Density. Trenches which lie outside limits of pavement shall be compacted to a minimum of 90% Standard Proctor Density (ASTM D-698).

54. **TRENCH WALLS:** The Contractor shall use shoring or a drag box in those areas where it is required to protect existing improvements. This shall be subsidiary to the linear foot cost of the pipe and not a separate pay item.
55. **SUSPENSION OF WORK RELATED TO DANGER:** In addition to the other remedies for suspension of the Work as provided for in the General Provisions and Special Provisions, the Town of Addison has the authority to suspend all work immediately if, in the Town of Addison's opinion, there is imminent danger to workers or the general public. If there is no imminent danger to workmen or the general public, but trench conditions are not in compliance with Federal Regulations 29 C.F.R. 1926.650-1926.652, the Town of Addison shall warn the Contractor who shall then immediately order all workmen in and adjacent to the trench away from the area. The Contractor must then bring the trench into compliance with the regulations. If the Contractor does not make the required corrections, all work on the Contract shall cease and the Town of Addison will issue a letter of Temporary Suspension of Work. The only work authorized after issuance of this letter is work approved by the regulations. Other work shall not be permitted until the Town of Addison issues a letter of Release of Temporary Suspension of Work. The Contractor shall not be entitled to additional compensation, an extension of time or payment of damages as a result of a temporary suspension of work under this provision.
56. **PROPERTY LINES AND MONUMENTS:** The Contractor shall protect all property corner markers, and when any such markers or monuments are in danger of being disturbed, they shall be properly referenced and if disturbed shall be reset at expense of the Contractor.
57. **CONSTRUCTION STAKING:** Construction staking will not be provided by the Town of Addison or Engineer. This item will be performed by the Contractor and shall be subsidiary to other bid items. The Contractor will also be responsible for maintaining stakes. If re-staking is required for any reason, it will be the Contractor's responsibility, including associated costs.

All construction staking shall be done under the supervision of a Registered Professional Land Surveyor registered in the State of Texas. The Contractor shall submit copies of cut sheets and field books for the construction of all paving, water, wastewater, and stormwater improvements to the Town of Addison for review prior to construction of the improvements. The information on the cut sheets and field books shall include but not be limited to the following:

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- a. Heading to include date, contract number, Project name, surveying firm, Contractor, and construction plan sheet number.
 - b. Location, description of street/line and street/line name, number, letter, etc. designation.
 - c. Benchmark Data: Location, description, and elevation.
 - d. Slope or percent of grade of each curb line or utility line.
 - e. Stations at 50 foot intervals and including all PC, PT, PI, PVC, PVI, PVT, PRC, grade changes, etc.
 - f. Offset description including distance to center line or back of curb and direction of offset; left, right, east, west, etc,
 - g. Cut to subgrade, pavement, top of curb, or flowline of the street or utility being staked.
 - h. Clarifying remarks such as top of curb, gutter, pavement, subgrade, manhole, cleanout, valve, tee, cross, fire hydrant, wastewater lateral, water service, etc.
 - i. Cut sheets shall be signed by a Texas Registered Professional Land Surveyor.
58. **DURING CONSTRUCTION:** During construction of the Work, the Contractor shall, at all times, keep the site of the Work and adjacent premises as free from material, debris and rubbish as is practicable and shall remove same from any portion of the site if, in the opinion of the Town of Addison or the Engineer, such material, debris or rubbish constitutes a nuisance or is objectionable. In case of failure on the part of the Contractor to maintain a clean site, the Town of Addison may, upon 24 hour written notice, clean the site, and the cost thereof shall be deducted from any monies due or to become due to the Contractor under its contract; or where sufficient contract funds are unavailable for this purpose, the Contractor or its surety shall reimburse the Town of Addison for all such costs.
59. **CONSTRUCTION TRAFFIC OVER PIPE LINES:** The design of the new pipes and the design of the existing pipe have been taken into account and provided for highway live loads. It is apparent, however, that certain construction vehicles could exceed this highway load condition under shallow bury conditions. It will be the responsibility of the Contractor to protect both the new line and the existing lines from these possibly excessive loads. The Contractor shall not at any time cross the existing or new pipe with a truck delivering new pipe to the site. Any damage to the existing or new pipe will be repaired or replaced by the Contractor to the satisfaction of the Town of Addison.

In locations where it is not permissible to cross the existing or proposed pipes without additional protection, the Contractor may elect to provide additional protection of the pipes so that more frequent crossings of the pipes are allowed. It still is, however, the

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responsibility of the Contractor to repair any damage to the existing or proposed lines if the damage results from any phase of its construction operation.

60. **CONTRACTOR'S CONTINUING OBLIGATION:** Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the Town of Addison, nor the issuance of a certificate of Substantial Completion, nor any payment by Town of Addison to Contractor under the Contract Documents, nor any use or occupancy of the Work or any part thereof by Town of Addison, nor any act of acceptance by Town of Addison nor any failure to do so, nor any review and approval of a Shop Drawing or sample submission, nor the issuance of a notice of acceptability by the Town of Addison pursuant to final payment nor any correction of defective Work by Town of Addison will constitute an acceptance of Work not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents.
61. **IRRIGATION AND SPRINKLER REPAIR:** The Contractor shall maintain all existing irrigation systems within the limits of the Project during the duration of the contract. The Contractor shall employ a licensed irrigator who is responsible for the repair or replacement of any damage to irrigation lines, valves, controllers, sprinklers, wiring and appurtenances which are damaged during construction. This repair is subsidiary to the various other items bid. The Contractor will be responsible for any vegetation that dies as a result of damage to the irrigation system and replace it with equal vegetation at its own cost.
62. **REMOVAL OF DEFECTIVE AND UNAUTHORIZED WORK:** All Work which has been rejected or condemned shall be repaired; or if it cannot be repaired satisfactorily, it shall be removed and replaced at the Contractor's expense. Defective materials shall be immediately removed from the Work site. Work done without line and grade having been provided; Work done beyond the line or not in conformity with the grades shown on the Plans or as provided, Work done without proper inspection; or any Extra or unclassified Work done without written authority and prior agreement in writing as to prices, shall be at the Contractor's risk and will be considered unauthorized, and at the option of the Town of Addison may not be measured and paid for and may be ordered removed at the Contractor's expense. Upon failure of the Contractor to repair satisfactorily or to remove and replace, if so directed, rejected, unauthorized or condemned Work or materials immediately after receiving notice from the Town of Addison, the Town will, after giving written notice to the Contractor, have the authority to cause defective Work to be remedied or removed and replaced, or to cause unauthorized Work to be removed and to deduct the cost thereof from any monies due or to become due the Contractor.
63. **DISPOSITION AND DISPOSAL OF MATERIALS:** All materials to be removed from the site including refuse and other debris shall become the property of the Contractor and shall be disposed of outside the limits of the Project. Contractor shall also comply with all applicable laws governing the spillage of debris while transporting to a disposal site.

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64. **CLEAN-UP FOR FINAL ACCEPTANCE:** The Contractor shall make a final cleanup of all parts of the Work before acceptance by the Town of Addison. This cleanup shall include removal of all objectionable rock and other construction materials, and in general preparing the site of the Work in an orderly manner and appearance.
65. **TV INSPECTION OF SANITARY SEWER AND STORM DRAIN SYSTEMS:** Part of the final inspection of the wastewater and storm drain systems on this Project shall include a closed circuit TV survey of the completed pipe installation, exclusive of services, and all imperfections in the installed facility revealed by the TV survey of the imperfections in the installed facilities revealed by the TV survey shall be remedied by the Contractor prior to acceptance of the Project as complete. All TV survey Work, including furnishing of necessary personnel, equipment and material shall be performed by the Contractor.
66. **TESTING REQUIREMENTS:** Testing shall be conducted in accordance with Town of Addison Specifications except as modified in the Special Provisions, Technical Specifications, or as on the plans. The Town of Addison will provide random testing. The Contractor shall coordinate construction with the Town of Addison, and shall provide assistance to the testing labs by providing trench safety, excavation, or other work to insure all testing requirements are met. Work performed to accommodate testing will be a subsidiary item and no extra payment will be authorized. All retesting shall be at the expense of the Contractor. As a general guide, the Contractor shall be responsible for providing the following tests:
- (1) Density and associated tests on embedment and backfill.
 - (2) Compressive strength tests on concrete.
 - (3) Gradation soil tests on backfill as may be required.
 - (4) Providing test results from manufacturer as specified in Town of Addison Specifications.
67. **SILICONE JOINT SEALANT:** Silicone joint sealant must be used in all instances where joint sealant applies to Portland Cement Concrete pavement and curbs. Payment for the use of silicone joint throughout this Project will in all cases be subsidiary to this contract at no extra cost.
68. **CLAIMS FOR DAMAGES OR INJURY:** General Provision Item 1.24.3 - SMALL CLAIMS FOR DAMAGE OR INJURY is amended to read as follows: "If any person files a claim against the Town of Addison or Contractor for personal injury or property damage resulting from, arising out of, or caused by, the operations of the Contractor, or any Work within the limits of the Project, the Contractor must either submit to the Town of Addison, a duly executed full release within thirty (30) days from the date of written claim, or immediately report the claim to its liability insurance carrier for their action in adjusting the claim. If the Contractor fails to comply with this provision within the stipulated time limit, it will be automatically deemed that the Contractor has appointed the Town as it's irrevocably Attorney-In-Fact authorizing the Town to report the claim directly with the liability insurance carrier. This provision is in and of itself a Power-of-Attorney from the Contractor to the Town which authorizes the Town to take said action

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on behalf of the Contractor without the necessity of the execution of any other document. If the Contractor fails to comply with the provisions of this item the Town, at its own discretion, may terminate this contract or take any other actions it deems appropriate. Any payment or portion thereof due the Contractor, whether it is a final payment, progress payment, payment out of retainage or refund payment may be withheld by the Town as is authorized by Item 109.4. Bankruptcy, insolvency or denial of liability by the insurance carrier shall not exonerate the Contractor from liability.

As a result of the additional Work created to Town of Addison due to un-responded claims for damages by Contractor to third parties, Contractor shall incur penalties for failure to abide by this Special Provision.

Contractor shall respond to the claimant in writing regarding the status of the claim, including whether Contractor disputes the claim, wishes to settle, or will notify its liability insurance carrier regarding the claim. Contractor will be assessed a penalty by the Town of \$75.00 per claim, for its failure to respond to the claimant as described above within thirty days of its written notice of claim by the Town.

To ensure Contractor compliance, the Town of Addison shall be notified, by copied correspondence of responses or settlement by Contractor.”

69. WAIVER OF CLAIMS: The making and acceptance of final payment will constitute:

A. A waiver of all claims by Town of Addison against Contractor, except claims arising from unsettled Liens, from defective Work appearing after final inspection or failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will not constitute a waiver by Town of Addison of any rights in respect of Contractor’s continuing obligations under the Contract Documents.

B. A waiver of all claims by Contractor against Town of Addison other than those previously made in writing and still unsettled.

70. MECHANICS AND MATERIALMEN’S LIEN: The Contractor shall be required to execute a release of mechanics and materialmen’s liens upon receipt of payment and shall ensure that the Project remains free and clear of all liens related to the Work. The Contractor shall have all liens removed by obtaining releases acceptable to the Town of Addison or shall bond around such liens by obtaining a discharge of all liens.

71. CONTRACTOR’S AFFIDAVIT OF BILLS PAID: The Contractor shall be required to execute the form provided in Section BP prior to the acceptance of the Project.

72. PRODUCT RECORD DOCUMENTS: The Contractor shall maintain record Plans and legibly annotate shop drawings to record changes made after review. A red felt-tip marking pen shall be used for all recording.

Maintenance of Documents: The Contractor shall maintain at the job site one record copy of the Contract Plans, Specifications, Shop Drawings, Change Orders, other modification

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to the Contract, field test records and other documents submitted by Contractor in compliance with specification requirements. These documents shall be maintained at the job site apart from documents used for construction. These documents are not to be used for construction purposes. The documents shall be maintained in clean, legible condition. The documents shall be made available at all times for inspection by the Town.

Recording: Each document shall be labeled Project Record Copy in 2-inch high printed letters. The record documents shall be kept current. No Work shall be covered until required information has been recorded.

Contract Plans: The appropriate drawing shall be legibly marked to record, where applicable:

- a. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
- b. Field changes of dimension and detail made during construction process.
- c. Changes made by Change Order or Supplemental Agreement.
- d. Details not on original Contract Plans.
- e. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
- f. Changes made by Change Order or Supplemental Agreement.
- g. Other matters not originally specified.

Shop Drawing: The Contractor shall maintain the Shop Drawings as record drawings and legibly annotate shop drawings to record changes made after review.

Submittal: At the completion of the Project, the Contractor shall deliver record Plans to the Town. The transmittal letter shall be accompanied, in duplicate, with:

- a. Date, Project title and number.
- b. Contractor's name and address.
- c. Title and number of each record document.
- d. Certification that each document as submitted is complete and accurate.
- e. Signature of Contractor or its authorized representative.

73. **OWNERSHIP OF WORK AND MATERIALS:** All Work performed by Contractor pursuant to the Contract shall be the property of the Town of Addison. The Town of Addison shall own all construction, and any data, documents, plans, specifications, working papers, computer programs, photographs, or other material produced by Contractor pursuant to the Contract, and Contractor hereby assigns and transfers to the

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Town of Addison any and all copyrights for such material. To the extent that such programs used are internal, proprietary programs used by Contractor in the performance of the Work, Contractor will provide the Town of Addison such access to the programs as is necessary for the Town of Addison to be able to use the products and documents generated by the program, but Contractor is not required to transfer the copyrights or other intellectual property rights to the program to the Town of Addison. As security for partial, progress, or other payments, title to work for which such payments are made shall pass to the Town of Addison at the time of the payment. To the extent that title has not previously been vested in the Town of Addison by reason of payments, full title shall pass to the Town of Addison at delivery of the Work at the location specified in the Contract.

Unincorporated Work to which the Town of Addison has received title by reason of progress, partial or other payments shall be segregated from other Contractor or Subcontractor materials and clearly identified as the Town of Addison property. The Contractor shall be responsible for all materials until they have been incorporated into the Work and the Work has been finally accepted by the Town of Addison. The title transferred as above shall in each case be good, and free and clear of any and all security interests, liens, or other encumbrances. The Contractor promises and agrees that it will not pledge, hypothecate, or otherwise encumber the items in any way that would result in any lien, security interest, charge, or claim upon or against said items. The transfer of title as provided above shall not imply acceptance by the Town of Addison, nor relieve Contractor from the responsibility to strictly comply with the Contract, and shall not relieve Contractor of responsibility for any loss of or damage to such items.

The Contractor shall insert provisions in its subcontracts sufficient to ensure compliance with the content of this Section.

74. **DRAWINGS AND OTHER DATA:** All documents developed by Contractor in the performance of the Contract shall become the sole property of the Town of Addison and may be used by the Town of Addison on any other project without additional compensation to Contractor. Use by the Town of Addison of these documents on other projects does not confer any liability on Contractor.

The Town of Addison shall be considered the “person for whom the work was prepared” for the purpose of authorship in any copyrightable work under 17 U.S.C. § 201(b). With respect thereto, Contractor agrees not to assert or authorize others to assert any rights or establish any claim under the design related patent and copyright laws. All design drawings, as-built drawings and specifications, in any form, shall contain a copyright mark of the Town of Addison.

75. **TOWN OF ADDISON APPROVAL:** This Project is subject to final approval and acceptance by the Town of Addison. Final approval acceptance will not be given until the punch list items are completed to the Town’s satisfaction and as-built Plans are given to the Town of Addison.

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76. **USE OF EXPLOSIVES:** The use of explosives by the Contractor to complete the Work shall be prohibited.
77. **POWER FOR CONSTRUCTION:** The Contractor shall contract with the local power provider and make the necessary arrangements for securing power required for the construction, including power required for temporary offices. There will be no separated pay item for connection into the existing power system or for the power required for construction purposes.
78. **LIQUIDATED DAMAGES:** If the Contractor fails to complete the Work within the time specified in the contract, the Contractor shall pay liquidated damages to the Town of Addison in the amount of \$750 for each calendar day of delay until the Work is completed or accepted.
79. **CONTRACT DELAY:** The parties anticipate that delays may be caused by or arise from any number of events during the course of the Contract, including, but not limited to, Work performed, disruptions, permitting issues, actions of subcontractors, suppliers, or other contractors, actions by third parties, weather, weekends, holidays, or other such events, forces or factors sometimes experienced in construction work. Such delays or events and their potential impacts on performance by the Contractor are specifically contemplated and acknowledged by the parties in entering into this Contract, and shall not extend the Contract time for completion. Further, any and all costs or impacts whatsoever incurred by the Contractor in accelerating the Work to overcome or absorb such delays or events in an effort to complete the Contract prior to expiration of the Contract time to complete, regardless of whether the Contractor does so or not, shall be the sole responsibility of the Contractor in every instance.
80. **SUBCONTRACTORS:** No subcontract shall relieve Contractor of any of Contractor's obligations or liabilities under the Contract. Contractor shall be fully responsible and liable for the acts or omissions of all Subcontractors, including persons directly or indirectly employed by them, their guests and invitees. Contractor shall have sole responsibility for managing and coordinating the operations of its Subcontractors, including the settlement of disputes with or between them. Nothing contained in the Contract shall be deemed to create a contractual relationship between any Subcontractor, and the Town of Addison.

Contractor shall provide to the Town of Addison one (1) copy of all executed subcontracts associated with the Contract, including any changes or modifications to the subcontracts, within three (3) days of their execution. No Subcontractor shall be permitted to perform work associated with the subcontract until the Subcontractor (or Contractor on the Subcontractor's behalf) is in compliance with the insurance requirements specified elsewhere in the Contract, and has furnished satisfactory evidence of insurance to the Town of Addison.

81. **PAYMENTS TO SUBCONTRACTORS:** Contractor shall comply with the provisions of applicable laws and regulations relating to Contractor's relations with Subcontractors. Payments by Contractor to Subcontractors associated with the Town of Addison

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Contracts are subject to the time periods established in the Texas "Prompt Payment Act", contained in Chapter 2251 of the Texas Government Code.

All persons employed in the performance of the Work under the Contract, or any subcontracts hereunder, shall be paid not less than the general rates of per diem, holiday, and overtime wages prevailing in the locality of the Work of a similar character as detailed in the Special Provisions. Failure to comply with this provision shall subject Contractor to the penalties prescribed in Chapter 2258 of the Texas Government Code, as amended.

Contractor will include in each subcontract for property or services entered into by Contractor and a Subcontractor, including a supplier, for purposes of performing the Work under the Contract a payment clause that obligates Contractor to pay the Subcontractor for satisfactory performance under its subcontract within seven (7) days out of such amounts as are paid to Contractor by the Town of Addison under the Contract. A false certification to the Town of Addison under the provisions of the Payments clause may be a principal offense in violation of Section 37.10 of the Texas Penal Code.

- 82. USE OF COMPLETED PORTIONS OF THE WORK:** Whenever, as determined by the Town of Addison, any portion of the Work performed by Contractor is in a condition suitable for use, and the best interests of the Town of Addison requires such use the Town of Addison may take possession of or use such portion of the Work. Such use by the Town of Addison shall in no case be construed as final acceptance, and shall neither relieve Contractor of any of its responsibilities under the Contract, nor act as a waiver by the Town of Addison of any of the conditions thereof. Contractor shall not be liable for the cost of repairs, rework, or renewals, which may be required due to ordinary wear and tear resulting from such use. However, if such use increases the cost or delays the completion of remaining portions of the Work, Contractor shall notify the Town of Addison in writing as required by the Contract and shall be entitled to such additional compensation or extension of time, or both, as determined in accordance with the Contract.

If in the course of such use, the Work proves to not be in compliance with the Contract, the Town of Addison shall have the right to continue such use until such portion of the Work can, without injury to the Town of Addison, be taken out of service for correction of defects, errors, omissions, or replacement of unsatisfactory materials, as necessary for such portions of the Work to comply with the Contract. Contractor shall correct the Work as soon as practical, but not later than one (1) month after notification by the Town of Addison.

Contractor shall not use any permanently incorporated materials unless such use is approved in writing by the Town of Addison. Where Contractor's request is granted for the use of certain materials, Contractor shall properly use and maintain and, upon completion of its use and at its own expense, recondition such materials to the satisfaction of the Town of Addison.

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83. **COMPLETE AGREEMENT:** The Contract (including Attachments, the Special Provisions, other documents and manuals incorporated herein) is the full and complete agreement between the Town of Addison and Contractor with respect to the subject matter herein and supersedes any and all prior agreements between the parties hereto.
84. **WAIVER:** The waiver by the Town of Addison of the breach of any provision of the Contract by Contractor shall in no way impair the right of the Town of Addison to enforce the provision for any subsequent breach thereof. All remedies provided hereunder are cumulative and are in addition to all other remedies available at law or in equity.
85. **EXECUTION OF THE CONTRACT:** The Contract may be executed in multiple counterparts, each of which shall, for all purposes, be deemed an original but which together shall constitute one and the same instrument, and the signature pages from any counterpart may be appended to any other counterpart to assemble fully executed documents, and counterparts of the Contract may also be exchanged via electronic facsimile machines and any electronic facsimile of any party's signature shall be deemed to be an original signature for all purposes.
86. **DEFINITIONS:** The following definitions are added to the General Provisions and Special Provisions:
- BIDDER:** Any person, persons, partnership, company, firm, association, or corporation acting directly or through a duly authorized representative submitting a bid for the work contemplated.
- PROJECT:** The Town of Addison's overall objective and endeavor of which the Contract forms a part and ultimately creates, which encompasses all Contract Documents constructed to final completion and final acceptance.
- WORKING DAY:** A working day is defined as a calendar day not including Saturdays, Sundays, or legal holidays authorized in the list prepared by the City of Dallas for contract purposes, in which weather or other conditions not under the control of the Contractor shall permit the performance of the principal units of work underway for a continuous period of not less than 7 hours between 7 A.M. and 6 PM. A principle unit of work shall be that unit which controls completion time of the contract. Nothing in this definition shall be construed as prohibiting the Contractor from working on Saturdays, if the Contractor so desires and permission of the Town of Addison has been granted. Work on Sundays shall not be permitted except in cases of extreme emergency and then only with the written permission of the Town of Addison. If Saturday or Sunday work is permitted, working time shall be charged on the same basis as weekdays. Where the working time is expressed as calendar days or a specific date, the concept of working days shall no longer be relevant to the contract.
87. **MODIFICATIONS TO THE LANGUAGE OF THE GENERAL PROVISIONS:**
The General Provisions are modified as follows:

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- A. Add the following words to the General Provisions before the word “Certificates” found on the fourth line of Section 103.4.1:

“When permitted by law,”

- B. Delete the sentence “A model Certificate of Insurance is illustrated in Model Form A.6 in Appendix A.” beginning on the ninth line of Section 103.4.1 of the General Provisions and replace with the following:

“Certificates of Insurance shall be provided on a state approved form.”

- C. Delete the following sentence beginning on the second line of the fifth subparagraph of Section 104.2.1 of the General Provisions:

“The foregoing notwithstanding, the total original Contract amount shall not be increased more than 25 percent; the CONTRACTOR, by submission of a bid and execution of the Contract, is deemed to consent to the OWNER’S right to reduce the total original Contract amount by more than 25 percent.”

- D. Add the following word before the word “decide” found on the second line of Section 105.7.1 of the General Provisions:

“initially”

- E. Add the following word after the word “work” found on the fifth line of Section 105.7.1 of the General Provisions:

“, subject to the agreement of the Owner”

- F. Delete the following sentence beginning on the sixth line of Section 105.7.1 of the General Provisions:

“Engineer shall determine the amount and quality of work performed and materials furnished, and Engineer’s decision and estimates shall be final.”

- G. Delete Section 105.9.3 of the General Provisions titled “Inspection Overtime” in its entirety.

- H. Delete Section 107.2 of the General Provisions titled “Indemnification” in its entirety and replace with the following:

“THE CONTRACTOR AGREES TO INDEMNIFY, SAVE, PROTECT, DEFEND, AND HOLD HARMLESS THE OWNER, ITS AFFILIATES AND THEIR OFFICERS, DIRECTORS, AGENTS, INVITEES, AND EMPLOYEES

(“INDEMNIFIED PARTIES”) FROM AND AGAINST ANY AND ALL LIABILITY, COST, DAMAGE, EXPENSES, FINES AND ALL REASONABLE LEGAL FEES AND COURT COSTS, CLAIMS, LOSSES, CAUSES OF ACTION, SUITS, AND LIABILITY OF ANY KIND, INCLUDING ALL EXPENSES OF LITIGATION AGAINST THE INDEMNIFIED PARTIES, WHETHER OR NOT CAUSED IN PART BY ANY ACT OR OMISSION OF A PERSON OR ENTITY INDEMNIFIED HEREUNDER, OR WHETHER LIABILITY IS IMPOSED UPON SUCH PERSON OR ENTITY, FOR ANY LOSS, INJURY, DAMAGE OR DEATH ARISING FROM OR OUT OF THE CONTRACTOR’S ACTS OR OMISSIONS, INCLUDING, BUT NOT LIMITED TO CONTRACTOR’S NEGLIGENT OR GROSSLY NEGLIGENT PERFORMANCE OF THE WORK; NEGLIGENT OR GROSSLY NEGLIGENT USE OR MISUSE OF OWNER’S PROPERTY; NEGLIGENT OR INTENTIONAL ACTIONS, ERRORS OR OMISSIONS AND THOSE OF ITS EMPLOYEES, OFFICERS, DIRECTORS, AGENTS OR SUBCONTRACTORS; VIOLATION OF ANY FEDERAL, STATE OR MUNICIPAL LAWS, REGULATIONS AND/OR ORDINANCES; CONTRACTOR’S OR ITS SUBCONTRACTOR’S USE OF PROPERTY, EQUIPMENT, VEHICLES, OR MATERIALS; DEFECTIVE WORKMANSHIP; NEGLIGENT OR GROSSLY NEGLIGENT USE OR MISUSE OF UTILITIES; OR SUBCONTRACTORS’, EMPLOYEES’, AGENTS’, OFFICERS’, OR DIRECTORS’ NEGLIGENCE OR INTENTIONAL TORTS. IT IS THE EXPRESS INTENT OF CONTRACTOR TO INDEMNIFY THE INDEMNIFIED PARTIES FROM THE CONSEQUENCES OF THEIR JOINT AND/OR CONCURRENT NEGLIGENCE AND/OR SOLE NEGLIGENCE. IN THE EVENT OF FAILURE BY THE CONTRACTOR TO FULLY PERFORM IN ACCORDANCE WITH THIS INDEMNIFICATION PARAGRAPH, EACH OF THE INDEMNIFIED PARTIES, AT ITS OPTION, AND WITHOUT RELIEVING CONTRACTOR OF ITS OBLIGATIONS HEREUNDER, MAY SO PERFORM, BUT ALL COSTS AND EXPENSES SO INCURRED BY ANY OF THE INDEMNIFIED PARTIES IN THAT EVENT SHALL BE REIMBURSED BY CONTRACTOR TO THE INDEMNIFIED PARTIES, OR ANY OF THEM, AND UNTIL REIMBURSED BY CONTRACTOR SHALL BEAR INTEREST, AT THE RATE OF INTEREST PROVIDED TO BE PAID ON JUDGMENT UNDER THE LAWS OF THE STATE OF TEXAS. THIS INDEMNIFICATION SHALL

NOT BE LIMITED TO DAMAGES, COMPENSATION OR BENEFITS PAYABLE UNDER INSURANCE POLICIES, WORKERS' COMPENSATION ACTS, DISABILITY BENEFIT ACTS OR OTHER EMPLOYEE BENEFIT ACTS.

IN THE EVENT THIS CONTRACT RELATES TO A PROJECT OTHER THAN A SINGLE FAMILY HOUSE, TOWNHOUSE, DUPLEX, OR LAND DEVELOPMENT DIRECTLY RELATED THERETO OR A PUBLIC WORKS PROJECT OF A MUNICIPALITY THEN THE INDEMNITY PROVISIONS INCLUDED HEREIN SHALL BE LIMITED SUCH THAT SUBCONTRACTOR SHALL NOT BE REQUIRED TO INDEMNIFY, HOLD HARMLESS OR DEFEND CONTRACTOR OR ANY THIRD PARTIES AGAINST A CLAIM CAUSED BY THE NEGLIGENCE OR FAULT, THE BREACH OR VIOLATION OF A STATUTE, ORDINANCE, GOVERNMENTAL REGULATION, STANDARD, OR RULE, OR THE BREACH OF CONTRACT OF AN INDEMNIFIED PARTY, ITS AGENT OR EMPLOYEE, OR ANY THIRD PARTY UNDER THE CONTROL OR SUPERVISION OF THE INDEMNIFIED PARTY, OTHER THAN SUBCONTRACTOR OR ITS AGENT, EMPLOYEE, OR SUBCONTRACTOR OF ANY TIER EXCEPT THAT SUBCONTRACTOR SHALL INDEMNIFY, HOLD HARMLESS AND DEFEND THE INDEMNIFIED PARTY AGAINST ANY CLAIMS FOR THE BODILY INJURY OR DEATH OF AN EMPLOYEE OF SUBCONTRACTOR, ITS AGENTS, OR ITS SUBCONTRACTORS OF ANY TIER.

NOTWITHSTANDING ANYTHING HEREIN TO THE CONTRARY, THE INDEMNITY PROVISIONS INCLUDED HEREIN SHALL BE LIMITED SUCH THAT CONTRACTOR SHALL NOT BE REQUIRED TO INDEMNIFY, HOLD HARMLESS OR DEFEND OWNER OR ANY THIRD PARTIES AGAINST A CLAIM CAUSED BY THE NEGLIGENCE OR FAULT, THE BREACH OR VIOLATION OF A STATUTE, ORDINANCE, GOVERNMENTAL REGULATION, STANDARD, OR RULE, OR THE BREACH OF CONTRACT OF THE INDEMNIFIED PARTIES, ITS AGENT OR EMPLOYEE, OR ANY THIRD PARTY UNDER THE CONTROL OR SUPERVISION OF THE INDEMNIFIED PARTIES, OTHER THAN CONTRACTOR OR ITS AGENT, EMPLOYEE, OR SUBCONTRACTOR OF ANY TIER EXCEPT THAT CONTRACTOR SHALL INDEMNIFY, HOLD HARMLESS AND DEFEND THE INDEMNIFIED PARTIES AGAINST

**ANY CLAIMS FOR THE BODILY INJURY OR DEATH OF
AN EMPLOYEE OF CONTRACTOR, ITS AGENTS, OR ITS
SUBCONTRACTORS OF ANY TIER.”**

- I. Add the following language after Section 103.3.1.4 of the General Provisions:

“103.3.1.5. Maintenance Bond. A good and sufficient bond in an amount not less than 10-percent of the approximate total of the Contract, as evidenced by the proposed tabulation, or conditioned on the full and proper maintenance and repair of the Work to be done and performed for a period of one year from the date of final acceptance of the Work and the Contractor will do all necessary backfilling that may arise on account of sunken conditions in ditches, or otherwise, and do and perform the necessary Work and repair any defective condition growing out of or arising from the improper laying or construction of same, or on account of any breaking of same caused by the Contractor in construction of same, or on account of any defect arising in any of the Work laid or constructed by the Contractor or on account of improper excavation or backfilling, it being understood that the purpose of this Section is to cover all defective conditions arising by reason of defective materials, Work, or labor performed by the Contractor.”

- J. Add the following language after Section 104.2.5. of the General Provisions:

“104.2.6. Change Orders. A Change Order is a written instrument and signed by the Owner, Contractor and Engineer stating their agreement upon all of the following:

- (1) the change in the Work;
- (2) the amount of the adjustment, if any, in the Contract Sum;
and
- (3) the extent of the adjustment, if any, in the Contract Time.

In the event the Contractor proposes a Change Order, the Contractor shall provide sufficient detail for such Change Order to allow analysis and review by the Engineer.

Agreement on any Change Order shall constitute final agreement on the Work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments to the Contract Sum and the Contract Time. In the event a Change Order increases the Contract Sum, the Contractor shall include the Work covered by such Change Orders in Applications for Payment as if such Work were originally part of the Contract Documents.

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The Contractor, upon receipt of written notification by the Owner or the Engineer of a proposed item or change in Work, shall prepare as soon as possible a Change Order on the form provided by the Owner. If the Change Order is returned to the Contractor for additional information or if the scope of the proposed change in the Work is modified by additions, deletions or other revisions, the Contractor shall revise the Change Order accordingly and resubmit the revised Change Order to the Owner and Engineer.”

- K. Delete the language in Section 105.2.1 of the General Provisions and replace it with the following language:

“105.2.1. WORKMANSHIP: If the OWNER notifies the CONTRACTOR in writing of defective work, the CONTRACTOR shall correct the deficiencies within five (5) calendar days of the Notice at no additional cost to the OWNER. If the defective work is not corrected within five (5) calendar days, or the CONTRACTOR is not making satisfactory progress (in the opinion of the OWNER) to correct the deficiencies, the OWNER may withhold future payments for All Work until the defective work has been corrected to the satisfaction of the OWNER.”

- L. Add the following language after Section 105.10 of the General Provisions:

“105.10.2. GUARANTEE AFTER COMPLETION: Unless otherwise specified in the technical section of these specifications, the CONTRACTOR shall, after test and acceptance, and for a period of one year from date of final written acceptance by the OWNER or within such longer or shorter period of time as may be prescribed by law or by the terms of any other applicable special warranty on designated equipment or portions of work as required by the Contract Documents, rebuild, repair, or replace any and all items which have proven defective due to unsatisfactory material and/or workmanship. Upon written notice from the OWNER, the CONTRACTOR shall immediately make any repairs that may be ordered, or such repairs will be made by the Owner at the expense of the CONTRACTOR or the CONTRACTOR’S Surety. In case of an emergency where delay would cause serious loss or damage, the Owner may undertake to have the defects repaired without previous notice. The expense of all repairs, including all emergency repairs, shall be borne by the CONTRACTOR or the CONTRACTOR’S Surety, at no cost to the Owner. This obligation shall survive termination of the Contract.

105.10.3. OFFSET PROGRESS PAYMENTS: OWNER may, at its option, offset any progress payment or final payment under the Contract Documents against any debt (including taxes)

lawfully due to OWNER from Contractor, regardless of whether the amount due arises pursuant to the terms of the Contract Documents or otherwise and regardless of whether or not the debt due to OWNER has been reduced to judgment by a court.

105.10.4. FINAL ACCEPTANCE AND PAYMENT: This Project is subject to final inspection and final acceptance by the Owner. Whenever the Work provided for by the Contract shall have been completely performed on the part of the CONTRACTOR, including, but not limited to compliance with North Central Texas Council of Governments Standard Specifications for Public Works Construction, October 2004 Section 202.6.4.6., the CONTRACTOR shall notify the OWNER that the Work is ready for final inspection. The OWNER will then make such final inspection and if the work is satisfactory and in accordance with the specifications and contract documents, the OWNER shall issue a certificate of acceptance to the CONTRACTOR and submit a request to accept the Work performed by the CONTRACTOR and payment of a final estimate under the terms of which the OWNER will release 100% of the retainage, plus the unpaid portions of the final estimate as the OWNER deems advisable.

Whenever the improvements provided for by the Contract shall have been completely performed on the part of the Contractor, as evidenced in the certificate of acceptance, and all required submissions provided to the OWNER, a final estimate showing the value of the Work shall be prepared by the OWNER as soon as the necessary measurements and computations can be made. All prior estimates upon which payments have been made are subject to necessary corrections or revisions in the final payment. The amount of this final estimate, less any sums that have been previously paid, deducted or retained under the provisions of the contract, shall be paid the CONTRACTOR within 30 days after the final acceptance by the OWNER, provided the CONTRACTOR has furnished to the OWNER a consent of Surety and satisfactory evidence that all indebtedness connected with the Work and all sums of money due for any labor, materials, apparatus, fixtures, or machinery furnished for and used in the performance of the Work have been paid or otherwise satisfied, or that the person or persons to whom the same may respectively be due have consented to such final payment. This requirement is not intended and shall not be construed to recognize subcontractors for the purpose of privity of contract, and no third party benefit rights shall be obtained through these provisions for final payment. The acceptance by the CONTRACTOR of the final payment as aforesaid shall operate as and shall be a release to the OWNER from all claims or liabilities

under the Contract, including all subcontractor claims, for anything done or furnished or relating to the Work under the Contract or for any act or neglect of said OWNER relating to or connected with the Contract.

All warranties and guarantees shall commence from the date of the certificate of acceptance. No interest shall be due the CONTRACTOR on any partial or final payment, or on the retainage.

105.10.5. RIGHT TO AUDIT CONTRACTOR'S RECORDS:

By execution of the Contract, CONTRACTOR grants the OWNER the right to audit, at Owner's election, all of CONTRACTOR'S records and billings relating to the performance of the Work under the Contract. CONTRACTOR agrees to retain such records for a minimum of three (3) years following completion of the Work under this Contract. OWNER agrees that it will exercise the right to audit only at reasonable hours."

- M. Add the following language after Section 107.5 of the General Provisions:

"107.5.1. COMPENSATION AND ACKNOWLEDGEMENT OF WORK: The CONTRACTOR shall receive and accept compensation, as herein provided, as full payment for furnishing all labor, tools, material, equipment and incidentals; for performing all Work contemplated and embraced under the Contract; for all loss or damage arising out of the nature of the Work, or from the action of the elements; for any unforeseen defects or obstruction which may arise or be encountered during the prosecution of the Work and before its final acceptance by the OWNER; for all risks of whatever description connected with the prosecution of the Work; for all expense incurred by or in consequence of suspension or discontinuance of such prosecution of the Work as herein specified; for any infringement of patents, trademarks or copyrights; and for completing the Work in an acceptable manner according to the Plans and Specifications."

- N. Add the following language after Section 107.11 of the General Provisions:

"107.11.1. COOPERATION OF THE CONTRACTOR: The CONTRACTOR shall give to the work the consistent attention necessary to facilitate the progress thereof, and the CONTRACTOR shall cooperate with the OWNER, and with other CONTRACTORS in every way possible.

The OWNER and the OWNER'S representatives shall at all times have free access to the Work whenever it is in preparation or

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progress and the contractor shall provide safe, convenient and proper facilities for such access and inspection.”

- O. Delete Section 107.4 of the General Provisions and replace it with the following:

“107.4. VENUE AND CHOICE OF LAW

The Owner, the Contractor, and the Contractor’s sureties agree that this Contract shall be performed in Dallas, Dallas County, Texas, and if legal action is necessary in connection therewith, exclusive venue shall lie in Dallas County, Texas. The terms and provisions of the Contract Documents shall be construed in accordance with the laws and court decisions of the State of Texas.”

- P. Delete the following language (which is the first paragraph) from Section 109.5.1. of the General Provisions:

“Between the 25th day and the last day of each month, the Owner shall make an approximate estimate of the value of the work done during the month under the specifications. Whenever the said estimate or estimates of work done since the last previous estimate exceeds \$100 in amount, a percentage of such estimate sum shall be paid the Contractor on or before the 15th day of the month next following. The monthly estimate may include acceptable nonperishable materials delivered to the work; such payment shall be allowed on the same percentage basis of the net invoice value as provided hereinafter. The percent retained by the owner shall normally be up to 10 percent at completion, unless otherwise stated. At the midpoint, or at any subsequent time, if the owner determines that the progress of the Contract is satisfactory in all respects, it may at its discretion cease to retain additional funds until the completion of the project, or until progress ceases to be satisfactory. The owner shall make the sole determination in this matter.”

- Q. Add the following language after Section 109.5.1. of the General Provisions:

“109.5.1.1. Applications for Payment. Applications for progress payment (“Application for Payment”) will be submitted no more often than monthly and shall be submitted on the dates set forth in the Agreement. Each Application for Payment shall be (1) sworn to and notarized, (2) supported by such data substantiating the Contractor’s right to payment as the Owner or Engineer may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents, and (3) submitted by the Contractor for review to the Engineer in form and substance as mandated by the

Addison Athletic Club HVAC Improvements

Owner. The Contractor's Application for Payment shall be segregated and detailed in a manner satisfactory to the Owner.

In each Application for Payment, the Contractor shall certify that such Application for Payment represents a just estimate of portion of the Work that is complete as of the last day covered by the Application for Payment and shall also certify by sworn affidavit as follows:

'There are no known mechanics' or materialmen's liens outstanding at the date of this Application, all due and payable bills with respect to the Work have been paid to date or shall be paid from the proceeds of this Application for Payment, there is no known basis for filing of any mechanics' or materialmen's liens on the Work, and waivers from all subcontractors and materialmen have been or, at the time of payment, will be obtained in such form as to constitute an effective waiver of lien under the applicable laws of the State of Texas.'

109.5.1.2. Lien Waivers. Concurrent with each Application for Payment, the Contractor shall execute and furnish a waiver and release of its lien rights current through the effective date of such Application for Payment conditioned upon receipt of the payment that is the subject of the application. Beginning with the second Application for Payment, the Contractor shall also deliver with each such Application as a condition precedent to payment thereof, waivers of lien from each of the Subcontractors, Sub-subcontractors, and suppliers current through the effective date of the previous Application of Payment. The Contractor shall also execute and obtain any other reasonable forms as the Owner may require in order to assure an effective waiver and release of mechanics' and materialmen's liens in compliance with the laws of the State of Texas. The Contractor shall, if any Subcontractor, Sub-subcontractor or supplier refuses to furnish a release in full, furnish a bond satisfactory to the Owner to indemnify against any lien."

R. Delete Section 109.5.2 of the General Provisions and replace with the following:

"Ten-percent (10%) retainage shall be withheld until 40 days after Final Completion."

88. CONTRACTOR REPRESENTATIONS: By entering into the Contract, the Contractor makes the following representations to the Town of Addison:

Addison Athletic Club HVAC Improvements

- A. Contractor has examined and carefully studied the Bidding Documents and the related data identified in the Bidding Documents.
- B. The Contractor has visited the Project site where the goods are to be installed or services will be provided and become familiar with and is satisfied as to the observable local conditions that may affect cost, progress, or the furnishing of goods and services, if required to do so by the Bidding Documents, or if, in the Contractor's judgment, any local condition may affect cost, progress, or the furnishing of goods and services.
- C. The Contractor is familiar with and is satisfied as to all Laws and Regulations in effect as of the date of the bid that may affect cost, progress, and the furnishing of goods and services.
- D. The Contractor has carefully studied, considered, and correlated the information known to the Contractor; information commonly known to sellers of similar goods doing business in the locality of the Project site where the goods will be installed or where services will be provided; information and observations obtained from the Contractor's visits, if any, to the Project site where the goods will be installed or services will be provided; and any reports and drawings identified in the Bidding Documents regarding the Project site where the goods will be installed or where services will be provided, with respect to the effect of such information, observations, and documents on the cost, progress, and performance of the Contractor's obligations under the Bidding Documents.
- E. The Contractor has given the Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that the Contractor has discovered in the Bidding Documents, and the written resolution (if any) thereof by the Engineer is acceptable to the Contractor.
- F. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for furnishing the goods and services for which the bid is submitted
- G. The Contractor acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of bids, and final payment for all unit price bid items will be based on actual quantities, determined as provided in the Contract Documents. The Contractor also acknowledges that each unit price includes an amount considered by the Contractor to be adequate to cover the Contractor's overhead and profit for each separately identified item.

- 89. PREVAILING WAGE RATES:** Wage rates paid on this Project shall not be less than specified in the schedule of general prevailing rates of per diem wages as set forth below in the Davis Bacon Act General Decision No. TX130035:

General Decision Number: TX130035 01/04/2013 TX35

Superseded General Decision Number: TX20120035

Addison Athletic Club HVAC Improvements

State: Texas

Counties: Archer, Callahan, Clay, Collin, Dallas, Delta, Denton, Ellis, Grayson, Hunt, Johnson, Jones, Kaufman, Parker, Rockwall, Tarrant and Wise Counties in Texas.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of “identifiers” that indicate whether the particular rate is union or non-union.

Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than “SU” denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters , PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable , i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2011, following these characters is the effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

Non-Union Identifiers

Classifications listed under an “SU” identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union majority rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination

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- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

90. BID ITEMS/REFERENCE SPECIFICATIONS: The requirements of NCTCOG standard specifications for Public Works construction 4th Edition dated 2004, and TxDOT

Addison Athletic Club HVAC Improvements

standard specifications for construction and maintenance of highways, streets and bridges, dated 2004, shall apply as described.

91. **NO BOYCOTT ISREAL:** Pursuant to Texas Government Code Chapter 2270, Contractor's execution of this Agreement shall serve as verification that the Contractor does not presently boycott Israel and will not boycott Israel during the term of this Agreement.

SPECIAL PROVISIONS

Note: The series of numbers shown after the description are for either the Texas Department of Transportation (TxDOT) Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (2004), the North Central Texas Council of Governments (NCTCOG) Standard Specifications for Public Works Construction, Fourth Edition (October 2004), or technical specifications number provided with this document.

SP.1 PROJECT

The project covered by these specifications consists of the furnishing and installation of all material, supplies, appurtenances, equipment and labor and any other necessary items required to construct, test and complete, ready for use and operation by the Owner. Final clean up before acceptance by the Owner is included as a part of the project.

SP.2 NCTCOG CONSTRUCTION SPECIFICATIONS

NCTCOG shall be utilized for these areas:

- | | |
|---|--------------|
| • Site Protection & Preparation | Division 200 |
| • Roadway Construction | Division 300 |
| • Roadway Maintenance & Rehabilitation | Division 400 |
| • Underground Construction | Division 500 |
| • Structures | Division 700 |
| • Misc. Construction & Materials | Division 800 |

Contractor shall notify owner and engineer with any discrepancies between the NCTCOG Specifications and technical specifications prior to starting construction.

SP.3 DISPOSAL OF SURPLUS MATERIAL

Surplus material not required for other parts of the work and not otherwise specifically covered by the drawings or specifications shall become the property of the Contractor for proper disposal by him.

SP.4 REMOVING OBSTRUCTIONS

Existing driveways, mailboxes, fences, sidewalks, landscaping, signs, and RCP or CMP drainage pipes shall be removed and replaced where necessary. The Contractor shall replace existing obstructions with equal or better materials. The Contractor shall coordinate any removal with the Property Owner.

SECTION PS

PROJECT SIGN

PROJECT SIGN

1. Quantity

Two (2) Project Designation signs will be constructed and installed on the project site as directed by the Owner. It will be the responsibility of the Contractor to maintain the sign in a presentable condition at all times during construction. Maintenance will include painting and repairs as directed by the City Engineer or his appointee. The locations of the signs will be given to the Contractor by the Town of Addison at the Pre-Construction Conference.

2. Material

Sign shall be constructed of 3/4-inch thick smooth finish fir plywood (Grade A-C, exterior or better).

Sign will be securely mounted to 6" x 6" square posts. Nuts and bolts will not protrude from face of sign. Posts will be mounted to a support system that will provide adequate stabilization to ensure the sign will not fall over in heavy winds. Sand bags or other techniques may be necessary to protect sign.

3. Dimensions

Size of sign will be four feet tall and six feet wide. The height and arrangement of the lettering shall be in accordance with the attached detail.

4. Paint

Sign will be one-sided and will have a white background. Text will be black, except for the word "Addison!" which will be a blue color approved by the City Engineer. The paint will be an outdoor paint and will be maintained throughout the project in proper order. The quality of the paint, painting, and lettering on the signs shall be approved by the City Engineer or his appointee.

5. Payment

Project Signs will be a separate pay item. This will include all labor, equipment, tools, and incidentals necessary to complete and install the work.

The Town of



**PLEASE PARDON THE TEMPORARY
INCONVENIENCE DURING THIS PROJECT**

“PROJECT NAME”

CONTRACTOR: _____

ESTIMATED COMPLETION DATE: XXX

AN ADDISON PROJECT

FOR MORE INFORMATION, PLEASE CALL (972) 450-2871

City of Addison Athletic Club

SECTION 230000 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The work in this Division covers all HVAC work specified in all Division 23 Specification Sections and as illustrated on the HVAC Drawings. Comply with other Division 23 Specification Sections as applicable. Refer to other Divisions for coordination of work with other trades.
- B. Provide all labor, materials, equipment, transportation, tools and services, and perform all operations required for, and reasonably incidental to, the providing of mechanical system work described in this Division.
- C. Contractor shall include providing instructions and demonstrations of the operation of each installed system in its totality to the Owner. Refer to Division 23 specifications for specific Owner training requirements. As a minimum include training of the Owner's Operating Personnel on:
 - 1. Safety Shut-Down of HVAC Equipment.
 - 2. Sequence of HVAC Equipment Operation.
 - 3. Operation and Maintenance of all HVAC Equipment.
- D. The Conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this section.
- E. Refer to Specification Section for "Construction Progress Schedules".

1.2 RELATED DOCUMENTATION

- A. Section 01 60 00: Materials & Equipment.
- B. Section 01 70 00: Contract Close-Out.
- C. Section 01 73 00: Operation and Maintenance Data.

1.3 DESCRIPTION OF HVAC DEMOLITION WORK

- A. Contractor shall remove several items of materials and equipment under this Section of the Specifications. Equipment and materials to be removed shall be as indicated and noted on the Drawings and as required to facilitate the new installations.
- B. Generally, modifications to, replacing of, or making new connections into existing service lines shall be accomplished only during the times directed by the Owner's Representative.

PART 2 - EXECUTION

NOT USED

PART 3 - EXECUTION

3.1 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to Substantial Completion, fully instruct the Owner in the operation, adjustment, and maintenance of products, equipment, and systems; including, but not limited to all HVAC equipment, related accessories and components, temperature controls and the energy management system. Owner shall operate all systems in cooperation with Contractor for a period of at least five (5) working days prior to, or shortly after, Substantial Completion.
- B. Arrange for services of qualified manufacturer's representatives to fully instruct Owner on specialized portions of installations, such as air handling units and automatic temperature controls.
- C. Arrange for each installer of equipment that requires regular maintenance to meet with Owner to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by trained manufacturer's representatives. Include detailed review of the following items:
 - 1. Operating and Maintenance Manuals.
 - 2. Record Documents.
 - 3. Spare Parts and Materials.
 - 4. Lubricants.
 - 5. Cleaning.
 - 6. Standard and Extended Warranties.
 - 7. Maintenance Requirements, Agreements, and similar continuing commitments.

City of Addison Athletic Club

- D. As a part of these instructions for operating equipment, demonstrate the following procedures:
1. Start-Up.
 2. Shut-Down.
 3. General System Operating Instructions.
 4. Emergency Operating Conditions.
 5. Noise and Vibration Adjustments, where applicable.
 6. Safety Procedures.
 7. Economy and Efficiency Adjustments.
 8. Effective Energy Utilization.
- E. Return at first change of season for changeover from air conditioning to heating, or from heating to air conditioning, to demonstrate system operation in the opposite season.
- F. Submit a complete record of instructions as a part of maintenance instructions and the data book (Operations and Maintenance Manual) given to Owner. For each instructional period, supply the following data:
1. Date of Instruction.
 2. System or Equipment Involved.
 3. Names of Persons Giving Instructions.
 4. Other Persons Present.
 5. Time Period (in hours/minutes) Instruction Provided.
- G. Amount of time to be devoted to instructional sessions shall be reasonable and consistent with the size and complexity of equipment and systems installed and as specified in other sections of these specifications.

3.2 TEMPORARY WORKING ACCESS

- A. Each respective trade shall remove existing piping, equipment, fixtures, and other items to provide access for work in existing facilities and on the site. Contractor shall seek Owner's Representative approval prior to removal of any equipment and mechanical appurtenances.
- B. Reinstall and refinish items removed, or otherwise damaged, to match existing adjacent surfaces, or new finishes where applicable, upon completion of the work.

3.3 DISRUPTION OF EXISTING FUNCTIONS

- A. Access: Access to and use of the existing facilities and site will be restricted, and shall be under the direction and control of the Owner.
- B. Disruptions: Maintain existing mechanical, and other existing systems, and maintain all existing functions in service except for those specific portions scheduled for disruption. Where existing functions to remain in use are disrupted, they shall be fully restored after disruption, in full compliance with this Division of the Specifications for new work, as quickly and as reasonably possible.
- C. Scheduling of Disruptions: Seek and obtain approval by the Owner two (2) weeks in advance of each event. Failure to schedule such disruptions in advance will result in the Contractor being stopped or rescheduled by the Owner without added cost to the Owner.
- D. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior written approval and shall include the following information in the form of a memorandum submitted by the Contractor to the Owner's Representative for approval by the Owner:

Facility/System	Date	Starting Time	Duration
-----------------	------	---------------	----------

- E. Emergency Disruptions: When circumstances preclude obtaining advance approval as specified above; make request immediately on knowledge of the requirement, and perform the work so as to cause the minimum amount of disruption, for the minimum duration.
- F. Notification: Notify the Owner's Representative and the Owner immediately, by telephone and then in writing, as changes and additions to the scheduled disruption requirements become known.
- G. Duration:
1. Complete as large a portion of the work as possible before initiating disruption.
 2. Maintain adequate personnel, supplies, materials, equipment, tools, and other resources at job site to avoid unnecessary delay in resumption of normal services.
 3. Keep duration of disruption as short as possible.
 4. During the disruption, perform only the amount of work that requires the disruption, so as to minimize duration of disruption.

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3.4 MODIFICATIONS AND RELOCATIONS

- A. Modify, remove, or relocate materials and items indicated on the Drawings or required by the installation of new facilities.
- B. Relocations:
 - 1. Repair and restore to good functional condition, equipment, materials and items scheduled for relocation, which are damaged during dismantling or reassembly operations.
 - 2. Remove carefully, in reverse order to original assembly or placement, items which are to be relocated.
 - 3. Protect items until relocation is complete.
 - 4. Clean and repair items to be relocated, and provide new materials, fittings, and appurtenances required to complete the relocations as required to restore them to good operating order.
- C. Perform the relocation work in accordance with applicable Sections of these Specifications, utilizing skilled workers.

3.5 SCHEDULE OF WORK

- A. Reference Division 1 for Additional Scheduling Information.
- B. Work under the various specification sections must be expedited and close coordination will be required in executing this work. Various system installers shall perform their portion of the work at such times as directed so as to insure meeting scheduled dates, and to avoid delaying the work of other trades.
- C. The use of any type of fastening or hanging device which requires the use of shots or explosives of any nature shall not be used.
- D. Where required by conditions at the site, Contractor shall perform portions of work at night or at other such times as may be required to insure completion of work on schedule. No additional compensation to the Contractor will be paid for such work or required utilities.
- E. Contractor shall be available, as deemed necessary for job progress by the Owner, for weekly progress and coordination meetings with the Engineer, and other Owner's Representatives, when required. These meetings shall be used to monitor progress of submittals, receipt of materials, construction progress, cooperation of trades, field coordination by the Contractor, and to resolve unforeseen conditions in an expeditious manner. Failure to attend meetings, to respond in a timely manner to requests for information, or to progress at an acceptable pace to maintain the construction schedule shall constitute a delay by the Contractor and may be cause for assessment of fees to the Contractor as outlined in Division 1.
- F. Provide all temporary connections as necessary to facilitate the phasing of construction, even where not specifically shown. Where temporary work is required it may be required that the Contractor produce a Shop Drawing or field sketch to illustrate the intended methods which shall be submitted for approval by the Engineer.

3.6 SALVAGE, DEMOLITION, AND RELOCATION

- A. It shall be the responsibility of the Contractor to remove and store those items of existing equipment as indicated on the Drawings to be removed. All items of equipment or fixtures removed shall be protected from damage insofar as is practical.
- B. Mechanical items to be removed, salvaged, or relocated shall be removed by the respective trade who would normally be responsible to install new work similar to that to be removed. This shall include whatever selective demolition is necessary to avoid damaging other work of other trades. Each trade shall be responsible for their respective demolition. However, all trades shall keep informed as to the project schedule as it relates to the Demolition Scope of Work.
- C. These items shall be stored on site for a minimum of two (2) weeks unless indicated otherwise by the Owner's representative to allow for inspection by the Owner. Deliver, all items tagged to be retained by the Owner to a designated storage location on site or to the Owner's designated Service Center or Warehouse. All items not retained by the Owner shall be removed from the site by the Contractor at no additional cost to the Owner.
- D. The attendant piping, ductwork, hangers, foundations, etc., of those items of existing equipment to be removed, shall also be removed in their entirety. No piping, hangers, etc., shall be abandoned in place. Where branch lines are removed, the branch shall be capped as close to the main as possible.
- E. Relocations:
 - 1. Repair and restore to good functional condition materials and items scheduled for relocation and/or reuse and which are damaged during dismantling or reassembly operations.

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2. New materials and items of like design and quality may be substituted for materials and items indicated to be relocated, in lieu of relocation, upon approval of shop drawings, product data and samples.
 3. Remove carefully, in reverse to original assembly or placement, items which are to be relocated.
 4. Protect items until relocation is complete.
 5. Clean and repair and provide new materials, fittings, and appurtenances required to complete the relocation and to restore to good operative order.
 6. Perform the relocation work in accordance with pertinent sections of the specifications, utilizing skilled workers.
 7. Refer to Drawings for specific requirements of temporary services and relocated equipment and fixtures.
- 3.7 CLEAN UP
- A. Remove all debris, rubbish, and materials resulting from cutting, demolition, or patching operations from the work area on a daily basis.
 - B. Where such work generates dust and debris take all precautions necessary to prevent dust and debris from accumulating in or on other mechanical and electrical equipment. This may require adding temporary filter media over ventilation air openings of certain types of equipment.
 - C. At the conclusion of this work clean all building materials, mechanical equipment and electrical equipment so that all items are dust free and operating properly. Where dust causes damage to equipment the Contractor shall make repairs to this equipment at no cost to the Owner.
 - D. Transport all demolished materials and equipment indicated above in approved containers and legally dispose of all debris off site in a manner approved by the Engineer and Owner.

END OF SECTION 230000

City of Addison Athletic Club

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Conditions of the Contract including the General Conditions, Supplementary Conditions, and Division One, shall apply to work of this Division, whether attached or not.
- B. The requirements specified in this Section shall be applicable to work specified in other Sections within this Division.

1.2 SCOPE OF WORK

- A. All Division 23 sections of these specifications shall include all labor and material to complete the entire mechanical systems as specified and shown on the Drawings.
- B. All work shown and specified shall be completely installed and connected by mechanics properly qualified to perform the work required. All work shall be left in a satisfactory operating condition as determined by the Owner and Owner's Representative.
- C. Provide all services and perform all operations required in connection with, or properly incidental to, the construction of complete and fully operating systems with all accessories as herein specified and shown on the Drawings.
- D. Refer to "Conditions of Work" in Division 1.

1.3 GENERAL

- A. The accompanying Drawings show diagrammatically the sizes and location of the various equipment items and the sizes of the major interconnecting piping and ductwork, without showing exact details as to elevations, offsets, control lines, and other installation details. The Contractor shall carefully lay out his work to conform to the site conditions, to avoid obstructions and provide proper grading of lines. Exact locations of outlets, apparatus, and connections thereto shall be determined by reference to the Drawings, reviewed Shop Drawings, including equipment drawings, and rough-in drawings, by measurements at the building, and in cooperation with work specified in other sections of these specifications. Minor relocations necessitated by the conditions at the site or directed by the Engineer shall be made without any additional cost to the Owner.
- B. These specifications and the accompanying Drawings are intended to describe and illustrate systems which will not interfere with the structures, which will fit into available spaces, and which will insure complete and satisfactorily operating installations. Contractor shall coordinate the proper fitting of all material and apparatus into the building and shall prepare larger scale installation drawings for all critical areas, areas with limited working clearances, and areas of significant congestion requiring a higher level of coordination illustrating the installation of work specified in Division 23 in relation to all other portions of work specified in other Sections of these Specifications. Interferences with other portions of work, or the building structure, shall be corrected before any work proceeds. Should changes become necessary on account of the failure of the Contractor to comply with these stipulations, Contractor shall make all necessary changes at no expense to the Owner.
- C. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted on the Drawings.
- D. It is the intent of the Contract Documents to provide an installation complete and operational in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section, or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems and required to complete the installation.
- E. Contractor sets forth that all personnel have the necessary technical training and ability; and that all work specified in this Division will be installed to the best standard of each trade, and will be complete and in good working order. If any of the requirements of the Drawings and specifications are impossible to perform, or if the installation when made in accordance with such requirements will not perform satisfactorily, report same to the Architect promptly after discovery of the discrepancy.
- F. No extra compensation will be allowed for extra work or changes caused by failure to comply with the above requirements.

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1.4 EXAMINATION OF THE SITE

- A. Contractor shall visit the site, verify all items indicated on the Drawings or specified, and familiarize himself with the work conditions, hazards, grades, actual formations, soil conditions, points of connection, utility locations, and local requirements.
- B. Contractor shall take these conditions into consideration, and the lack of specific information on the Drawings shall not relieve the Contractor of any responsibility.
- C. All site visits shall be coordinated and scheduled with the Owner.

1.5 CUTTING AND PATCHING

- A. Excessive cutting of the building structure, walls, floors, ceilings, roof, etc., will not be permitted. No structural member shall be notched or cut unless specifically shown on the Drawings, or unless such cutting is authorized by the Engineer.
- B. Provide for all holes or openings of proper size and shape as may be necessary for the proper installation of work specified in Division 23, consulting with the Engineer regarding proper locations and sizes.
- C. Where deemed necessary, and after consulting with the Engineer, perform all cutting and patching required for the installation of piping, ductwork, etc. This shall include the cutting of concrete floors, concrete and tile floors, walls, ceilings, roofs, etc. It shall also include patching them as required to restore work to match existing finishes, following installation, testing, backfilling, insulation, etc.
- D. Holes through concrete shall be drilled with "Mole", "Core-It", or other diamond point hole saw.
- E. Refer to Section 01 04 50, Cutting and Patching.

1.6 CODE REQUIREMENTS

- A. Contractor is required to comply with the requirements of all National, State, and local codes and utility companies having jurisdiction. In no case does this relieve the Contractor of the responsibility of complying with the requirements of these specifications and Drawings where specified conditions are of higher quality than the requirements of the above specified offices. Where requirements of the specifications and Drawings are below the requirements of the above offices having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above offices and shall notify the Architect promptly.
- B. Contractor shall comply with the requirements and standards set forth by, but not limited to, the following:
 - 1. (NFPA) National Fire Protection Association.
 - 2. (OSHA) Occupational Safety and Health Administration.
 - 3. (NEC) National Electric Code.
 - 4. (IECC) International Energy Conservation Code.
 - 5. Local Plumbing Code.
 - 6. Local Building Code.
 - 7. Local Mechanical Code.
 - 8. Local Fire Code.
 - 9. Local Energy Code.
- C. Contractor shall obtain all permits, inspections, and approvals as required by all authorities having jurisdiction. Fees and costs incidental to these permits, inspections, and approvals must be assumed and paid by the Contractor.

1.7 RECORD DRAWINGS

- A. Contractor shall, during the execution of work, maintain a complete set of "Record Drawings" upon which all locations of equipment, ductwork, piping, and all deviations and changes in the work shall be neatly recorded for use in producing "As Builts" at Project Close- Out. This shall include the incorporation of all Supplemental Drawings issued during the Construction Period.
- B. All "Record Drawings" shall be reviewed monthly during the Construction Period, along with the monthly Pay Application Request.
- C. Refer to Section 01 70 00, Contract Close-Out.

1.8 RECORDS AND INSTRUCTIONS FOR OWNER

- A. Accumulate during the job's progress the following sets, in triplicate, in accordance with the provisions of Section 01 70 00 & 01 73 00:
 - 1. Warranties and guarantees and manufacturer's directions on equipment and material covered by the Contractor.
 - 2. Equipment and fixture brochures, wiring diagrams, and control diagrams.
 - 3. Copies of reviewed Shop Drawings, and material and equipment submittals. Copies of rejected submittals and Shop Drawings are not to be provided.

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4. Operating instructions for heating and cooling and other mechanical systems. Operating instructions shall include recommended maintenance and seasonal change-over procedures.
 5. Other data and drawings required during construction.
 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
 7. Valve tag charts and diagrams specified elsewhere herein.
 8. "As-Built" Record Drawings shall be provided in electronic format on a CD (provide two (2) copies) in a PDF or DWG format as determined by the Owner.
 9. Provide copies of all City Inspection Certificates of Approval.
 10. Provide Contractor's Certification Statement that all equipment furnished and all work performed is in compliance with all applicable codes referenced in these specifications, or those which are currently in effect.
- B. Provide not less than one (1) days of operating instructions, during the adjustment and testing period, to the Owner's operating personnel in order to familiarize them with the proper care and operation of all equipment.
- C. All of the above data should be submitted to the Engineer for approval at such time as the Contractor asks for his last payment request, just prior to his final payment request. In no case will any portion of retainage be released until these documents are submitted and accepted.
- D. Refer to related portions of Division 1 for Project Close-Out requirements, Operation and Maintenance Data, Warranties, and other related certificates.
- 1.9 SHOP DRAWINGS AND SUBMITTALS
- A. Contractor shall submit to the Engineer shop drawings, product submittals, and catalog data on all ductwork, equipment, and materials designated on the Drawings and specified herein. A minimum of three (3) copies of each shall be submitted or submittal shall be transmitted electronically. Additional copies will be required when indicated by the Engineer and as required for project coordination.
- B. Each submittal will be reviewed for compliance with general requirements of design and arrangement only; it is not a contract document and acknowledgement of compliance does not relieve the Contractor from responsibilities for performance of the work in compliance with all provisions and requirements of the Contract Documents. Job measurements and the coordination of all dimensions for proper fit of all parts of the work and performance of all equipment supplied to meet specification requirements are, and remain, specific responsibilities of the Contractor.
- C. Shop Drawings shall be furnished by the Contractor for the work involved after receiving approval on the make and type of material and in sufficient time so that no delay or changes will be caused. This is done in order to facilitate progress on the job, and failure on the part of the Contractor to comply shall render him liable to stand the expense of any and all delays, changes in construction, etc., occasioned by his failure to provide the necessary detailed drawings. Also, if the Contractor fails to comply with this provision, the Architect reserves the right to go directly to the manufacturer he selects and secure any details he might deem necessary; and, should there be any charges in connection with this, they shall be borne by the Contractor.
- D. Shop Drawings submitted shall not consist of manufacturers' catalogues or tear sheets therefrom that contain no indication of the exact item offered. Rather, the submission on individual items shall designate the exact item offered and accessories as specified.
- E. Shop Drawings are not intended to cover detailed quantitative lists of heating specialties, valves, air distribution devices, fixtures, and similar items, as the Drawings and specifications illustrate those items; and it is the Contractor's responsibility to procure the proper quantities required to comply with the established requirements.
- F. Shop Drawings prepared to illustrate how equipment, piping, ducts, etc., can be fitted into available spaces will be examined under the assumption that the Contractor has verified the conditions shown. Review by the Architect shall not relieve the Contractor of responsibility in the event the material cannot be installed as shown on those Shop Drawings.
- G. Various material submissions of such items as air devices, plumbing fixtures, drains, and other related items or accessories shall be assembled in brochures or in other suitable package form and shall not be submitted in a multiplicity of loose sheets. Cover sheets for each item submitted shall have sufficient bare space to allow for shop drawing review stamps.
- H. Contractor shall process his submitted data to insure that it conforms to the requirements of the Drawings and specifications, and there are no omissions and/or duplications.
- I. Shop Drawings and Submittals shall be accompanied by certification from the Contractor, and firm preparing such, that Shop Drawings have been checked for, and are in compliance with, the Contract Documents.

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- J. All Submittals and Shop Drawings shall have been submitted for review by the Architect and Engineer within 90 days after Contract Award Date.
- 1.10 PENETRATIONS THROUGH FIRE-RATED ASSEMBLIES
- A. Seal voids around ducts and pipes penetrating fire-rated assemblies and partitions using fire-stopping materials and methods.
- 1.11 DRAWINGS
- A. Drawings show diagrammatically the locations of the various pipes, ductwork, fixtures, and equipment, and the method of connecting and controlling them. It is not intended to show every connection in detail and all fittings required for a complete system. The systems shall include, but are not limited to, the items shown on the drawings. Exact locations of these items shall be determined by reference to the general plans and measurements at the building, and in full cooperation with work specified in other Divisions of these specifications; and, in all cases, shall be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable change in the location of any of this work without additional cost to the Owner.
 - B. Should any changes be deemed necessary in items shown on the Contract Drawings, the shop drawings, descriptions, and the reason for the proposed changes shall be submitted to the Architect for approval.
 - C. Exceptions and inconsistencies in plans and specifications shall be brought to the Engineer's attention prior to bids being submitted; otherwise, the Contractor shall be responsible for the cost of any and all changes and additions that may be necessary to accommodate the installation of any particular apparatus.
 - D. Lay out all work maintaining all lines, grades, and dimensions according to these Drawings with due consideration for the work of others. Verify all dimensions at the site prior to any fabrication or installation. Should any conflict develop or installation be found impractical, the Engineer shall be notified before any installation or fabrication, and the existing conditions shall be investigated and proper changes effected without any additional cost.
 - E. Titles of Sections and Paragraphs in these specifications are introduced merely for convenience and are not to be construed as a correct or complete segregation or tabulation of the various units of materials and work. The Engineer does not assume any responsibility, either direct or implied, for omissions or duplications by the Contractor due to real or alleged error in the arrangement of matter in the Contract Documents.
- 1.12 CONNECTION OF EQUIPMENT FURNISHED BY OTHERS
- A. Equipment supplied as portions of work specified under other Divisions of these specifications shall be furnished with proper roughing-in diagrams and shall be installed as a part of Division 23.
 - B. Furnish materials and labor required for the connection of this equipment.
 - C. Contractor shall ascertain that all equipment so specified is included as part of this work.
- 1.13 COOPERATION
- A. Coordinate all work indicated in Division 23 with work specified in other Divisions to assure proper and adequate interface with other portions of the work.
 - B. Maintain contact and be familiar with the progress of the general construction and the timely installation of sleeves and inserts, etc., before concrete is placed. Install the required systems in their several stages, at the proper time to expedite the work and avoid unnecessary delays in the progress of other portions of the work.
 - C. Should any questions arise between work specified in Division 23 with respect to other portions of work specified in other Divisions of the Specifications, reference shall be made to the Engineer for instructions.
- 1.14 MATERIALS AND EQUIPMENT
- A. All materials and equipment purchased shall be new. No used or reconditioned equipment will be allowed.
 - B. Substitutions: Products of same functions, performance and design will only be considered if in full accordance with the requirements of Section 01 60 00, Material and Equipment. The products of other manufacturers will be acceptable; only if, in the opinion of the Engineer, the substitute material is of a quality as good or better than the material specified, and will serve with equal efficiency, maintainability, and dependability, the purpose for which the items specified were intended.
 - C. Listed Manufacturers:

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1. Manufacturers listed in a product or system specification are those manufacturers considered capable of manufacturing products conforming to the specification requirements, and are listed therein to establish a standard.
 2. The "listing" of a manufacturer does not imply "acceptance" or "approval" of any standard product of that manufacturer.
 3. Products offered by listed manufacturers shall be equal to, or superior in all respects to, that specified by named products; and shall meet or exceed specification requirements.
 4. The description of specific qualities takes precedence over the reference standards and the description of qualities and reference standards together take precedence over the named product of listed manufacturers.
- D. Product Options:
1. Products specified only by Reference Standards or by Description only means that any product meeting those standards or descriptions, by any manufacturer, will be considered.
 2. Products specified by naming several products or manufacturers means that only the manufacturers named will be considered.
 3. Products specified by naming only one product and manufacturer means that no option exists unless a substitution is accepted. Submit a request for substitution for any product or manufacturer not specifically named.
 4. Products specified by Description, Reference Standard, and naming several products or manufacturers means that any product and manufacturer named meeting those descriptions and standards will be considered. Submit a request for substitution for any product or manufacturer not specifically named.
- E. Limitations or Substitutions:
1. During Bidding Period, Instructions to Bidders, in Division 1, will govern times for submitting requests for substitutions under requirements specified in this Section.
 2. No later than ten (10) days prior to the bid date, Contractor shall notify the Engineer in writing of any desired substitutions of products in place of those specified. These requests will be considered; and, if a favorable response is determined, this will be documented in the form of an Addenda.
 3. Substitutions will not be considered when indicated or implied on Shop Drawings or product data submittals without separate formal request, when requested directly by subcontractor or supplier, or when acceptance will require substantial revision of Contract Documents.
 4. Substitute products shall not be ordered or installed without written acceptance.
 5. Only one request for substitution for each product will be considered. If substitution is not accepted, Contractor shall provide specified product.
 6. Architect will determine acceptability of any and all substitutions.
- F. It is fully the Contractor's responsibility to assemble and submit sufficient technical information to fully illustrate that the material or equipment proposed for substitution is equal or superior, as the Engineer is under no obligation to perform the service for the Contractor. The proposal shall be accompanied by manufacturer's engineering data, specification sheet, and a sample, if practical or if requested or specified. In no event shall a proposal for substitution be cause for delay of work. This shall include a detailed comparison to each product specification paragraph.
- G. Should a substitution be accepted under the above provisions, and should the substitution prove defective or otherwise unsatisfactory for the intended service, within the warranty period, the Contractor shall replace the substitution with the equipment or material specified, and on which the specifications required him to base his proposal.
- H. No substitutions will be considered contingent upon pending certification and rating agency approvals. Such certifications and ratings shall be in effect at the time of bidding.
- 1.15 EQUIPMENT SIZES AND REQUIREMENTS
- A. Space allocations in machinery and mechanical equipment spaces are based on equipment scheduled in each case. Should the Contractor request a substitution for equipment of another make that requires more space in any critical dimension, the Contractor shall submit, together with other submittal data on the equipment, prints of drawings indicating how the equipment may be installed, indicating room for servicing and revisions in piping or ducting and any other details necessary for the Engineer to form a judgement as to the suitability of the substitute material, as to performance, suitability for the space and other variables.
- B. Duties of certain equipment items, horsepower of driving motors and electrical characteristics are scheduled for equipment items of a particular make in each case. Should requests for a substitute material be accepted which has other requirements that would involve allied equipment or other portions

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of work, the Contractor shall be responsible for all modifications required at no change in contract price. As examples:

1. If an accepted A/C Unit has a brake horsepower requirement above the motor horsepower scheduled, the Contractor shall be responsible for providing a larger motor and heavier drive and any change in size of the protective device, conduit run and conductors serving that motor. The latter shall be extended through an individual branch protective device and branch circuit on through the panel, feeder, feeder protective device, etc.
 2. If accepted, heat exchangers, coils, etc., having greater pressure drops than those on which pumping heads were based, the Contractor shall be responsible for selecting proper pumps and drives and adjusting electrical service work accordingly.
- C. Structural steel members are indicated to provide supports for certain specific sizes and weights of equipment. Should a substitution request involve other equipment, the spacing of the supports shall be varied to suite the equipment. Should the weight or size of a proposed substituted item of equipment require additional supporting steel members, the Contractor shall include documentation of the additional supports in the request for substitution and install them at no change in contract price if the substitution is accepted.
- D. Various large apparatus to be installed may require that the apparatus be installed prior to the installation of portions of structural, walls, or door frames. Coordinate the installation of these items to insure that no demolition of general construction is necessary for equipment installation or that the apparatus does not have to be disassembled for installation.
- 1.16 STORAGE AND PROTECTION OF MATERIALS
- A. Store and protect materials and equipment as specified in Section 01 60 00, Material and Equipment.
- B. Contractor shall provide storage space for protection and storage of his materials and assume complete responsibility for all losses due to any cause whatsoever. All storage shall be within the property lines of the building site, and as directed by the Engineer. In no case, shall storage interfere with traffic conditions in any public or project thoroughfare.
- C. All work and material shall be protected at all times. Contractor shall make good any damage caused, either directly or indirectly, by his workmen. He shall be responsible for safe handling of all mechanical equipment and shall replace, without charge, all items damaged prior to acceptance by the Owner.
- D. On site storage shall not be inside the building during construction progress, but shall be in approved trailers or as specifically approved otherwise by the Engineer. Storage inside the building shall only be allowed when so allowed by the Engineer.
- 1.17 EXCAVATION AND BACKFILLING
- A. Contractor shall do all necessary excavating and backfilling for the installation of his work. Trenches for underground conduits shall be excavated to required depths with bell holes provided as necessary to insure uniform bearing. Care shall be taken not to excavate below depth, and any excavation below depth shall be refilled with sand or gravel firmly compacted. Where rock or hard objects are encountered, they shall be excavated to a grade six inches (6") below the lowermost part of the piping and refilled to grade as specified. After the piping has been installed and reviewed by Engineer and local building authorities, trenches shall be backfilled to grade with approved materials, well tamped or puddled compactly in place. Where streets, sidewalks, etc., are disturbed, cut, or damaged by this work, the expense of repairing same in a manner approved by Engineer shall be a part of this contract.
- B. Contractor shall bear sole responsibility for design and execution of acceptable trenching and shoring procedures, in accordance with State of Texas Regulations. On trench excavations in excess of five feet (5') in depth, Contractor shall pay a qualified engineer to prepare detailed Drawings and specifications directing Contractor in the safe execution of trenching and shoring. It is understood that trench safety systems constitute a means and method of construction for which the Engineer and Owner are not responsible. Accordingly, such documents when prepared, shall be separately issued by Contractor's Consultant, independent of project contract Documents.
- 1.18 WIRING
- A. Unless otherwise noted, all wiring for motors, starters, and equipment is specified in Division 26.
- B. Wiring of temperature controls shall be performed in accordance with the requirements of Division 26 but shall be performed as outlined in other sections of these specifications.
- C. All power for control circuits required for the Temperature Control System shall be provided and installed where indicated on the Division 26 Drawings, but shall otherwise be provided as indicated in other sections of these specifications.

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- D. Each supplier of equipment requiring control shall have wiring diagrams furnished with submittals. This shall be used to determine conduit layouts required to complete the electrical portions of the instrumentation and control systems.
- E. All motors furnished as a portion of work specified in Division 23 shall be wired as specified in Division 26.
- F. Except where combination starter-disconnects are specified elsewhere herein or in Division 26, all motors shall be provided with safety disconnect switches in accordance with the National Electrical Code as specified in Division 26.
- G. Furnish all necessary wiring diagrams for equipment specified in Division 23, as a part of equipment submittals, for installation under other sections of these specifications.

1.19 EQUIPMENT STANDARDS

- A. All basic materials and equipment shall be standard catalog products of a reputable manufacturer and shall essentially duplicate equipment which has been in satisfactory service for at least one (1) year.
- B. First of a kind new technology devices will not be considered.
- C. Accessory equipment that is required to make a complete and functioning system that is not of the same manufacturer furnishing the basic materials or equipment shall carry the guarantee of the basic material or equipment manufacturer and repair and replacement parts shall be available through normal trade channels locally.

1.20 CLEAN UP

- A. Contractor shall be responsible for cleaning up after and during all work performed under this Division of the Specifications.
- B. Contractor shall, on a daily basis, remove construction trash and debris accumulation to minimize the entrance of dust, dirt, and debris in piping, ductwork, and mechanical equipment.
- C. At the completion of construction, just prior to Substantial Completion and sustained operation of equipment, thoroughly clean the inside of piping, ductwork, and equipment.
- D. Refer to Division 1.

1.21 FINAL CONSTRUCTION REVIEW

- A. Schedule: Upon completion of the work specified in Division 23, there shall be a final construction review of the completed mechanical systems installations. Prior to this walk-thru, all work specified in this Division shall have been completed, tested, adjusted, and balanced in its final operating condition and the preliminary test report shall have been submitted to and approved by the Engineer.
- B. Personnel: A qualified person representing the Contractor must be present at this final construction review to demonstrate the system and prove the performance of the equipment.
- C. Building mechanical systems shall have been in operation for a minimum of 15 days and Test and Balance work shall be substantially complete prior to this review.
- D. Exceptions to the aforementioned requirements will be considered on a case-by-case basis dependent on the size and type of project, as well as construction schedule limitations.

1.22 CERTIFICATIONS

- A. Before receiving final payment, the Contractor shall certify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications.
- B. Provide copies of all applicable approved notices and inspection certifications from the various inspections conducted by the Local Code Enforcement Authorities.

1.23 GUARANTEE

- A. The guarantee provision of this specification requires prompt replacement of all defective workmanship and materials occurring within one year of final job acceptance, Substantial Completion, or as defined by Extended Warranty Contracts. This includes all work required to remove and replace the defective item and to make all necessary adjustments to restore the entire installation to its original specified operating condition and finish at the time of acceptance.
- B. The Contractor shall also guarantee that the performance of all equipment furnished and installed under this Division of the Specifications shall be at least equal to the performance as called for in the specifications and as stated in the equipment submittals. Should there be indication that the equipment and installation is not producing the intended conditions, the Contractor shall make further tests as the Owner's Representative may direct to demonstrate that the equipment installed meets the specifications and is delivering the capacity specified or called for on the Drawings.

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- C. If there is any indication that the equipment does not meet the specified quantities, the Contractor shall, at his expense, institute a program to demonstrate the adequacy of the installation. This program shall include all necessary testing and testing equipment. Should the Contractor not have the equipment or technical skill to perform the tests, it shall be his responsibility to employ recognized experts to perform the tests and shall provide certified laboratory tests, certified factory reports and work sheets, or other certified data to support results of any tests required.

END OF SECTION 230500

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with Division 23 Sections, as applicable. Refer to other Divisions for coordination of work with other trades, as required.

1.2 SYSTEM DESCRIPTION

- A. Provide motors for all mechanical equipment furnished under Division 23, as indicated herein and as illustrated on the Contract Drawings.
- B. All motors shall be of the same manufacture for like pieces of equipment; i.e., air handling units shall have motors of the same manufacturer. Pumps shall have motors of the same manufacturer, but both types of equipment are not required to have the same motor manufacturer.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 30 00 and 23 05 00.
- B. Indicate on submittal the motors proposed for each system of equipment to be installed. This shall be in tabular form in one location for each type of equipment submitted. The lack of this information will be grounds for rejection of equipment submittals.
- C. Product Data shall be furnished which shall include:
 - 1. Motor Manufacturer.
 - 2. Motor Type; Open Drip Proof, Totally Enclosed (Fan Cooled or Air Over).
 - 3. Model of Manufacturer.
 - 4. Motor Horsepower.
 - 5. Motor RPM.
 - 6. NEMA Motor Efficiency at 25%, 50%, 75%, and 100% of Full Load Rating for motors served by variable frequency drives; 100% only for constant speed motors 1 HP and larger.
 - 7. Power Factor at 25%, 50%, 75%, and 100% of Full Load Rating for motors served by variable frequency drives; 100% only for constant speed motors 1 HP and larger.
 - 8. Service Factor.
- D. Certification: Provide manufacturer's literature indicating NEMA premium motor efficiency as tested in accordance with IEEE Standard 112, Test Method B. Provide documentation to verify motors served by variable frequency drives meet NEMA MG1, Part 30 for 6-step drives and Part 31 for PWM drives.
- E. Provide closeout documents as required in Division 1.

1.4 QUALITY ASSURANCE

- A. Comply with all regulatory requirements in the following order of precedence:
 - 1. Codes, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction over installation, inspection, and testing, including local codes.
 - 2. Provisions specified in this Section of Specifications.
 - 3. Applicable provisions of standards of National Electric Code (NEC).
- B. Manufacturer shall have been manufacturing the motors as described herein for a minimum of ten (10) years.

PART 2 - PRODUCTS

2.1 ELECTRICAL MOTORS, GENERAL

- A. All motors furnished under any of the several sections of these specifications shall be of a recognized manufacturer, be of adequate capacity for the loads involved, and wound for the electrical characteristics indicated on the Drawings and specified herein. Verify all job site voltages and power source available before submitting, ordering and installing any motor or related controls.
- B. Motors shall conform to the standards of manufacture and performance of the National Electrical Manufacturer's Association (NEMA) as shown in their latest publication.
- C. Motors shall be furnished with an open-frame, unless otherwise noted, or required by the NEC for the service conditions encountered. Motors exposed to weather shall be the totally enclosed type suitable for

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installation in ambient conditions for exposure to the sun, heat, and rain. Provide explosion proof motors where indicated and as required for the hazard in which to be installed.

- D. Unless otherwise noted, fractional motors rated at 1/2 horsepower and less shall be single phase, the motors rated at larger than 1/2 horsepower shall be three phase. Single phase motors shall be arranged for across-the-line starting.
- E. Single phase motors shall be capacitor start, induction run type, and shall be furnished with motor controller with pilot light where scheduled or indicated. Refer to Section 23 05 14.
- F. All motors shall be of the same manufacturer on similar equipment furnished by the same manufacturer, unless they are an integral part of the piece of equipment to which they are attached, such as a chiller. Air Handling Units shall have motors of the same manufacture and pumps shall have motors of the same manufacture; but, pumps and air handling units are not required to have motors of the same manufacturer.
- G. Where other sections of specifications do not call for premium efficiency motors this section shall apply to motor requirements. Where premium efficiency motors are required in the other Sections of these Specifications refer to Article 2.2 herein.
- H. Motor manufacturers shall be Reliance, Baldor, General Electric, A.O. Smith or U.S. Motors. Other manufacturers will not be considered.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Motors shall typically be furnished by the manufacturer of the equipment which the motor will serve.
- B. Motors shall be factory installed in the equipment and be mounted on equipment bases, wired to a terminal box, connected to the mechanical device to be rotated, and factory run tested.
- C. When project schedules will not allow the above due to excessive lead time requirements, the Contractor shall do one of the following all at no additional cost:
 - 1. Locally procure the specified motors, while meeting all of the above requirements, and field install the motors on the equipment in accordance with the manufacturer's installation instructions.
 - 2. Accept factory installed standard efficiency motors and replace with high efficiency motors as noted above.
- D. Motors disconnects will be furnished and installed under Division 26, unless integral with, or specified to be a part of, the equipment as indicated elsewhere in other sections of these Specifications. The wiring to the motor and installation of the motor controller, if not specified to be integral with the equipment, as furnished under other sections of these specifications, shall also be installed under Division 26.
- E. Interlock and control voltage wiring shall be installed as outlined in other Sections of these Specifications.

END OF SECTION 230513

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SECTION 230514 - COMMON MOTOR STARTER REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with Division 23 Sections, as applicable. Refer to other Divisions for coordination of work with other trades, as required.

1.2 SYSTEM DESCRIPTION

- A. Provide a complete system of motor starters as indicated herein and as illustrated on the contract Drawings.
- B. Provide other devices as indicated for control of motors and interface with automation or control systems, and as further required by the local authorities having jurisdiction.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00.
- B. Indicate on submittal the starter type proposed to be used for each system and for the various sizes of motors required to be installed. This shall be in tabular form with attached cut sheets.
- C. Product Data:
 - 1. Snap Action Manual Motor Starters.
 - 2. Magnetic Across-the-Line Motor Starters.
 - 3. Control Transformers.
 - 4. Hand-Off-Automatic Switches.
 - 5. Pilot Lights.
 - 6. Number and Type of Auxiliary Contacts.
 - 7. NEMA Enclosure Type.
 - 8. Power and Control Wiring Diagrams.
- D. Provide closeout documents as required in Division 1 at Substantial Completion.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in following order of precedence:
 - 1. Codes, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction over installation, inspection, and testing, including local codes.
 - 2. Provisions specified in this Section.
 - 3. Applicable provisions and standards of the National Electric Code (NEC).
- B. Manufacturer shall have been manufacturing the product proposed to be used as described herein for a minimum of ten (10) years; or it shall essentially duplicate a product line that has been manufactured for that length of time.
- C. Source Quality Control:
 - 1. Manufacturer's tests to meet applicable Underwriters' Laboratories, Inc., Standards.
 - 2. Equipment designed and manufactured to meet applicable ANSI, NEMA, and IEEE Standards.

PART 2 - PRODUCTS

2.1 MOTOR STARTERS

- A. Except as specified otherwise, a starter providing overload protection shall be furnished with each motor provided in Division 23, under this section of the specifications, unless:
 - 1. Starters are provided in Division 26 as part of a motor control center, or
 - 2. Starters are furnished under Division 26 as a combination motor starter-disconnect.
 - 3. Disconnects on fractional horsepower motors are not substitutes for a motor controller (starter). However, a motor controller on these size motors may substitute for a disconnect only where the required location for both is in the same location.
 - 4. Unit heater and ceiling fan fractional horsepower, motors, 1/8 HP or smaller, with inherent thermal overload protection are not required to have motor starters.
- B. Each starter furnished herein shall have a NEMA horsepower capacity rating within the required limits of the motor which it serves.

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- C. Unless otherwise indicated, starters mounted indoors shall be furnished with NEMA Type 1 enclosures, and those exposed to the weather shall be furnished with NEMA Type 3 enclosures.
- D. Each three phase starter shall be provided with three thermal overload protection relays, one in each phase, be of the full voltage, across-the-line, non-reversing, single or two-speed, magnetic controller type. Overload relays shall be reset from outside the starter enclosure by means of an insulated bar or button.
- E. Starters shall have auxiliary contacts as required to comply with provision for electrical interlocks as defined hereinafter. Provide a minimum of one (1) normally open (N.O.) and one (1) normally closed (N.C.) auxiliary contacts with each three (3) phase starter.
Where used, the secondary side of the control transformer shall be grounded and the other side shall be fused. Where starters are interlocked, the starter holding coils shall be of one voltage. Where starter line voltages are different and above 120 volts to ground, provide control voltage transformers in the starters that are interlocked. The control systems installer shall supply all electrical power supply and transformers as needed to serve control circuit requirements for temperature controls. Control voltage in each starter shall be not more than 120 volts to ground, with an individual control transformer provided in each interlocked starter. Control safety circuits shall de-energize the respective motors served via holding coils in the respective starter.
- F. Manual starters for fractional horsepower single phase motors shall be on-off, or snap action switch type combined with thermal overload device. The switch shall be so constructed that it cannot be held closed under a sustained motor overload. This shall be equal to an Allen Bradley No. 600-TAX216, toggle switch with neon pilot light and NEMA 1 enclosure unless indicated otherwise for severe duty.
- G. Provide starter covers with Hand-Off-Auto Switch and pilot light where equipment is interlocked or remotely controlled. Provide starter covers with Start-Stop buttons and neon pilot lights where equipment is locally controlled.
- H. The Hand-Off-Auto Switches shall be so wired that, when in automatic position, the control of their motors is transferred to the control system as outlined elsewhere herein; and, when in hand position, they themselves assume control of their motors irrespective of the remainder of the equipment, although the temperature control sequences shall operate the same while in either the "Hand" or "Auto" position. Safety devices will not be bypassed when in "Hand" position.
- I. Coordinate the purchase of all starting equipment, insofar as practical, such that all starting equipment on the project shall be of the same manufacturer.
- J. Starters shall be a regularly manufactured product to meet the intent of all requirements specified herein.
- K. Acceptable starters and controllers shall be manufactured by
 - 1. Allen-Bradley.
 - 2. General Electric.
 - 3. Cutler-Hammer.
 - 4. Square D.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. All starters furnished under this section of the Specifications shall be installed under Division 26 of the specifications.
- B. Securely mount all starters level against walls where shown to be fully accessible and convenient for use. Where not specifically shown locate in a convenient and fully accessible location in a Mechanical Closets, Electrical Room, Janitor Closet, Storage Room or above accessible lay-in ceiling when no higher than six inches (6") above the finished ceiling height and mounted to a wall or physically secure and stable surface.
- C. Where no wall exists for installation, furnish a unistrut fabricated stand secured to the floor, or other suitable structure. Use corrosion resistant fasteners.
- D. Where motor starters are ganged together, mount, insofar as is practical, all at the same distance from the floor, or other referenced point, to the bottom of the starters.
- E. Refer to manufacturer's wiring diagrams for proper wiring procedures.
- F. Wire all safety devices in series to be active in both the "Hand" and "Auto" position.
- G. Coordinate starter type and size with motor manufacturer's data for equipment actually installed.
- H. Field verify correct sizes of replaceable thermal overload elements for each motor actually installed. Do not over or under size elements.

END OF SECTION 230514

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SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with all other Division 23 Sections, as applicable. Refer to other Divisions for coordination of work with other portions of work.

1.2 SYSTEM DESCRIPTION

- A. A complete system of vibration isolation for all mechanical equipment subject to the transmission of noise and vibration to the building.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the best quality and have been manufactured by a firm with a minimum of five (5) years of experience in this field.
- B. All equipment and materials shall be installed in a workmanlike manner by experienced mechanics and as recommended by the equipment and vibration isolation manufacturers.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions for all vibration isolation equipment.
- B. Shop Drawings: Submit in accordance with Section 23 05 00.

1.5 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall be rejected.
- B. Storage and protection of materials shall be in accordance with Section 23 05 00.
- C. Install materials and equipment at the proper time to keep pace with the general construction and the work of other trades involved so as not to delay the project completion schedule.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Objectionable vibration or noise created in any part of the building by the operation of any equipment furnished and/or installed under Division 23 will not be permissible.
- B. Contractor shall take all precautions against the same by isolating the various items of equipment, pipes, and ducts from the building structure and by such other means as may be necessary to eliminate the transmission of excessive vibration and objectionable noise produced by any equipment installed thereby.
- C. Design all foundations, supports, etc., for equipment, piping and ductwork with this end in view.
- D. Contractor shall supervise and instruct the construction of all foundations and supports, in order that they may be constructed in such manner as to prevent the transmission of noise and vibration.

2.2 APPLICATIONS

- A. Isolating material shall be selected in each case in accordance with the manufacturer's recommendations and the latter shall be prepared to demonstrate, upon request of the Architect, the isolation effectiveness of the material which has been installed upon his recommendation.
- B. Isolators shall be so selected that when all the items in each of the mechanical rooms are in simultaneous operation, the vibration transmission to the building at the lowest disturbing frequency shall be limited to a maximum of 10% for a mechanical equipment room floor that is on the ground and 5% for all other building surfaces, including those in fan rooms, from all the equipment when the various items are in harmony.
- C. For all curb mounted roof-top units and condensing units use two inch (2") wide x 3/8" thick neoprene isolation strips to be in continuous contact at all curb to equipment contact areas.
- D. Condensing units or other equipment to be installed on housekeeping pads shall be mounted on ribbed neoprene pads equal to Amber Booth Ampad Type NR or NRC, Style B isolators.

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2.3 MANUFACTURER

- A. Isolating material used shall be equivalent to Amber-Booth, Peabody, Korfund Vibration Mountings, or Mason.

PART 3 - EXECUTION

3.1 PERFORMANCE OF ISOLATORS

- A. Comply with recommendations set forth by the American Society of Heating, Refrigerating and Air Conditioning Engineers for the selection and application of vibration isolation materials and units.
- B. Comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.
- C. Place isolators where indicated and where specified herein. Coordinate all isolator selections with approved equipment and other pertinent shop drawings of exact equipment to be isolated. Verify to ensure accuracy of load points and take into account any accessory devices adding to equipment loads to be supported by isolators.

END OF SECTION 230548

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SECTION 230553 - IDENTIFICATION FOR HVAC EQUIPMENT AND PIPING

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with all other Division 23 Sections as applicable. Refer to other Divisions for coordination of work with other portions of the work.

1.2 SYSTEM DESCRIPTION

- A. Provide a complete system of Piping and Equipment Identification as specified herein for each of the systems as described herein.
- B. Provide a complete system of equipment identification tags as described herein.

1.3 QUALITY ASSURANCE

- A. The installation of all mechanical system identification devices shall be performed under this Section of the Specifications using materials which are the product of reputable manufacturers. The application of the materials shall be in strict accordance with the published standards of the manufacturer of the materials, using any special materials as required by these specifications and by those published standards.
- B. Manufactured Piping Identification markers, equipment name plates and valve tags shall be a product of Seton Name Plate Corporation, EMED Company, Inc., or Craftmark Identification to meet all ANSI Standards pertaining thereto.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions in accordance with Section 23 05 00.
- B. Shop Drawings:
 - 1. Submit a list of all piping systems to be identified, color of background to be used, legend or wording to be displayed for each system, and the intended location of all markers to be displayed.
 - 2. Submit a list of equipment to receive identification tags, cut sheets and proof copies of tags which indicate location of tag and wording to be engraved thereon.
 - 3. Submit a list of valves with location, indicate type of service, type of tag, tag number and proposed valve tag chart as specified herein.
 - 4. Submit a list of units and areas served per ground source loop.

1.5 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall and will be rejected.
- B. Storage and protection of materials shall be in accordance with Section 23 05 00.

PART 2 - PRODUCTS

2.1 PIPING IDENTIFICATION SYSTEM

- A. Furnish piping identification markers for all insulated and uninsulated piping systems in sizes and colors in accordance with ANSI Standard A13.1. Markers shall be as manufactured by Seton Name Plate Corporation similar to their vinyl plastic "Setmark" pipe markers with flow arrows. For systems with overall outside diameters under 6" use the snap-around markers. For systems with overall diameters 6" and over use strap-around markers attached with nylon ties.
- B. Markers shall be provided as a minimum for the following systems:
 - 1. Drains (Green background), for all insulated drains not contained in one space or roof; i.e., an A/C condensate drain in a fan room shall not require identification, whereas, as drain extending to another space would.
 - 2. Refrigerant Suction Piping (Yellow background).
 - 3. Refrigerant Liquid Piping (Yellow background).
- C. Refer to Section 09 90 00 for color code paint requirements for all exposed mechanical equipment and piping.

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2.2 EQUIPMENT IDENTIFICATION

- A. This Contractor shall provide identification plates similar and equal to Seton Name Plates, Style 15671(M4564).
- B. Name plates shall be a minimum of 1/16" thick flexible multi-layered acrylic and be 1" X 3" in size with beveled edges. The surface shall be a black satin with a white core for lettering. Other color combinations may be used for specific systems where warranted. Each plate shall be drilled with two mounting holes sized for 3/8" No. 3 round head nickel plated steel screws. Lettering shall be a minimum of 3/16" high and lettering shall be cut through the black surface to the white core and be "Gothic Normal". Only name plates equal to those specified will be considered. No punched plastic tape or engraved aluminum plates are acceptable. Stick-on only plates are not acceptable.
- C. Provide and install identification plates on the cover of all starters or disconnects or combination starter-disconnects, where not mounted directly on the equipment, delivered by the mechanical system installer to the electrical systems installer and on each piece of Mechanical Equipment to include but not necessarily limited to:
 - 1. Roof-Top Units.
 - 2. Exhaust Fans.
 - 3. Split DX A/C Units.
 - 4. Condensing Units.
 - 5. Condensate Pumps.
- D. Name plates shall have complete words describing equipment type, use and service. As an example, air handlers shall be designated "AHU-S-X MEP Shop" to designate the equipment as an air handler, number of air handler and area served. Use multiple or larger name plates as required to fulfill this requirement.
- E. Provide and install an additional identification plate mounted on the ceiling grid (lay-in Clg) or on access door (Hard Clgs.) for all above ceiling mounted equipment.

PART 3 - EXECUTION

3.1 PIPE MARKER INSTALLATION

- A. Provide flow arrows at each marker location.
- B. Markers shall be spaced not more than 30 feet on center and at each change of direction but not more than 4 feet in each direction from each elbow and tee. Markers not required on piping runouts less than four feet (4') in length and 1-1/4" or smaller in size.
- C. Identification markers shall be installed on all new piping; indoors, outdoors and in the crawl space except for drain and waste lines 3/4" and smaller.
- D. Install markers on exposed piping systems only after jacketing systems and finish paint coats are complete. Refer to Sections 09 90 00 and 23 07 00.

3.2 IDENTIFICATION TAG INSTALLATION

- A. Secure tags level and in a conspicuous location with adhesive on equipment starters or combination starter disconnects and on the equipment where starters are not immediately adjacent to the equipment served.
- B. Additionally, secure all tags with screw fasteners after secured with adhesive.
- C. Provide and install an additional identification plate mounted on the ceiling grid (lay-in Clg) or on access door (Hard Clgs.) for all above ceiling mounted equipment.

END OF SECTION 230553

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SECTION 230593 - MECHANICAL SYSTEMS TESTING, ADJUSTING, AND BALANCING (TAB)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This Section shall be related to the General Provisions of the contract, including General and supplementary conditions.
- B. Refer to Section 23 05 00 for general provisions.

1.2 SCOPE OF WORK

- A. The work included in this Section consists of the furnishing of all labor, instruments, tools and services required in connection with the Testing, Adjusting and Balancing (TAB) of the Heating, Ventilating and Air Conditioning (HVAC) systems as described in the mechanical specifications and shown on the mechanical Drawings, or reasonably implied therefrom, to include the overall commissioning of systems and subsystems such as verification of operation of each control device and all equipment sequences of operation.
- B. TAB of the HVAC systems will be performed by an impartial independent Technical Firm who is a member of the Associated Air Balance Council (AABC) and whose operations are limited only to the field of professional TAB work. The firm selected shall not be engaged in any contracting, manufacturing or engineering services. TAB services shall be included in the Contractor's Base Bid.**
- C. TAB Firm is responsible to and shall submit all reports directly to the Architect/Engineer and as requested to the Owner.
- D. TAB services shall result in the optimum temperature, humidity, airflow, pressurization, ventilation rates, and noise levels in the conditioned spaces of the building.
- E. The following basic components of the HVAC systems shall be tested, adjusted and balanced:
 - 1. Air distribution systems.
 - 2. Air moving equipment.
 - 3. Cooling systems.
 - 4. Heating systems.
 - 5. HVAC control systems verification to include end devices, control sequences of operation and energy management system control and monitoring point verification.
- F. Document Review
 - 1. The TAB Firm shall be responsible for reviewing the HVAC Drawings and specifications relating to the TAB services for proper arrangement and adequate provisions of devices for testing, adjusting and balancing.
 - 2. TAB Firm shall review HVAC manufacturer's submittal data relative to suitable provisions to allow system to be balanced
 - 3. TAB Firm shall review submitted HVAC automatic temperature control sequences for conformity to the specifications.
- G. Two (2) hard bound copies and three (3) .PDF file copies sent electronically of final report shall be submitted to the owner, or representative thereof, indicating a summary of actual operating data and any abnormal operating conditions. The report will contain all required information as described within this specification. The files shall also include copies of HVAC drawings annotated to reflect tags used for air and water components balanced.

1.3 SERVICES OF CONTRACTOR

- A. Contractor shall start up and test all materials and equipment which normally require testing. All piping, ductwork, etc., shall be tested to meet code requirements and the specification requirements, whichever is the more stringent. All equipment shall operate a sufficient length of time at the Contractor's expense to prove to the Engineer, and Owner that the equipment is free from mechanical defects, runs smoothly and quietly and performs satisfactorily to meet the requirements set forth in the Mechanical Drawings and Specifications.
- B. In order that all HVAC systems can be properly tested, adjusted and balanced, the Contractor shall operate the HVAC systems at their expense for the length of time necessary to properly verify their completion and readiness for TAB, and shall further operate and pay all costs of operation during the TAB period if not otherwise specifically addressed to be paid by the Owner. Operating expenses to be paid for

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by the Contractor (not TAB firm) will include, where applicable, but not necessarily be limited to, the following:

1. Utility costs; electrical, gas, etc., as applicable.
 2. Personnel costs to start, operate and stop all HVAC equipment.
 3. All start-up labor and materials costs.
 4. All maintenance costs.
- C. The drawings and specifications have indicated dampers and miscellaneous adjustment devices for the purpose of testing, adjusting and balancing the HVAC systems to obtain optimum operating conditions. It will be the responsibility of the Contractor to install these devices in a manner that will leave them fully accessible and readily adjustable to include access to allow recording of all motor and fan nameplate data. The TAB firm shall be consulted if there is a questionable arrangement of a control or adjustable device. Should any such device not be readily accessible, the Contractor shall provide access as required by the TAB firm.
- D. Contractor shall provide and coordinate the services of qualified, responsible sub-contractors, suppliers, and personnel as required to correct, repair or replace any and all deficient items or conditions found before and during the TAB period.
- E. As a part of this Project Contract, the Contractor shall make any changes in the sheaves, belts, motors, dampers and valves, or the addition of dampers and valves as required, to correctly balance the HVAC systems as required by the TAB firm at no additional cost.
- F. Provide sufficient time in Project Contract completion schedule to permit the completion of TAB services prior to Owner occupancy of the project.
- G. Contractor shall furnish, without charge to the TAB Firm, the following (Digital and Hard Copies):
1. One (1) complete set of project specifications to include all mechanical sections.
 2. One (1) complete set of Contract Drawings.
 3. All pertinent change orders and all Addenda.
 4. Two (2) complete sets of mechanical plans with latest revisions.
 5. Any "As-installed" and shop drawings.
 6. Approved HVAC system control diagrams.
 7. Approved manufacturer's submittals for all HVAC equipment to be included in the TAB scope of work.
- H. Have all HVAC systems complete and in operational readiness prior to notifying the TAB Firm that the project is ready for TAB services. So certify in writing to the Architect, Engineer, and Owner that such a condition exists. Complete operational readiness prior to commencement of TAB Services shall include the following:
1. Construction status of building shall permit the closing of doors and windows, ceilings installed, etc., to permit the obtaining of projected actual operating conditions. Preliminary air testing may be conducted without ceiling tiles and completion of the facility. However, final air testing requires that ceilings be completely installed so that air pressurization relationships can be properly verified.
 2. Air Distribution Systems:
 - a. Verify installation for conformity to design of all supply, return and exhaust ducts. Document and certify that all duct leakage tests as required by the mechanical specifications have been performed and the test results are within specified limits (provide copies of leakage test results). TAB firm shall be notified of the time when all leakage tests are to be conducted to allow them to witness as needed.
 - b. Verify that minimum outside air, maximum outside air, return air and relief air dampers provide tight closure, open fully and operate smoothly and freely.
 - c. Verify that all supply, return, exhaust and transfer air diffusers, grilles and registers are installed as indicated on the mechanical Drawings.
 - d. Verify that the correct size and type of terminal boxes are installed as indicated on the mechanical Drawings, and that they are fully operational.
 - e. Verify that all built-up type air handling systems, air handling units, etc. and associated apparatus such as heating coils, cooling coils, filter sections, access doors, etc., have been blanked and sealed to eliminate the bypass of air around the coils, filters, etc. or leakage of air into or out of the unit.
 - f. Install the specified type and quantity of clean filters at each air handling unit and maintain these filters for the complete period that the subject system is being tested, adjusted, and

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balanced. Refer to Section 23 30 00. New filters shall be installed just before air balance work is performed to insure clean filters are the basis of the test data provided.

- g. Verify that all (supply, return, relief and exhaust) fans are operational including proper fan rotation, operates free from vibrations, belts are properly aligned, and belt tension is proper.
 - h. Verify that all motor starter overload heater elements are of proper size and rating; nameplate amperage to be within the range of the heater element size.
 - i. Make a record of actual motor amperage and voltage, for each phase, and verify that they do not exceed nameplate ratings.
 - j. Verify specified vibration isolation accessories are correctly installed and adjusted.
 - k. Insure that all fan drive components, motors, belts, sheaves, and fan wheels are all accessible to allow for servicing and verification of name plate data, sizes, and model and serial numbers, as applicable.
 - l. Provide additional air balance dampers, water balance valves, and replacement sheaves and belts as required to successfully complete TAB work.
 - m. Flag all air balance dampers with fluorescent, or other high visibility tape, leaving a minimum of one inch (1") wide by three inches (3") long exposed to view.
- I. Automatic Controls:
- 1. Verify that all control components are installed in accordance with project requirements and are functional as intended by these specifications, including all electrical interlocks, damper and valve sequences, air and water temperature resets, firestats, duct smoke detectors, high limit pressure sensors, freezestats, safeties, etc.
 - 2. Verify that all controlling instruments are calibrated and set for design operating conditions with the exception of room thermostats which shall be calibrated at the completion of TAB services in full cooperation between TAB Firm and controls system installer.
 - 3. Automatic temperature control and/or energy management system installer shall thoroughly check all controls, sensors operators, sequences of operation, etc. before notifying the TAB agency that the automatic temperature controls and energy management system are operational. Automatic temperature control and/or energy management system installer shall provide technical support staff (technicians and necessary hardware and software) to the TAB agency to allow for a complete check out of these systems; controls personnel to be on site with TAB firm as needed to assist the TAB firm in completing the TAB work.
 - 4. The controls system installer shall also provide trending reports with the specific points and trend intervals, as requested by the TAB firm or engineer, when abnormal conditions are experienced.
 - 5. The scope of the TAB work, as defined herein, is indicated in order that the contractor will be apprized of their responsibility regarding the coordination and assistance required to complete the project requirements for final TAB. The TAB Firm will be responsible to the Engineer, and Owner for the satisfactory execution of the TAB services.

1.4 SERVICES OF THE TAB FIRM

A. TAB Firm Qualifications:

- 1. TAB Firm shall be one which is organized to provide independent professional testing, adjusting and balancing services. The firm shall have one (1) Professional Engineer licensed in the State of Texas, with current registration, on their staff. TAB Firm shall have operated a minimum of ten (10) years, under its current firm name.
- 2. All personnel used on the job site shall be either TAB engineers or TAB technicians, who shall have been permanent, full-time employees of the Firm for a minimum of one (1) year prior to working on this specific project.
- 3. TAB Firm shall submit the following to the Engineer and/or Owner for approval prior to commencing services:
 - a. Name and biographical data of the firms Professional Engineer and all other key personnel to be assigned to this project.
 - b. Proof of company operation for a minimum of ten (10) years.
 - c. Current AABC certification.
 - d. Documentation of number of full time staff size, specifically those personnel who perform or supervise the performance of TAB work.

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B. TAB Firm Responsibilities:

1. Liaison: The TAB personnel on the job shall act as liaison between the Architect, Engineer, Owner and Contractor.
2. Inspect the installation of mechanical piping systems, sheet metal work, temperature controls and other component parts of the HVAC systems during the early construction stages, and at other appropriate stages, for the purpose of reviewing that part of the work relating to proper arrangement and adequate provisions for TAB.
3. When performing inspection services prepare a punch list to be copied to the Architect, Engineer and Contractor noting observed deficiencies that would prevent adequate access to equipment and components installed or missing that would prevent the TAB Services from being carried out successfully.
4. Witness the first duct static pressure test performed on duct systems rated over 3.0 Inches W.G. to verify proper testing procedures are followed and documented. Include time for witnessing approximately 20% of all tests performed. Should the initial testing be unsatisfactory, then witnessing of the retest will be required. Document tests witnessed in writing.

C. TAB Firm Services:

1. TAB personnel shall, upon completion of the installation and start-up of the mechanical equipment systems, test, adjust and balance the HVAC systems to provide optimum temperature, airflow and noise conditions in the conditioned spaces in the building while the HVAC equipment is operating efficiently.
2. The Firm shall be responsible for testing, adjusting, balancing and logging actual data on all air distribution and air moving equipment, water distribution and water circulating equipment, fans, pumps, heating and cooling equipment and the operating conditions of all motors, etc. as indicated in this specification.

a. Air Distribution Devices:

- 1) Preset all volume dampers in the 100% open position.
- 2) Determine and verify proper air pattern deflection devices have been installed.
- 3) Verify size and types of all air devices installed, versus, the sizes and types indicated on the Drawings, to include neck sizes of diffusers.
- 4) Read out all air distribution devices served by their source (VAV Terminal, FPB Terminal, Constant Volume Air Handling Unit, Supply Fan, Exhaust Fan, etc.)
- 5) Balance all air distribution devices proportional to design CFM.
- 6) Adjust source to design CFM.
- 7) Verify that all air distribution devices are balanced to within plus or minus 10% of design (and all proportional to one another, + 10% from high to low, on each system even if the total can not be within 10% of design).
- 8) Tolerances for 100% outside air ducts and outside air introduced through air handling equipment shall be +5% to -10%.

b. Supply/Exhaust Fans:

- 1) Verify correct fan rotation.
- 2) If belt driven, verify proper belt tension and that fan and motor sheaves are properly aligned.
- 3) Verify that all safeties and interlocks are operational.
- 4) Verify correct size and rating of motor overload protection.
- 5) Verify fan motor is not overloaded; amperage readings do not exceed nameplate rating, for each phase, as applicable.
- 6) Determine total air quantities of system served by the respective fan. Air quantities to be determined by duct traverse if duct configuration permits and air velocity is 800 to 1000 feet per minute or greater. If the duct main is not suitable for traverse then traverse branch ducts as required to total air flows supplied by the system.
- 7) If air volume is less than design and motor capacity is available, adjust fan to design CFM. If new sheave or sheaves and belts are required, data will be submitted to Contractor.

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- 8) Witness positive pressure duct leakage tests performed by the contractor on large exhaust systems to minimize duct leakage in these systems.
 - 9) Balance air distribution system (see Air Distribution Devices).
- c. Rooftop Air Conditioning Units (RTU) and Split DX AC Units:
- 1) Verify that the outside, return and relief air dampers are operational and move freely.
 - 2) Verify that filters are new and clean at the time of testing.
 - 3) Verify correct evaporator and return or relief air (as applicable) fan rotation.
 - 4) If belt driven, verify proper belt tension and that fan and motor sheaves are properly aligned. If direct drive, verify that motor is a multi-speed motor and adjust speed setting for air balance purposes unless a single speed fan is used in conjunction with a variable frequency drive.
 - 5) Verify that all equipment safeties are operational, as applicable, (low and high pressure limit switches, freezestat, high static pressure, anti-recycle timer, etc.).
 - 6) If applicable, verify that unit air volume control (static pressure) on VAV type units is operational. Set fan volume control device for 100% capacity (terminal boxes set at 100% capacity). Set point shall be slightly higher than the minimum pressure required to obtain design air flow at all terminals.
 - 7) Verify correct size and rating of motor overload protection for each supply, return and relief fan motor.
 - 8) Verify each fan motor above is not overloaded; amperage readings do not exceed motor nameplate rating.
 - 9) Determine total supply and return air. Air quantities to be determined by duct traverse if duct configuration permits and air velocity is 800-1000 feet per minute or greater.
 - 10) Balance air distribution system (see Air Distribution Devices).
 - 11) If air volume is less than design and motor capacity is available, adjust fan or fans, to obtain supply and return design CFM quantities to within + 10% of design. If new sheave or sheaves and belts are required, data will be submitted to Contractor for change out. For direct drive fans, adjust fan speed setting. For fans served by variable frequency drives record fan speed and drive hertz at 100% design air flow. After adjustments are made, retest units to determine final air balance quantities.
 - 12) Test and adjust the minimum outside air up to any maximum values scheduled, for demand controlled ventilation, and return air CFM relationship to design.
 - 13) Verify all temperature control devices are set and calibrated at design set points. Document sensor values as compared to a calibrated temperature test instrument and further record Energy Management System offsets programmed to obtain calibration requirements specified herein.
- d. Cooling and Heating Coils:
- 1) Verify that all coils and heat exchangers are installed properly.
 - 2) Verify that all cooling and heating coils have filters installed upstream of coils.
 - 3) Verify operation of all safety devices.
 - 4) Record entering and leaving air dry bulb temperatures, as applicable, to determine actual air temperature drop or rise as compared to the design value for all equipment tested. Additionally, for cooling coils, record the entering and leaving wet bulb temperatures for each component.
3. During the balancing process, all abnormalities or malfunctions of equipment or components discovered by the TAB personnel, will be reported promptly to the Architect, Engineer, Owner and Contractor so that the condition can be corrected expediently.
 4. The temperature controls will be verified for calibration and proper relationship between control devices. The Contractor will be advised of any instruments out of calibration so that the Automatic Temperature Controls (ATC) contractor can recalibrate, using data supplied by the TAB Firm as required.

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5. Thoroughly test the Energy Management System (EMS), as applicable. The testing of the Energy Management System shall include all HVAC controls, sensors, operators, sequences, etc. The tests shall include verification that commands introduced at the EMS console actually occur and temperatures, pressures, etc. indicated at the EMS console correlate with the actual reading at the sensing point. The ATC and EMS contractor shall provide technical support to the TAB Firm for a complete check out of the HVAC temperature controls and the Energy Management System. The EMS workstation console and field direct digital control panel displays of measured variables such as temperature, relative humidity, and pressure shall have the displayed values offset through software to be within 0.3 Deg.F. of the temperature, 5.0 percent for relative humidity 20 parts per million for carbon dioxide and 0.01% for pressure of the actual variables measured in the field, with recently calibrated test equipment, at the sensor locations.
 6. After testing, adjusting and balancing to the design conditions, if comfort conditions are not being maintained, the air conditioning system shall be rebalanced within the limitations of the equipment installed to obtain comfort conditions. If comfort conditions cannot be obtained, a report will be submitted giving specific data regarding the trouble area.
 7. Make not less than three (3) inspections within ninety (90) days after occupancy of the building, and make adjustments if required, to insure that satisfactory conditions are being maintained throughout. Inspections are to be coordinated with Architect, Engineer, and Owner; and shall be documented with a supplemental report containing data and information, as required, after each visit, to document in writing that such visit took place and to note any unusual operating conditions.
 8. Make an inspection during the opposite season from that in which the initial adjustments were made and at that time make any necessary modifications to the initial adjustments required to produce optimum operation of the systemic components to produce the proper conditions in each conditioned space. The opposite season inspection shall be coordinated with the Architect/Engineer and Owner. This inspection shall be documented with a supplemental report containing any pertinent data and information regarding readings and adjustments made.
 9. Include testing and verification of domestic water centralized thermostatic mixing valves where connected to a pumped re-circulating system as well as TAB on the associated pumps and water balance stations on each separate system.
- 1.5 TAB REPORT
- A. TAB report shall incorporate all performance data for the HVAC systems. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operating personnel.
 - B. All measurements and recorded readings (of air, electricity, etc.) that appear in the report must be made on site by the permanently employed technicians or engineers of the TAB Firm.
 - C. TAB report shall include but not be limited to the following:
 1. Index.
 2. Preface: A general discussion of the system, an outline of normal and ventilation modes of operation, any unusual operating conditions and any deficiencies not corrected as of the time the report was written.
 3. Instrumentation List: A list of instruments used by type, model, range and calibration date. All instruments must be calibrated within six (6) months prior to the starting date of TAB services. Test probes used in domestic water system testing shall be sterilized before being used in these systems.
 4. Air Distribution Devices (Supply, Exhaust, Return, and Relief Air type where Balance Dampers are Used):
 - a. Manufacturer, model and size; include neck sizes for diffusers.
 - b. Location (Room name and number, ceiling, wall, etc.).
 - c. Design and actual CFM (cooling and heating).
 - d. Air distribution devices, where a velocity indicating instrument is used to determine CFM; provide the required and actual velocity in FPM (when an air flow hood is used to determine CFM, only CFM is required to be recorded.)
 5. Supply/Exhaust Fans:
 - a. Manufacturer, model and size; include neck size where different than the designated device size.
 - b. Location (Room name and number, above ceiling, roof mounted, etc.).
 - c. Design and actual CFM.

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- d. Design and actual fan RPM.
 - e. Design and actual static pressure (leaving minus entering).
 - f. Motor nameplate data.
 - g. Motor starter data and motor overload protection (heater) sizes and rating.
 - h. Actual motor amperage and voltage (all phases).
6. Coils and Heat Exchangers:
- a. Manufacturer, model, size and serial number where available.
 - b. Design and actual CFM.
 - c. Design and actual entering and leaving air static pressures.
 - d. Design and actual entering air dry bulb temperatures. Provide design and actual entering air wet bulb temperatures for each cooling coil.
 - e. Design and actual leaving air dry bulb temperatures. Provide design and actual leaving air wet bulb temperatures for each cooling coil.
 - f. Actual outside air temperature, dry and wet bulb, during testing.
7. Electric Heating Coils:
- a. Manufacturer, Model Number, size and serial number.
 - b. Design and actual CFM where duct mounted.
 - c. Design and actual entering and leaving static air pressures.
 - d. Design and actual entering air temperatures.
 - e. Design and actual leaving air temperatures.
 - f. Heater sizes; design and actual Kw to include number of stages.
 - g. Unit nameplate data versus actual, volts and amps per phase with heater fully energized, and per stage.
 - h. Actual outside air temperature during testing.
8. Split System Indoor Units:
- a. Manufacturer, Model, Size, and Serial Number.
 - b. Design and actual CFM (supply, return, and outside air).
 - c. Design and actual evaporator motor RPM.
 - d. Static pressure entering and leaving filters, coils, furnaces, and fans.
 - e. Evaporator motor name plate data.
 - f. Evaporator motor starter data and motor overload protection size and rating, or setting, for adjustable devices.
 - g. Actual evaporator motor amperage and voltage (all phases).
 - h. Filters; type, thickness, sizes, quantities of each size, and condition (new, clean, dirty, loaded, wet, etc.).
9. Condensing Units:
- a. Manufacturer, Model, Size, and Serial Number.
 - b. Location.
 - c. Actual unit name plate data.
 - d. Actual unit (compressor and condenser unit motors) amperage and voltage, all phases.
 - e. Ambient air temperature entering condenser during indoor and outdoor unit testing.
10. Rooftop Air Conditioning Units:
- a. Manufacturer, model, size and serial number.
 - b. Design and actual CFM (Supply, Return and Outside Air).
 - c. Design and actual Evaporator Fan RPM.
 - d. Static air pressure entering and leaving filters, coils, heaters, control dampers, and evaporator fan.
 - e. Evaporator, Return and Relief Air (as applicable) motor nameplate data.

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- f. Evaporator, Return and Relief Air (as applicable) fan motor starter data and motor overload protection heater sizes and rating (for each phase).
 - g. Actual evaporator motor amperage and voltage (all phases).
 - h. Filters; type, manufacturer, model, MERV rating, thickness, sizes, quantities of each size, actual static pressure drop across filters and condition (new, clean, dirty, loaded, wet, etc.).
 - i. Total unit Nameplate data (Volts, Amps, and overcurrent protection required).
 - j. Actual Unit volts and amps, for each phase, and actual overcurrent protection device rating, with the unit operating in full cooling.
 - k. Actual outside air temperature, dry and wet bulb (or relative humidity) during testing.
 - l. Condenser coil entering and leaving air dry bulb temperatures at full cooling.
- D. Instructions to Operating Personnel: TAB Firm shall instruct the operating personnel regarding the following:
- 1. Systems Operation.
 - 2. Unusual Operating Conditions
 - 3. System Troubleshooting Procedures.
- E. Guarantee: Provide extended warranty of twelve (12) months after occupancy during which time the Engineer and/or Owner may, at his discretion, request check of the balance of any HVAC equipment. Provide TAB technicians to assist as required in making such tests. When any device is found not balanced in accordance with the mechanical plans and specifications, that HVAC system shall be completely rebalanced as directed by the Architect/Engineer and/or Owner at the TAB Firm's expense.

END OF SECTION 230593

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SECTION 230700 - INSULATION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with all other Division 23 Sections as applicable. Refer to other Divisions for coordination of work with other portions of work.

1.2 SYSTEM DESCRIPTION

- A. Provide the systems of insulation which are specified for the control of heat transfer, sound control, and prevention of condensation.
- B. Provide protective devices to prevent compression abrasion or puncture of the piping insulation systems installed to include inserts, pipe shields, PVC jacketing and aluminum jacketing as specified herein.
- C. Provide piping identification systems as specified in Section 23 05 53, Identification for Equipment and Piping.

1.3 QUALITY ASSURANCE

- A. The installation of all thermal insulation shall be performed by a single firm regularly engaged in the insulation business, using skilled insulation mechanics and using insulation materials which are the product of reputable manufacturers. The application of the materials by the insulator shall be in accordance with the published standards of the manufacturer of the materials, using any special materials as required by these specifications and by those published standards.
- B. Materials shall be manufactured by Schuller, Pittsburg Plate Glass, Owens-Corning, Foster, Certainteed, Johns Mansville, or Knauf.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions to allow review of Materials and Methods to ensure complete compliance with specifications.
- B. Shop Drawings: Submit materials to be used and method of application for each system in tabular form. General statements not specifically identifying means or methods to be used shall be cause for rejection. Include descriptive data and cut sheets on each type of insulation material, sealing method, adhesives used, insert types, shield sizes, and PVC or aluminum jacketing as specified.

1.5 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall and will be rejected.
- B. Promptly replace all damaged, deteriorated or wet insulation materials.
- C. Storage and protection of materials shall be in accordance with Section 23 05 00.

PART 2 - PRODUCTS

2.1 PIPING AND EQUIPMENT INSULATION MATERIALS

- A. Waste, Drain and Miscellaneous Lines:
 - 1. The drain from each piece of Air Handling Equipment condensate drain pan and all refrigerant suction piping shall be insulated with foamed plastic, Armacell Armaflex or Aeroflex Aerocell slipped on while the piping is being fabricated, and with all joints, butt type, sealed using an adhesive recommended by the manufacturer of the plastic. The insulation shall be continuous from the drain opening in the Air Handling equipment condensate pan to the point of discharge with an open sight air gap over a drain. All formed plastic insulation shall meet ASTM E-84 requirements. Provide 1/2" thick insulation on condensate drains and 1-1/2" thick insulation on refrigerant suction piping.
- B. Refrigerant Lines and Gas Flue Condensate Lines Exposed to the Outdoors:
 - 1. Insulate as described in A.1 above.
 - 2. Cover with an 0.016 inch thick aluminum with locked seams and banded joints made watertight. Jacketing shall be equivalent to Childers Aluminum roll jacketing conforming to ASTM B-209, with smooth mill finish.

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3. Cover mechanical couplings and fittings with prefabricated aluminum jacketed fitting covers with factory applied moisture barriers to thickness to match that on piping and band in place. Fitting covers shall be equivalent to Childers ELL-JACS., Tee-Jacs, Flange-JACS, and Valve-JACS. Seal ends to prevent moisture penetration and to make completely weatherproof

2.2 DUCTWORK INSULATION MATERIALS

A. Duct Insulation - External:

1. Concealed (above ceilings) external duct insulation shall be glass fiber blanket-type insulation of not less than 3/4 lb. per cu. ft. density with a factory applied flame-retardant vapor barrier facing. Facing shall consist of a layer of aluminum foil, reinforced layer of glass fibers, and a layer of kraft paper all bonded together with fire-retardant and adhesive. Insulation, adhesives, and tapes shall be rated in accordance with U.L. 181A or 181B. Minimum ductwrap insulation thickness shall be two inches (2") thick and be equal to Certainteed Type IV duct wrap.
2. All insulation systems shall meet the requirements of the 2015 version of the International Energy Conservation Code, which requires a minimum installed R-value of 6.0 for conditioned, cooled or heated, and outside air system ductwork and plenums when located inside buildings or spaces. Increase insulation thicknesses as required to comply.
3. Water Vapor Permeance shall be no greater than 0.05 Perms per ASTM-E-96.
4. Fire Hazard Classification of installed duct insulation systems shall meet the requirements of ASTM-E-84; Flame Spread of 25, or less; Smoke Developed and Fuel Contributed of 50, or less. All insulation systems, adhesives, mastics, sealants, and tapes shall be U.L. rated for the application. All tapes used shall be acrylic based.
5. All external duct insulation shall be a regularly manufactured product of one of the following:
 - a. Knauf.
 - b. Owens Corning.
 - c. Johns Manville.
 - d. Certainteed.

B. Duct Insulation - Internal:

1. Internal duct insulation, liner, shall be in thicknesses as indicated herein, and be as specified in Specification Section 23 30 00. Duct liner shall be one inch (1") thick on all return, transfer, and relief air ducts, and on portions of general exhaust air ductwork systems as specified elsewhere herein. Internal duct insulation on all conditioned, cooled or heated, supply, all outside air ductwork systems and all mixed air plenums shall be 1-1/2" thick duct liner.
2. All duct liner shall be made of glass fiber coated with a bonded mat on the air stream side of the insulation. Coating shall be neoprene based meeting the requirements of NFPA-90A and U.L. Standard 723. Insulation shall not be less than 1.5 lbs. per cu.ft. density, and have a K-value of 0.28 per ASTM-C-177 at a mean temperature of 75 Deg.F.
3. All insulation systems shall meet the requirements of the 2015 version of the International Energy Conservation Code, which requires a minimum installed R-value of 6.0 for conditioned, cooled or heated, supply and all outside air system ductwork and mixed air plenums when located inside buildings or spaces. Increase insulation thickness as required to comply.
4. Fire Hazard Classification of installed duct insulation systems shall meet the requirements of ASTM-E-84; Flame Spread of 25, or less; Smoke Developed and Fuel Contributed of 50, or less.
5. All insulation systems, adhesives, mastics, sealants, and tapes shall be U.L. rated for the application.
6. All duct liner shall be suitable for the air velocities to be encountered in each system, and shall generally be suitable for velocities of up to 6000 FPM.
7. Acceptable duct lining manufacturers shall be:
 - a. Certainteed.
 - b. Knauf.
 - c. Owens Corning.
 - d. Johns Manville.

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PART 3 - EXECUTION**3.1 GENERAL**

- A. Apply insulation and pipe covering after all of the piping system to be insulated has been pressure tested, found to be completely tight (without leaks), and accepted as such. All extended handles and caps should be installed prior to commencing with insulation. Thoroughly clean and dry all surfaces prior to being covered.
- B. All insulation shall be continuous through wall and ceiling openings and sleeves. Use exterior duct wrap insulation on the outside of smoke and fire damper sleeves. Create a secondary sleeve around the primary sleeve to allow a complete insulation system as allowed by the local authority having jurisdiction.
- C. All insulation and accessories shall have composite (insulation, jacket and adhesive used to adhere the jacket to the insulation) fire and smoke hazard ratings as tested under procedure ASTM E-84, NFPA 255, and UL 723 not exceeding:

Flame Spread	25
Smoke Developed	50
Fuel Contributed	50

- D. Unskillful work shall be cause for rejection, including poor application of adhesives and coatings beyond the insulation which coats valves or other piping specialties.
- E. Damage or Modification to Insulation: Where new insulation is disturbed or damaged during the process of installing other new materials, making new connections, etc., it shall be repaired or replaced to return it to its original condition and appearance. Where lines are removed and connections to insulated lines are capped, insulate those caps as well as repairing damaged insulation. Materials shall match those presently installed in thickness, density, insulating value, jacketing, etc.
- F. Miscellaneous Lines: Piping connected to chilled or hot water lines through which there might be fluid flow on occasions such as the lines connected to air vents, lines running to compression tanks, etc. shall be insulated as described for other piping in those systems.
- G. Hanger and Support Locations: At the location of hangers or supports for pipes run above ground and finished with a vapor seal insulation, provide rigid sections of cork, Foamglas, calcium silicate or high density polyurethane, at least the same thickness as the adjacent insulating material to adequately support the pipe without compression of the insulating material and cover with a vapor seal that is bonded to the adjacent insulation as described for fittings in the lines. Where the insert has an insulating value less than the adjacent pipe insulation the thickness of the insert shall be increased to equal the insulating value of the adjacent pipe insulation. Wood inserts shall not be allowed. Hangers and supports for piping insulation to receive a vapor barrier shall be installed exterior to the insulation.
- H. Material Changes: Wherever there is a change in materials on lines that are vapor sealed, apply a suitable adhesive that is compatible with both materials, tapes, etc., as required to maintain the vapor barrier.
- I. The following describes materials, thickness and finishes for insulation on piping. In the following "exposed" shall mean any line or duct exposed below the finished ceiling and structure where no ceiling is installed, in any room space, area, mechanical rooms, closets, and any line or duct run exterior to the building, including above the roof. "Concealed" shall mean any line or duct located above ceilings, in furrings, in chases, in crawl spaces, and buried in direct contact with the soil.
- J. All insulation materials and jacketing shall exhibit the following characteristics:
 - 1. Water sorption, per ASTM C 1104, shall be less than 0.02%.
 - 2. Linear shrinkage, per ASTM C 356, shall be negligible.
 - 3. Stress corrosion, per ASTM C 795, shall not cause corrosion.
 - 4. Corrosiveness, per ASTM C 665, shall not be any greater than sterile cotton.
 - 5. Resistance to fungi, mold and mildew and bacteria, per ASTM C 665, shall be rated as not promoting growth of fungi and bacteria. Inhibitors shall be added to specified products to meet these requirements.

3.2 DUCTWORK

- A. Duct Insulation - Internal: Provide sound absorbing and thermal insulation to the interior surface of the following duct systems: Line the first 10 feet from the unit of all rectangular low pressure supply, return, relief and transfer, air ducts and supply, mixed, and return air plenums, unless noted, otherwise on the drawings. All lined ductwork shall be increased in size to maintain the clear inside (air stream) dimensions designated on the Drawings.
 - 1. Duct liner shall be applied in accordance with the manufacturer's recommendations, with the coated, or mat-faced, surface located away from the metal (exposed to air stream). It shall be adhered to

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the metal with Foster 85-10 or 85-15 adhesive applied to the entire inner surface of the duct. The liner shall be further secured to the duct with Graham Insulating Pins and Clips or other metal clips of the type which do not protrude through the duct. Those clips shall be installed on not greater than 12" centers both ways. All seams and openings in the liner shall be carefully sealed with adhesive.

2. Paint all joints in liner and butter the edges of sections where sections of ductwork will be joined using Foster No. 30-35, or equivalent adhesive.
3. Where damper rods occur, suitable metal bushings shall be provided on each end of the damper rod inside the duct, to provide clearance between the damper blade and the lining.
4. Refer to Section 23 30 00, HVAC Air Distribution.
5. Due to the 2015 version of the International Energy Conservation Code, conditioned air, heated or cooled air (includes outside air intake ductwork), ductwork insulation located inside the building envelope shall have a minimum installed R-value of 6.0. For lined ductwork, this shall be accomplished by using 1-1/2" thick duct liner. Coordinate insulation requirements with other Sections of these Specifications.

B. Duct Insulation - External:

1. Externally insulate all rectangular and round supply, return, and outside air ducts not containing internal lining (Kitchen make-up air ducts shall not contain internal lining and shall always be externally insulated).
2. Additionally insulate the outside of all fire, fire-smoke, and smoke damper sleeves penetrating walls and floors to insure a continuous insulation system.
3. External insulation shall be applied in accordance with the manufacturer's recommendations by impaling over pins using speed clips or be secured with adhesive.
4. Seal all joints, breaks, fastener penetrations and punctures with a 3" wide vapor barrier strip similar to that of facing materials secured with adhesive. Pins shall be spaced 12" on center both ways. Adhesive shall cover the entire duct surface.
5. Blanket type insulation shall generally be used on concealed ductwork only with rigid insulation board being used exclusively on exposed ductwork, which shall also receive a PVC jacket when located 12'-0", or less, above the finished floor.
6. Mastic seal all jacketing penetrations with a vapor barrier coating with a maximum perm rating of 0.02 Perms.

3.3 SHIELDS AND INSERTS

- A. Metal saddles, shields, shall be applied between hangers or supports and the pipe insulation. Saddles shall be formed to fit the insulation and shall extend up to the centerline of the pipe and the length specified for hanger inserts. Shields shall be made of galvanized sheet metal and shall be of sufficient size and length to prohibit the crushing of the insulation materials. Saddle shields shall be as follows:

Pipe Size	Metal Saddles	
	Metal Gauge	Length
3/4" to 3"	18	12"
4" to 6"	16	12" - 18"
8" to 10"	14	24"
12" & Larger	12	24"

END OF SECTION 230700

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SECTION 230900 - INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with Section 23 0500, General Provisions, and all other Division 23 Sections, as applicable.
- C. Refer to other divisions for coordination of work with other trades.

1.2 SYSTEM DESCRIPTION

- A. The scope shall include the furnishing and installing of an electronic controls system with new direct digital controllers, all local and remote control panels, temperature control field devices, appurtenances, etc., to accomplish specific control sequences specified herein, to provide fire and freeze protection; sensing and indicating devices; pressure and temperature indicating instruments; supporting structures, and other required components for a complete and operating system.
- B. The scope shall include all new electric connections to new thermostats, sensors, dampers and actuators, and relays, and all other new components of the system requiring electric connections.
- C. **The controls contractor shall be contracted by the Mechanical Contractor.** Mechanical contractor shall coordinate all required control interface connections with this contractor.
- D. Provide all software programs as required to implement the sequences of control, monitoring, reporting, etc., as indicated herein.
- E. The new system installed shall be fully automatic, subject to various types of remote surveillance, routine remote adjustments, remote status, remote alarms, remote data collection for trending/historical files, and other operations as indicated herein, from a new local remote microprocessor-based Local Area Network (LAN), with the local system capable of stand-alone operation. **The new system shall be expandable and will eventually control and operate the entire facility.**
- F. **This system of equipment and software shall be provided and installed by the single local factory trained and authorized sales, installation and service agent of Trane, Logical Solutions Inc. (LSI), Johnson Controls Inc. (JCI), Reliable Controls, and Delta Controls.**
 - 1. Trane
 - 2. Logical Solutions Inc. (LSI)
 - 3. Johnson Controls Inc. (JCI)
 - 4. Reliable Controls
 - 5. Delta Controls
 - 6. Alerton
- G. The existing pneumatic system will continue to operate and control the existing building central plant and air handling units. Refer to the air handling unit schedule for the air handling unit replacement schedule. The controls contractor shall reuse as much of the pneumatic system as possible for the replacement air handling units.

1.3 QUALITY ASSURANCE

- A. The equipment provided under this Section of the Specifications shall be installed, calibrated, adjusted, and put in completely satisfactory operation by a Control Systems installer experienced in this type of work.
- B. The successful Control Systems installer shall meet the following requirements:
 - 1. All spare parts must be locally stocked and readily available within a 24 hour period.
 - 2. Service personnel shall be available, on call, on a 24 hour a day, year round basis, or service personnel will respond by visitation to the site within four (4) hours of a service call considered serious in nature or classified by the Owner as an emergency.
 - 3. Be able to provide evidence of having successfully installed similar sized and types of systems for a minimum of ten (10) years.
- C. All control devices shall be as specified in the technical portion of this section of the specifications. The system shall be installed by workmen skilled, experienced, and specifically trained in the application, installation, calibration, adjusting, and testing of instrumentation of the type specified.
- D. A service representative of the installer shall check the instrumentation for proper installation, calibrate all instruments and make all adjustments necessary to insure proper operation of the system in full cooperation with the Testing, Adjusting, and Balancing (TAB) Firm. Refer to Section 23 0593. All instruments required for checking, calibrating, and proving the system shall be provided under this

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Section of the Specifications. The service representative shall spend sufficient time with all of the Owner's Representatives after the system is installed and properly functioning to instruct the Owner's Representative (Operations and Maintenance Personnel) in the operation of the system for a minimum of eight (8) hours for the basic Controls System. At final completion of the installation provide personnel and instruments of satisfactory quality available to check the calibration of all instruments, and to demonstrate system operation as described in "Sequences of Operation".

- E. All basic control devices, parts, and other materials, shall be standard catalog products of a single reputable manufacturer and shall essentially duplicate equipment which has been in satisfactory service for at least one (1) year. All materials and parts shall be items in current production by the manufacturers. First of a kind new technology devices will not be considered. Accessory equipment that is required to make a complete and functioning system that is not of the same manufacturer furnishing the basic control equipment shall carry the guarantee of the basic control equipment manufacturer and repair and replacement parts shall be available through normal local trade channels.
- F. All software updates and enhancements which evolve during the first year warranty period following system acceptance, "Substantial Completion", shall be furnished to the Owner without additional cost. This shall include the local stand-alone direct digital controllers and the building network manager computer(s).
- G. All controllers shall be Native "ASHRAE BACNET" and shall communicate to an "ASHRAE BACNET" Building Level "Front End" controller at the building network level.

1.4 SYSTEM START-UP AND COMMISSIONING

- A. After completion of the installation, Contractor shall place the system in operation and shall perform all necessary testing and debugging operations of the basic systems.
- B. An acceptance test shall be performed in the presence of the Testing, Adjusting, and Balancing (TAB) Company, to verify correct sequences of operation, calibration, and operation of the Controls, when installed, with every part of the system functioning satisfactorily and having been fully commissioned, and with no outstanding items requiring completion or correction, the system will be accepted by the Architect and Owner for "Substantial Completion", and will then be placed under Warranty.
- C. The Automatic Temperature Controls Installer shall thoroughly check all controls, sensors, operators, sequences, etc., before notifying the TAB Agency that the Automatic Temperature Controls are operational. The Automatic Temperature Controls Installer shall provide technical support (technicians and necessary hardware and software) to the TAB Agency to allow for a complete check-out of these systems.

1.5 SUBMITTALS

- A. Submittals shall be complete and be in full accordance with Section 23 0500, General Provisions.
- B. Submittals shall include complete, continuous line, point to point wiring diagrams including tie-in points to equipment with written sequences of control adjacent to pertinent control diagrams. Specification sheets shall be submitted on each piece or type of equipment in a separate brochure and show sufficient detail to indicate compliance with these specifications. Drawings and Specification sheets shall show setpoints, throttling ranges, actions, proportional bands, and integration constants, where applicable. Complete brochures shall include the wiring diagrams as well as operating and maintenance instructions on the equipment.
- C. Complete and approved shop drawings shall be obtained prior to commencing installation work, unless otherwise approved by the Owner or Owner's Representative.
- D. Tag numbers, as shown or specified, shall appear for each item on the wiring diagrams and data sheets. Data sheets shall properly reflect in every detail the specific item submitted.
- E. After completion of the work, Contractor shall prepare and furnish maintenance brochures for the Owner. The maintenance brochures shall include operating instructions, specifications, and instruction sheets for all instruments and a complete set of "As-Built" control drawings. After approval of submittal, completion of all installation work, software checkout, and system commissioning in conjunction with the Testing, Adjustment and Balance (TAB) Firm, furnish to the Owner the following:
 - 1. Three (3) sets of Blue or Black line prints of "As-Built" drawings, half size (11" X 17"), inserted in a three ring binder.
 - 2. Three (3) copies of the final approved Shop Drawings in suitably sized three ring binders.
 - 3. Provide a complete replacement spare parts list to the Owner, three (3) copies.
 - 4. Two (2) CD's with PDF files of all items furnished under items 1, 2 and 3 above, along with all operations and maintenance manuals.

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1.6 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored, and which is damaged or defaced during construction shall be rejected.
- B. Cover control panels, open ends of control piping and open ends of control valves stored on site until just prior to installation of wiring and valves respectively.
- C. Storage and protection of materials shall be in accordance with Division 1.

PART 2 - PRODUCTS

2.1 TEMPERATURE SENSORS

- A. Temperature sensors shall be nickel wire thermistor, 10,000 or 30,000 ohm resistance, or RTD Type, with 1000 ohms resistance at 70 Deg.F., and a 3 ohms/degree F temperature coefficient.
- B. Ambient temperature limits shall be minimum of 0-125 Deg.F. with a +/- 0.50% accuracy of nominal resistance at 70 Deg.F.
- C. Mixed air temperature sensors shall be the averaging capillary type to sense duct temperature across the full duct width. Minimum sensor length shall be 15 feet and include adequate supports for element within the duct or at the face of the coil, maintain minimum one inch (1") separation from coil.
- D. Furnish sensors with maximum 6 to 9 inch insulated pigtail leads.
- E. All sensor actions shall be the same for the entire building.
- F. Mount all room wall sensors at 48" inches above finished floor to comply with A.D.A., unless indicated or approved otherwise by the Architect or Owner's Representative.
- G. Wall space temperature sensors shall include the following accessories, features and functions:
 - 1. Impact Resistant Lexan type cover material.
 - 2. Local override pushbutton to energize controlled equipment for after-hours operation.
 - 3. Local operator interface communication service jack compatible with mobile trouble shooting terminal unit. Alternately, provide spare service jack on terminal equipment controller on controlled terminal equipment.
 - 4. Temperature increase/decrease adjustment capability.
- H. Sensors shall be as manufactured by General Eastern, ACI, or Reliable.

2.2 RELATIVE HUMIDITY SENSORS

- A. Provide a 100% solid state copolymer wafer, of bonded layer hygrometric materials, humidity sensor and transducer. Sensor shall require no periodic maintenance or recurring calibration. Sensor shall be linear and temperature compensated.
- B. Sensor shall have +/-2% Relative Humidity (RH) accuracy over a 100% RH range and +/-1% over the 30-80% RH range.
- C. Sensor shall produce outputs of 4-20 ma or 1-11 vdc.
- D. Sensor shall be in an impact resistant cover with ventilating openings in occupied spaces. Provide duct or remote mount probes as required for the application.
- E. Wall mounted sensors shall be mounted 48 inches above finished floor to comply with A.D.A., unless indicated or otherwise approved by the Architect or Owner's Representative.
- F. Acceptable Manufacturers:
 - 1. Vaisala (+2% to 3% acceptable).
 - 2. General Eastern (+2 to 3% acceptable).
 - 3. Alerton, Reliable, Delta or Honeywell Controls (+2% only).

2.3 CARBON DIOXIDE SENSORS

- A. Furnish and install "CarboCap" technology (Vaisala) or Single Beam, dual wavelength, Infrared type technology (Tel-Aire) carbon dioxide sensors where indicated and as specified elsewhere herein.
- B. Sensors shall accurately sense carbon dioxide levels from 250-2000 Parts Per Million (PPM) with an accuracy of ± 60 ppm ($\pm 2\%$ of range (2000 PPM) and $\pm 2\%$ of reading (use 1000 PPM)), repeatability of $\pm 2\%$ of full scale, maximum drift of $\pm 5\%$ of full scale in five (5) years, $\pm 1\%$ of full scale in six (6) months, and linearity of less than $\pm 3\%$ of full scale.
- C. Sensors shall be suitable for operation in environments of 60 Deg.F. to 104 Deg.F. and 15-95% relative humidity, non-condensing, and air velocity ranges of 200 to 2750 feet per minute when located in ductwork. Wall mount sensors shall be able to sense accurately with air velocities as low as 20 feet per minute.
- D. Sensors shall be calibrated at the factory at 1,000 PPM, ± 50 PPM; at 72 Deg.F, ± 4 Deg.F.; and at 50% relative humidity, $\pm 5\%$.

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- E. Power requirements shall be 24 volts AC with a power consumption not to exceed 5 watts.
- F. Wall mount sensors shall be mounted at 48-54 inches above the finished floor.
- G. Sensors shall be as manufactured by:
 - 1. Vaisala, Model GMD/W20 or equals by;
 - 2. Tel-Aire (Model 8101/8102), or
 - 3. Alternate equal models by Veris Industries.

2.4 COMBINATION SENSORS

- A. Where space temperature and relative humidity sensors are all designated to be located in the same location for control or monitoring purposes combination sensors are desired such that one wall mounted device and single back box is required.
- B. Where combination sensors are required the specified levels of accuracy will be required. The use of combination sensors does not relieve these requirements.

2.5 SMOKE DETECTORS

- A. One (1) smoke detector shall be furnished and installed under Division 26 for each new unit over 2,000 CFM of airflow or unit 2,000 CFM of airflow to be mounted in the return air stream, which shall stop the fan motors upon detection of smoke.
- B. Coordinate with Division 26 requirements to insure sampling tubes are provided suitable to the width of duct in which installed.
- C. Detectors shall be supplied with 120 volts, or 24 volts, power supply under Division 26. Control circuit interlock wiring shall be under this section of specifications.
- D. Acceptable duct detectors, where not specified elsewhere, shall be THORN-DH-22, BRK-DH2851AC, or Gamewell MS-69433, suitable for single station operation.

2.6 AUTOMATIC DAMPERS

- A. Provide all control dampers, under this Section of the Specifications, of the types and sizes indicated on the Drawings, including but not limited to outside air intakes, return, relief, and other motorized air control dampers where shown, or where not an integral part of the equipment furnished and specified in other sections of these specifications. All dampers shall be special low leakage extended performance type.
- B. Damper frames shall be not less than 16 gauge galvanized steel formed for extra strength with mounting holes for flange and enclosed duct mounting.
- C. Dampers shall be available in two-inch size increments from 8" horizontal and vertical to 48". Requirements for dampers over 48" in size shall be met by using standard modules with interconnecting hardware to limit damper blade length to a maximum of 48". Provide separate actuator for damper modules exceeding 32.0 square feet and as required for smaller sizes due to torque requirements.
- D. All damper blades shall be not less than 16 gauge galvanized steel roll formed for high velocity performance. Blades on all dampers must be not over 6" wide.
- E. Blade bearings shall be nylon or oilite with 1/2" zinc plated steel shafts.
- F. All blade linkage hardware shall be of corrosion-resistant finish and readily accessible for maintenance after installation.
- G. Provide continuous replaceable neoprene or butyl rubber edging seals for all outdoor and relief air dampers where blade edges meet when dampers are closed. Spring loaded stainless steel side jamb seals shall be provided for all dampers.
- H. Dampers and seals shall be suitable for temperature ranges of -20 degrees F to 200 degrees F at specified leakage ratings.
- I. Dampers used for proportional control shall have opposed blades.
- J. Leakage rates for all controlled dampers shall not exceed 5 CFM of air flow per square foot of face area based on a 16 square foot damper, at 1.0" W.C. differential, rated in accordance with AMCA 500. Furnish test data with Submittals.
- K. Acceptable manufacturers (No other manufacturers will be allowed):
 - 1. Johnson Controls, Inc.
 - 2. Honeywell, Inc.
 - 3. American Warming and Ventilating, Inc.
 - 4. Ruskin.

2.7 ELECTRIC DAMPER ACTUATORS

- A. All control valves and dampers shall receive electric actuators.

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- B. Electronic direct-coupled actuation devices shall be provided.
 - C. Electric Actuators shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a "V" bolt design with associated "V" shaped toothed cradle attaching to the shaft for maximum strength and to eliminate slippage.
 - D. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jack shaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or set screw type fasteners are not acceptable.
 - E. Actuators shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
 - F. For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable. This applies to all dampers directly connected to outside and relief air systems. Heating water valves serving coils on air handling equipment directly connected to an outside air intake shall have spring return. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
 - G. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. Floating point type control is acceptable on fan coil units, unit heaters and variable air volume terminals. All actuators shall provide a 2 to 10 VDC position feedback signal.
 - H. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA.
 - I. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper or valve when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose.
 - J. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
 - K. Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 - L. Actuators shall be Underwriters Laboratories Standard 873 listed.
 - M. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a minimum 2-year manufacturer's warranty, starting from the date of substantial completion.
 - N. All actuators connected to all sequenced dampers shall have independent control and adjustment from one another to emulate a pilot positioner.
 - O. Acceptable Manufacturer's:
 - 1. Belimo.
 - 2. Johnson Controls, Inc.
 - 3. Siemens.
 - 4. Invensys.
 - 5. Honeywell, Inc.
- 2.8 CURRENT SENSING STATUS RELAY
- A. Prove current sensing status relays for motor operation status monitoring as specified elsewhere herein.
 - B. Sensors shall be 100% solid state, no mechanical parts, and have no calibration drift.
 - C. Sensors shall have an adjustable trip level, be isolated, have single set point adjustment, require no external power (power induced from conductor), and have integrated adjustable wall or floor mounting bracket.
 - D. Sensors shall be suitable for motor loads from 0 to 100 HP, with a supply current of 1 ampere up to 135 amperes, 600 VAC RMS, set point adjustable to +/-1% range from 0-95% non-condensing relative humidity.
 - E. Sensors shall be as manufactured by Veris Industries.
- 2.9 LOCAL CONTROL PANELS
- A. New local equipment control panels shall be installed in each equipment room, or other locations as indicated or as required, for new electric equipment and control devices. They shall be totally enclosed, pre-piped, and wired to labeled terminals to house all associated controllers, thermometers, relays,

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- switches, etc. serving that equipment. Provide one cabinet for each air handling unit or group of units in the same room.
- B. Panels shall be mounted at a convenient height for access. Acceptable locations include mechanical equipment rooms, storage closets, electrical rooms, or other spaces as indicated on the Drawings. Above ceiling locations are not acceptable.
 - C. Thermometers, pilot light switches, and gauges shall be flush mounted on panel surface.
 - D. Cabinet frames shall be extruded aluminum sections with riveted corners supported by internal angle brackets. Door shall have continuous hinged door, with latch and key lock.
 - E. Sub-Panel and face panel shall be removable for ease of installation and replacement. Face panel shall be of a finished color with a finished frame.
 - F. Knockouts for 1/2" x 3/4" EMT connection and 1-1/2" x 1-1/2" trough shall be provided at top and bottom of panel.
 - G. Identify each panel, switch, and device by an engraved, bolt-on, black phenolic nameplate with white lettering securely attached. Identify all control devices inside panels similarly. Embossed plastic tape will not be acceptable on panel front faces but will be allowed on panel interiors.
 - H. Switches and pilot lights shall be mounted on the panel face with all other devices mounted inside the panel. Devices inside panels shall be wired to numbered dual terminal strips.
 - I. Start-Stop Pushbuttons and Pilot Lights, where called for, shall be of the low voltage and neon type. Pushbuttons shall be heavy duty type. Pilot lights shall be interlocked with starter auxiliary contacts except fans and pumps which shall have differential pressure sensors to indicate run status.
 - J. Each new control panel installed shall have a minimum of 25% consolidated spare/extra space available inside the panel for mounting of control devices for future system modifications or changes. This space shall be indicated on the panel shop drawing.
 - K. All wiring inside panels shall be concealed in a wiring harness.
 - L. Permanently affix inside each panel a final "as-built" control drawing of the piping and wiring of the panel.
 - M. All panels shall be factory assembled, piped and wired.

2.10 ELECTRICAL WIRING

- A. All wire, wiring, and conduit required for the operation of the control system shall be the responsibility of this section of the specifications and shall be installed as described and in full accordance with the requirements of Division 26 of these Specifications. Conduit down in walls to space sensors and back to accessible ceiling space to be provided by Division 26. Automatic Controls Contractor to coordinate installation of conduit of space sensors with Division 26 and provide if not provided by Division 26.
- B. The control manufacturer shall be responsible for supplying complete and approved wiring diagrams and installation supervision of the wiring of the control system and shall perform all necessary set-up and calibration labor.
- C. Starters, furnished in other sections of these specifications, shall be installed under Division 16, but all wiring from auxiliary contacts or relays shall be under this section of the specifications.
- D. All wiring, including Class 2 signal wiring, shall be installed as a Class 1 electrical system as defined by the National Electrical Code (NEC).
- E. All control conduits with #8 conductor or smaller (cross-sectional area) shall have one (1) spare conductor each run in conduits carrying 5 or more conductors. Spare conductor shall be same size as the majority of conductors sized in the conduit. Conduits with 9 or more conductors shall have two spare conductors. Terminate spare conductors at control panels in an acceptable manner and tag wires as "spare".
- F. The electrician shall be licensed by the City and local authorities having jurisdiction over the area in which the work is to be performed.
- G. All class 1 control wiring conduit shall be run with not more than 30% fill based on inside conduit diameters and cross-sectional area. This provision is for future modifications or additions to the control system.
- H. All conduit carrying shielded twisted pair cabling, communication, or signal, Class 2 wiring, shall be sized for a maximum of 40% fill based on inside conduit diameter and cross-sectional area. This provision is for future modifications or additions to the control system.
- I. All wiring shall be run in conduit. All Class 1 power wiring shall be run in conduit. All Class 2 signal wiring, low voltage control type, shall be run in conduit. No exposed wiring of any kind will be allowed. Class 2 signal wiring may be installed without conduit but only when installed above fully accessible lay-in ceilings and if run-in plenum rated cable supported independently from structure and run parallel and perpendicular to the structure.

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- J. All conduit shall be 3/4 inch size minimum, except raceways terminating at control devices manufactured with 1/2" knock-outs, i.e., conduit from junction box to smoke or fire detectors (local single device wiring only).
- K. Electrical Systems Installer on project may perform temperature control conduit and wiring installation on project only that this portion of work shall be bid directly to the Temperature Control Systems Installer, and all work in relation to temperature control wiring shall be done subordinate to this Section of the Specifications. Wiring terminations shall be under this Section of the Specifications.
- L. Under this Section of Specifications, coordinate the furnishing and installation (by the job site electrician), at an early stage of construction (when walls are being constructed) galvanized steel back boxes for all wall mount space sensors, suitably secured with 3/4" EMT routed to four inches (4") above an accessible ceiling. This will also require the installation of pull wire for installation of sensors and related wiring at a later stage of construction under this Section of Specifications.
- M. Work Not Included Under this Section of Specifications: The Electrical Systems Installer shall provide:
 - 1. Branch circuit and motor feeder circuit conductors, raceway, connections, and overcurrent protection for each motor or item of equipment furnished by the Owner or other Contractors.
 - 2. Installation of motor controllers furnished by the Owner or other Contractors, along with branch circuit and motor feeder circuit conductors, raceway, and connections in accordance with the manufacturer's approved wiring diagrams.
 - 3. Disconnect switches, where indicated on the drawings or required by codes, except as provided as an integral part of manufactured equipment.
 - 4. Power supply conductors, raceway, connections, and over-current protection for input power to HVAC Temperature Controls, HVAC Automation, and HVAC Energy Management Systems in accordance with approved rough-in and connection diagrams furnished by the system suppliers only when shown on Division 26 Drawings.
 - 5. The above represents an outline of the work for the purpose of describing one division of the work which is acceptable to insure that all work is contained within the General Contract. The Contractor is fully responsible for the installation of complete, operating systems in accordance with the functional intent of the specifications.
 - 6. Nothing herein shall be construed to confine the Contractor from assigning the work to any single member or group of systems installers deemed best suited for executing the work to effect completion of the contract. Refer to specific bidding instructions of the General Contract for the actual division of the work.
 - 7. Installation of all control conduit in walls to accessible above ceiling space.
- N. Work Included Under this Section of the Specifications: The Mechanical Systems Installer shall provide:
 - 1. Motors and equipment, erected in place and ready for final connection of power supply wiring, along with manufacturer's approved wiring diagrams.
 - 2. Motor controllers, in suitable enclosures and of the type and size in accordance with the manufacturer's recommendations and NEMA requirements, along with properly sized overload elements or devices which are normally provided as part of manufactured equipment.
 - 3. Disconnecting switches or devices which are normally provided as a part of manufactured equipment.
 - 4. Rough-in and connection diagrams for input power supply and connections for the HVAC Temperature Control, HVAC Automation, and HVAC Energy Management Systems.
 - 5. The above represents an outline of the work for the purpose of describing one division of the work which is acceptable to insure that all work is contained within the General Contract. The Contractor is fully responsible for the installation of complete, operating systems in accordance with the functional intent of the specifications.
- O. Contractor, under this Section of the Specifications, shall insure the furnishing and installation of:
 - 1. All new branch circuit wiring, conduits, protective devices and accessories for power wiring to serve new control panels, control transformers, electric control dampers and valve actuators, combination fire-smoke dampers and any other control system power requirements where not shown to be performed by others. Field verify spare electrical circuits available where applicable. Do not tap into existing branch circuits without approval by the Owners Representative. Run all new circuits back to electrical feeder panels.
 - 2. Conductors and raceways for the HVAC temperature control, HVAC automation, and HVAC Energy Management System in accordance with approved rough-in and connection diagrams furnished by the system suppliers.
 - 3. Termination of all conductors, raceways, devices, and connections for low voltage systems for the HVAC Temperature Control, HVAC Automation, and HVAC Energy Management Systems in

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accordance with the provisions of Division 26, and approved systems shop drawings to provide complete operating systems in accordance with the functional requirements of the specifications.

- P. Wire all safety devices in series to include freezestats, firestats, smoke detectors, and static pressure high limit controls; any single device when tripped, shall de-energize air handling equipment.
- Q. Wiring Requirements shall also include the following:
 - 1. The conduit/wiring system required for the basic electric controls and Energy Management System shall be a complete and operating system. Conduit sharing with other unrelated electrical systems is not permitted.
 - 2. All wiring shall be labeled at both ends and at any spliced joint in between. Wire and tubing shall be tagged using 3M, Scotch Code Write On Wire Marker Tape Identification System; product number SWD-R-11954 with 3/4" x 5/16" write-on area or SLW 12177 with 1" x 3/4" write-on area and with 3M Scotch Code SMP Marking Pen. In addition to tagging at field device end and at spliced joints, a tag shall be placed 6" after entering each DDC panel. Identification and tag information shall be included in engineering/wiring submittal which must be submitted for Owner approval prior to beginning work. Tag information shall coincide with equipment/point information as written in the specification Input/Output summary.
 - 3. Digital Input (D.I.) wiring (Class 2) may be run in a common conduit with Digital Output (D.O.) Wiring (Class 1) where local codes permit.
 - 4. Analog Input (A.I.), Analog Output (A.O.), Digital Input (D.I.), and Network Communications Trunk (N.C.T.) wiring may be run in a common conduit.
 - 5. Digital Output (D.O.) wiring run in a common conduit with Analog Input (A.I.), Analog Output (A.O.), or Network Communication Trunk (N.C.T.) is not permitted under any circumstances.
 - 6. AC line power to DDC panel shall be #12 THHN.
 - 7. Digital Output (D.O.) wiring shall be #14 THHN.
 - 8. Digital Input (D.I.), Analog Input 4-20 mA (A.I.) and Analog Output (A.O.) wiring shall be #18 TSP (twisted shielded stranded pair with drain wire).
 - 9. Analog Input or voltage types (A.I.) wiring shall be #18 TSP (twisted shielded stranded pair with drain wire).

2.11 GENERAL

- A. System shall be installed complete with DDC panels, remote panels, thermostats, sensors, control dampers, all actuators, switches, relays, alarms, etc., in accordance with the extent of the sequences of operation. Provide all auxiliary equipment required. All controls shall be installed under this section of work, with the exception of automatic dampers and pressure sensing devices which shall be installed under Section 23 3000.
- B. Control Systems manufacturer shall submit a complete and final check list verifying final calibration and set points for each system prior to final construction review.
- C. Complete control drawings shall be submitted for approval before field installation is started. The submittals shall give a complete description of all control devices and show schematic piping and wiring, as well as a written sequence for each operation.
- D. All control dampers shall be furnished by Control manufacturer and shall be set in place, under other sections of the specifications, and be adjusted for proper operation, including the installation of necessary linkages with actuators under this section of specifications. Contractor shall also furnish, under other sections of the specifications, install any necessary blank-off plates required to fill duct when damper size is smaller than the duct. All outside and relief air damper frames and blank-off plates shall be caulked air tight with non-hardening silicone caulking to the ductwork or frame opening.
- E. Work under this section shall regulate and adjust the control system, including all thermostats, relays, motors, and other equipment provided under this contract. They shall be placed in complete operating condition subject to the approval of the TAB firm. Contractor shall cooperate fully with the balancing agency in the testing, check-out and adjustment of the various systems. Contractor, under other sections of these specifications, shall install all and automatic dampers.
- F. Control system herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from the date of "Substantial Completion", any of the equipment herein described is proven to be defective in workmanship or material (except electrical wiring done by others), it shall be adjusted, repaired, or replaced free of charge.

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PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATION - AIR COOLED CHILLER

- A. The liquid chiller system shall be energized by the Energy Management System and software interlocked to run when any air handling unit or group, as designated by the Engineer, or fan coil units served with chilled water is energized, requires cooling and the economizer cycle cannot meet load demand. Provide manual disconnect for each control circuit.
- B. Provide a primary chilled water return temperature sensor set at 52 degrees F., adjustable, to energize the primary chilled water pump and the chiller.
- C. Chiller capacity shall be controlled by individual chilled water discharge thermostats for each chiller, set at 42 degrees F. (adjustable).
- D. Chiller safety and operating controls shall be master over auxiliary controls.
- E. Chiller shall be turned on only after the primary pump has started and proof of flow is made in both the evaporator. Flow switches are differential pressure type furnished under other Sections of these Specifications. Chillers shall be turned off 15 minutes, adjustable, prior to the respective primary pumps being de-energized unless the chiller manufacturer allows this time to be decreased.
- F. Provide differential pressure flow switches, under this Section of the Specifications, if not specified to be furnished with the chillers, in the chilled water lines to prevent chiller operation unless flow is proven. Flow switches shall be located between isolation valves and chillers. Utilize McDonnell & Miller differential pressure type switches.
- G. Provide other interlocking relays to de-energize pump as required by safety controls of chiller manufacturer, under this section of the specifications.
- H. A variable frequency drive (VFD) shall be utilized, for control of primary chilled water pump, and shall be provided under other Sections of these Specifications. Control and interlock wiring through motor controllers shall be performed under this Section of the Specifications. Wiring shall be such that the pump shall be capable of turning "On" in the hand position without energizing the chiller or other interlocks that should operate only when turned on in the automatic position. However, all safety devices shall be wired to operate in both the "Hand" and "Auto" positions.
- I. A flow meter shall be installed in the chilled water return piping upstream of the pump. A bypass line between the chilled water supply and chilled water return piping with a modulating 2-way Control Valve that is normally closed will be utilized to maintain the minimum water flow to the chiller.

3.2 SEQUENCE OF OPERATION - CHILLED WATER DISTRIBUTION PUMP

- A. Chilled Water Distribution Pump CHP-1 shall distribute chilled water to the building for cooling effect.
- B. Provide manual disconnect for the control circuit. Additionally provide for Hand-Off-Automatic (H.O.A.) switch control through the individual motor controller, controllers furnished under other Sections of these Specifications, for each pump. Only the pump served shall operate through the "Hand" position, to include full functioning of all safety devices. In the "Auto" mode, both safety and interlock wiring shall function as specified. This wiring shall be performed under this Section of the Specifications.
- C. Chilled Water Distribution Pump CHP-1 shall operate anytime an air handling unit, or group of units, or designated group of fan coil units is operating and requiring cooling, during building cool-down, night set-up and during the freeze protection mode. Each pump shall be started at minimum pump manufacturers recommended speed and ramp up to maintain the system design differential pressure set point.
- D. Provide one (1) differential pressure sensors with transmitters at the chilled water coil of AHU-4 in the second floor Mechanical Room. The design differential of greatest demand shall be maintained through the variable frequency drive modulating the speed of the active distribution pump. The design differential shall be the combined pressure drop of the control valve and the cooling coil, and shall be field determined by the Testing, Balancing and Adjusting (TAB) Agency. Utilize a 30 PSIG range differential sensor. Provide test tee with gauge cock for TAB firm testing.
- E. During chilled water distribution system freeze protection, all inactive air handling unit and fan coil unit chilled water valves shall be open to the coil and the chilled water distribution pump shall be activated and maintain the design differential water pressure set point. This sequence shall be activated by software any time the outside air temperature is below 35 Deg.F., the building is secured (generally unoccupied); air handling and fan coil units are generally all off, and not operating in a night set-back or morning warm-up mode.

3.3 SEQUENCE OF OPERATION - AIR HANDLING UNITS (4 PIPE)

- A. The fan control circuit shall include all safety controls, an H.O.A. Switch, timer (EMS) energized controls, and a manual disconnect switch.

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- B. Safety controls shall consist of but not be limited to the following:
 - 1. Building fire alarm relay as required by local code.
 - 2. Return air duct smoke detectors.
 - C. With all safety controls closed and the H.O.A. Switch in the "auto" position, the fan circuit shall be controlled by the EMS. Start chilled or heating water system, if not already operating, whenever any air handling unit is started.
 - D. A low limit thermostat in the mixed air stream is required as the outside air is not preheated prior to delivery to the air handling equipment.
 - E. Ionization smoke detectors shall be provided in the return air ducts and shall stop the air handling unit whenever products of combustion are sensed for units over 2000 CFM in capacity.
 - F. The supply fan is of the constant volume type and space temperature shall be controlled by a room temperature sensor which will modulate a two or three-way, normally closed, control valve on a chilled water coil sequenced with a heating water coil two or three-way, normally open, control valve, no simultaneous heating and cooling. Both valves shall close when the fan is de-energized except during the freeze protection mode; in which case, they shall both open (fan off). The cooling set point shall be 74 Deg. F. and the heating set point shall be 71 Deg. F. The offset shall be a minimum of 2 Deg. F. All set points shall be adjustable.
 - G. A minimum outside air pressure independent single duct constant volume terminal damper (N.O.) shall open when the fan is energized and close when de-energized. No vent cycle to be provided.
 - H. When the O.A. temperature is sensed below 30 degrees F., close the O.A. damper.
 - I. Provide for a normal, morning warm-up, morning cool-down, night set-up and night set-back modes of operation as indicated elsewhere herein. Outside air damper to remain closed during all but the normal mode of operation.
- 3.4 SEQUENCE OF OPERATION - AIR HANDLING UNITS (2 PIPE - ELECTRIC HEAT)
- A. The fan control circuit shall include all safety controls, an H.O.A. Switch, and timer (EMS) energized controls.
 - B. Safety controls shall consist of but not be limited to the following:
 - 1. Building fire alarm relay as required by local code.
 - 2. Manually reset adjustable freezestat(s).
 - 3. Return air duct smoke detector, manually reset.
 - C. With all safety controls closed and the H.O.A. Switch in the "auto" position, the fan circuit shall be controlled by the EMS. Start chilled system, if not already operating, whenever any air handling unit is started.
 - D. A low limit thermostat in the mixed air stream, upstream of the water coil, shall stop the air handling unit when the temperature falls below setpoint, field adjustable, of 40 Deg.F. Freezestat shall have a minimum 20 feet long element and shall be sensitive to temperature changes along any 12 inch length. Element shall be installed in a serpentine fashion with element parallel to the horizontal. The element shall extend across the unit cross-section (coil width) a minimum of three times. If this cannot be achieved with one element, then multiple freezestats shall be used. All freezestats and other safety devices shall be wired in series.
 - E. Ionization smoke detector shall be provided in the return air duct and shall stop the air handling unit whenever products of combustion are sensed.
 - F. Each supply fan is of the constant volume type and will be served by a variable frequency drive to allow the unit to be switched from off to 50% speed or up to 100% speed based on load and dependent on whether the unit is in either the cooling or heating mode. Space temperature shall be controlled by a room temperature sensor which will first start the AHU initially at 50% speed after which a two-way, normally closed to the coil, chilled water coil control valve shall modulate, as required, to meet the cooling set point. With the AHU fan operating at 50% speed, the chilled water control valve at 100% open, adjustable, and upon a further increase in demand for cooling in the space the fan speed shall be increased to 100%. The cooling control valve shall continue to modulate as required to satisfy set point. When the load decreases such that the corresponding chilled water control valve closes to a 40% open, adjustable, or less position, then the fan speed shall be reduced back to 50% speed. Once the chilled water valve closes fully and there becomes a demand for heat, the fan shall go to full (100%) speed. The heating control valve shall modulate as required to satisfy set point, however, the discharge air temperature shall be limited to 85 Deg.F., adjustable, during the heating mode. A normally closed (N.C.) minimum outside air damper shall open when the fan is energized in the normal mode and close when de-energized.

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- G. Provide interlocks for minimum outside air and ventilation cycle control as follows:
1. When the AHU is energized and operated in the occupied mode the normally closed minimum outside air control damper, shall open to minimum quantity scheduled except during morning warm-up, morning cool down, night-setback or night set-up as described elsewhere herein in which case it shall be closed. The minimum outside air control dampers shall be closed when the respective AHU served is not operating.
 2. Maximum outside air control for the ventilation cycle shall consist of the sequenced opening of the separate normally closed (N.C.) maximum O.A. dampers, and the closing of the normally open (N.O.) return air dampers to maintain the space temperature set point. Ventilation cycle shall be energized when the outside air temperature drops to 55 Deg.F., field adjustable. Normally closed (N.C.) relief air dampers shall be interlocked to operate in sequence with the maximum O.A. dampers or based on the space pressurization control sequence.
 3. Provide a low limit mixed air plenum thermostat, separate from the system freezestat(s), serpentine capillary sensor, to override the ventilation cycle controls to prevent supply air less than 52 Deg.F. from entering the system. This shall include modulated closing of the maximum outside air dampers to maintain the set point.
 4. Provide for independent control and adjustment for each of the minimum and maximum outside air dampers and the return and relief air dampers to provide for maximum flexibility in optimizing system performance.
 5. The economizer cycle shall be the optimized type such that the chilled water valve shall remain closed until the economizer is utilizing 100% outside air for cooling and it cannot satisfy the designated cooling set point.
- H. When O.A. temperature is sensed below 30 degrees F., adjustable, close the O.A. dampers and fully open the return air dampers.
- I. Provide normal (occupied), morning warm-up and cool-down (unoccupied), and night set-back and set-up (unoccupied) modes of operation similar to that specified elsewhere herein. Outside air dampers shall remain closed during all but the normal occupied mode of operation.
- J. Whenever the outside air temperature is above 57 Deg.F., adjustable, the air handling unit is operating in the normal occupied mode, and the space relative humidity level rises to above 60% R.H., adjustable, the chilled water control valve shall modulate open to effect further dehumidification regardless of whether the space temperature set point is satisfied. Should over-cooling of the space occur, the electric duct heater shall modulate to maintain the normal heating set point.
- 3.5 SEQUENCE OF OPERATION - FAN COIL UNITS (4 PIPE)
- A. The fan control circuit shall include all safety controls, an H.O.A. Switch, timer (EMS) energized controls, and a manual disconnect switch.
- B. Safety controls shall consist of but not be limited to the following:
1. Building fire alarm relay as required by local code.
 2. Return air duct smoke detectors.
- C. With all safety controls closed and the H.O.A. Switch in the "auto" position, the fan circuit shall be controlled by the EMS. Start chilled or heating water system, if not already operating, whenever any air handling unit is started.
- D. A low limit thermostat in the mixed air stream is required as the outside air is not preheated prior to delivery to the air handling equipment.
- E. Ionization smoke detectors shall be provided in the return air ducts and shall stop the air handling unit whenever products of combustion are sensed for units over 2000 CFM in capacity.
- F. The supply fan is of the constant volume type and space temperature shall be controlled by a room temperature sensor which will modulate a two or three-way, normally closed, control valve on a chilled water coil sequenced with a heating water coil two or three-way, normally open, control valve, no simultaneous heating and cooling. Both valves shall close when the fan is de-energized except during the freeze protection mode; in which case, they shall both open (fan off). The cooling set point shall be 74 Deg. F. and the heating set point shall be 71 Deg. F. The offset shall be a minimum of 2 Deg. F. All set points shall be adjustable.
- G. A minimum outside air pressure independent single duct constant volume terminal damper (N.O.) shall open when the fan is energized and close when de-energized. No vent cycle to be provided.
- H. When the O.A. temperature is sensed below 30 degrees F., close the O.A. damper.
- I. Provide for a normal, morning warm-up, morning cool-down, night set-up and night set-back modes of operation as indicated elsewhere herein. Outside air damper to remain closed during all but the normal mode of operation.

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3.6 SEQUENCE OF OPERATION - NIGHT SET-BACK

- A. A night set-back mode shall be provided to keep equipment from operating except as needed to heat the space to protect the building systems from freezing and potential water damage.
- B. Designate a space temperature sensor, to be located on an interior partition within 8 feet of a Northern exposure, selection as recommended by the balancing agency, to be used for night set-back control. Sensor, adjustable, shall be set for 55 Deg.F. Provide one per AHU or system.
- C. Below set-back set point, respective Split DX A/C units shall receive a control signal and shall be started if not already energized.
- D. Lockout cooling systems, ventilation cycles, morning warm-up and cool-down modes, night set-up mode, close all outside and relief air dampers and de-energize all EMS controlled toilet and locker exhaust fans located in the spaces served.

3.7 SEQUENCE OF OPERATION - MORNING WARM-UP MODE

- A. A warm-up mode shall be provided to warm the building, or area served by a system, to within 1 Deg.F. of the normal occupied heating setpoint, adjustable of 71 Deg.F., through the building Energy Management System optimized start feature.
- B. Warm-up shall function the same as night setback, except the set point shall be as noted above.
- C. Lockout the warm-up mode after the cycle is completed until the following scheduled cycle, generally not to occur more than once per day.
- D. Lockout cooling systems, ventilation cycles, night set-back, morning cool-down, night set-up, close all outside and relief air dampers and de-energize all EMS controlled toilet and locker exhaust fans.

3.8 ELECTRICAL INTERLOCKS

- A. Certain electrical interlocks shall be as listed herein and in other sections of these specifications.
- B. All electrical interlocks shall be made by means of auxiliary contacts on motor starters or shall be accomplished with separate relays unless indicated otherwise. No motor power lead shall be utilized in an interlock circuit, unless indicated otherwise. Each separate control power lead serving a starter shall be provided with a disconnecting switch suitably identified and housed, which may be a toggle switch or other suitable disconnecting device, of proper capacity and number of poles.

3.9 TEST, ADJUST, AND BALANCE SUPPLEMENTARY PROVISIONS

- A. Under this section of the specifications, provide a temperature test port adjacent to all duct mounted EMS sensor locations. Additionally, furnish any other permanent test tees or wells for sensor calibration and for verification of all system monitoring data.
- B. Under this section of the specifications, provide all pressure taps, sensors, wiring/cabling, etc., to be connected to the Energy Management System to include all points necessary for the sequence of operations specified hereinafter.
- C. Assist the TAB Agency in all sensor calibration and during all functional performance testing of controls, basic and devices and EMS controlled equipment.

3.10 DDC CONTROL

- A. Provide complete DDC Control for all equipment as indicated elsewhere herein.
- B. Not more than one local unitary direct digital controller shall be utilized per AHU/piece of equipment. Each DDC controller used for Global System control and for air handling units shall have their own real time clock.

END OF SECTION 230900

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SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with all other Division 23 Sections, as applicable. Refer to other divisions for coordination of work with other portions of Work.

1.2 SYSTEM DESCRIPTION

- A. Furnish and install all piping of every kind required, specified, or shown on the Drawings for the installation of the work specified in Division 23. The location, direction, and size of the various lines are indicated on the Drawings.
- B. Piping systems shall include all appurtenances shown on the drawings and specified herein.
- C. Valves or cocks shall be installed to control the flow of water to each of the various systems, to segregate individual items of equipment and parts of fluid circulating or supply systems, and to permit draining of systems or portions thereof, to blow-off strainers, etc., as directed on the Drawings and specified.
- D. The work shall include the furnishing and installing of all supporting structures and members for pipes, ducts, and equipment.
- E. Support devices and members shall include vibration and noise isolating devices and assemblies. Penetrations of walls to structure shall be sealed off to limit noise transmission through sleeves.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the best quality.
- B. All equipment and materials shall be installed by experienced mechanics certified and trained for the work performed.

1.4 SUBMITTALS

- A. Product Data: Submit complete manufacturer's descriptive literature and installation instructions in accordance with Division 1 for all piping materials to be used for each system, valves and hydronic specialties as specified herein.
- B. Shop Drawings:
 - 1. Submit in accordance with Division 1 and 23 05 00.
 - 2. Submit 1/4" = 1'-0" Scale HVAC and Plumbing Piping Shop Drawings.
 - 3. Overlay piping Shop Drawings over other Shop Drawings of other trades to include electrical and sheet metal Shop Drawings.
 - 4. Plan views of congested areas and sections thereof shall be drawn at a scale of 3/8" = 1'-0".
- C. Fully coordinate all piping shop drawings with sheet metal shop drawings and other trades. Failure to submit shop drawings in a timely manner, as required to keep pace with the construction and work of all other trades, will result in delays, and possible stoppage, of payment to the Contractor. Additionally, no work may proceed until such shop drawings are submitted, reviewed, and found to be acceptable by the Engineer.

1.5 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall and will be rejected.
- B. Storage and protection of materials shall be in accordance with Section 23 05 00.
- C. Take special precautions to protect control valve internals from construction dirt and debris. If valves are stored on site cover valve openings until just prior to installation but in no case shall valves be unprotected for more than 48 hours.
- D. Openings in piping system, coil headers, boilers, pumps, valves and other heat exchangers shall be covered during the construction period to protect the interior accumulation of dirt and debris in these systems until immediately prior to connection to these components to similarly protected systems.

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PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. In general, the following listed materials shall be used in fabricating the piping systems. Where special classes of piping are involved and are not listed, the Contractor shall request instructions as to the class of material involved and the method of fabricating it before ordering the materials. Steel pipe 2-1/2" and larger shall generally have plain ends to be assembled by welding and pipe 2" and smaller shall generally have screwed ends, except where special requirements dictate otherwise.
 - 1. Chilled and Heating Water Lines:
 - a. Schedule 40 black steel pipe conforming to ASTM A-53, Type "F" for sizes 2" and smaller, and Grade "B", Type "ERW, for all sizes 2-1/2" and larger. Piping 12" and larger weight piping.
 - b. For pipe sizes two inches (2") and smaller the Contractor may use Type "L" copper, with soldered joints, in lieu of threaded black steel pipe, using dielectric unions as specified elsewhere herein.
 - 2. Miscellaneous drains from Air Handling Units, Fan coil units, Pump Bases, strainer blow-offs, backflow preventors and compression tanks: Type "M" or DWV (1-1/4" and larger) hard drawn copper.
 - 3. Miscellaneous Lines: Pilot, bleed, control, sampling, and equalizing lines, and similar auxiliary lines shall be fabricated of the material used in the system to which they are connected in each case. Drains from appurtenances installed in copper lines shall be of Type "L" hard drawn copper tubing. Drains from air vent valves installed in steel piping systems shall be Schedule 40 black steel pipe. Other drains shall similarly match the piping system materials.
 - 4. Chemical treatment piping and valves shall be Schedule 80 PVC or Type "L" hard drawn copper, up to final connections to the main system which shall be schedule 40 black steel or Type "L" hard drawn copper.
- B. Steel pipe shall be made and tested in accordance with the latest edition of the "Standard Specifications for Welded Steel Pipe" of the National Tube Company, or Youngstown Sheet and Tube Company. Piping 2" and smaller shall be manufactured by LeClerc, Sawhill, or Wheatland. Piping 2-1/2" and larger shall be manufactured by Tex-Tube, Paragon, U.S. Steel, Wheatland or Armco. Unless otherwise specified, all pipe shall be Schedule 40 of ASA Standard B36.10.
- C. In general, fittings used for the various piping systems shall be as listed below. Special fittings shall be used where required by job conditions and when approved for particular use.
 - 1. Welding Fittings: All fittings in welded lines shall be factory fabricated welding fittings of the same material and the same schedule or weight as the piping system in which installed.
 - a. All elbows, reducers, tees, caps and special fittings shall be standard factory fabricated butt welding fittings, conforming to ANSI B16.9, with the following exceptions: Branch takeoffs from lines 2-1/2" in size and larger and where the size of the takeoff does not exceed two-thirds of the nominal diameter of the mains to which connected may be made with shaped nipples or with Bonney or Grinnell Weldolets or Thredolets as required by the class of fabrication. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
 - b. Welding fittings shall be Weldbend Corporation, Tube Turn, Hackney, or approved equals. Welding and fittings shall have the same bursting pressure as pipe of the same size and schedule. All elbows shall be the long radius type unless noted otherwise.
- D. Screwed Fittings in Steel Lines: 150 lb. black malleable iron banded pattern screwed fittings made by Grinnell Company, Crane Company, or Walworth Company. All screwed fitting elbows shall be the long radius type unless noted otherwise.
- E. Fittings for copper tubing shall be Chase Sweat Fittings, Nibco, Elkhart, or Mueller Brass Company's "Streamline" type solder fittings. Drainage type fittings shall be used wherever possible in drainage systems only. All solder for copper tubing shall be 95-5, Silfos or Eutectic No. 180F. All piping shall be installed according to the manufacturer's instructions. All joints shall be thoroughly cleaned before connecting. Silfos solder shall be used on all refrigerant piping. All elbows shall be the long radius type unless noted otherwise.

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- F. Miscellaneous Fittings: Provide all reducers, increasers, adapters, bushings, etc., as required to properly inter-connect the various items, to change sizes, etc. Steel fittings shall be used in steel lines, and copper and red brass fittings shall be used in copper lines.
- G. All piping materials and fittings shall be manufactured in the United States.

2.2 GROOVED PIPE AND FITTINGS

- A. Grooved steel pipe and fittings shall comply with all requirements specified above in Paragraph 2.1 except as otherwise stated herein.
- B. Grooved steel piping shall only be allowed for the following systems:
 - 1. Chilled Water Lines located outdoors.
 - 2. Chilled and Heating Water Lines inside Mechanical Equipment Rooms (Air Handling Equipment) only.
 - 3. Chilled Water Lines located in areas outside Mechanical Rooms.
- C. For pipe sizes 2" through 12" the Contractor shall use roll grooved pipe and installation-ready, angled bolt-pad Victaulic couplings with grade "EHP" gaskets that are rated to NDF 61 for hot and cold water systems. For pipe sizes 14" and larger Contractor shall use Victaulic advanced grooved system couplings with grade "E" gaskets that are rated to the NSF 61 for hot and cold water systems. Rigid type couplings shall be used except to accommodate thermal expansion/contraction or elimination of expansion loops, vibration attenuation to eliminate flex connectors, or accommodating seismic movement.
- D. Grooved Fittings: All fittings in grooved piping systems shall be of the same manufacturer as the grooved couplings.
- E. All elbows, reducers, tees, caps and special fittings shall be ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A53M, Type F, E or S, grade fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts locking pin, locking toggle, or lugs to secure grooved pipe and fittings. All elbows shall be the long radius type unless noted otherwise.
- F. Grooved Fittings to Flange Adapters: For use with grooved steel pipe and fittings to mate up to ANSI Class 125/150 flanges. Use Victaulic Style 641/741/W741 adapters.
- G. In lines assembled with grooved mechanical couplings and/or screwed joints, use a Victaulic type (Style 47) dielectric nipple, or coupling, to separate dissimilar metals (steel to copper/brass).
- H. All grooved pipe, fittings, gaskets, valves and accessories shall be rated for -30 to +250 Deg.F. for pipe sizes 2" to 12" and -30 to +230 Deg.F. for pipe sizes 14" - 24", with pressure ratings up to 200 PSIG at the highest temperature rating.
- I. Valves in grooved pipe systems may be the grooved type where suitable grooved style valves exist. All grooved style valves shall meet all of the same valve requirements specified for the same size valves specified in Paragraph 2.6.
- J. Grooved style plug valves shall be Victaulic Series 377 or approved equals only.
- K. Grooved style check valves in pump discharge lines shall be non-slam type silent check valves, Victaulic - Series 716/779/W715, or approved equals only.
- L. Grooved Style Swing Check valves 2-1/2" and larger shall be the swing-type, Victaulic - Series 712/713, or approved equals only.
- M. Grooved style butterfly valves shall be Victaulic Series 608/761/W706/W715, or Nibco GD4765 Series or approved equals only.
- N. Grooved style pump suction diffuser/flow straighteners, at the Contractor's option, shall be the grooved model Victaulic Series 731/W731, or approved equals only.
- O. Grooved style triple duty valves, at the Contractor's option, shall be the Victaulic grooved-end triple service assembly that incorporates the combination of shut-off, throttling and non-slam check-balancing valve or venture check valve.
- P. Grooved style wye stainers shall be FDA approved, heat fused epoxy coated (interior and exterior) "Y" pattern type bodies, unless shown or specified otherwise, and shall be Victaulic Series 732/W732/730/W730 or Engineer approved equals only.

2.3 FLANGES

- A. Flanges in welded lines for water systems shall be 150 pound forged steel, welding neck flanges, except where cast iron fittings are used as specified elsewhere in these specifications, and except as otherwise shown.
- B. Flanges in screwed ferrous lines shall be 125 pound cast iron or 150 pound forged steel screwed flanges.
- C. Where ferrous flanges connect to flat faced flanges on valves, items of equipment, etc., the companion flange shall be flush faced and where the flanges on items of equipment are raised face flanges, the companion flanges shall have raised faces.

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- D. Flanges in copper lines shall be solder joint type cast brass flanges.
- E. Flange bolts and nuts shall conform to the applicable requirements of the latest edition of the Code for Pressure Piping.
- F. Slip-on welding neck flanges are prohibited.
- G. Flanges shall be Weldbend, Tube Turn, Hackney, or approved equals.

2.4 GASKETS

- A. Install gaskets between flanges of all flanged joints. Where used with brass or bronze flanges or with flat face ferrous flanges, they shall be full face type. For all other flanges they shall be ring gaskets properly cut to fit within the inside edges of the bolts.
- B. Gaskets in water lines shall be Garlock No. 24 Wire Insertion Red Rubber Sheet Packing, 1/16" thick and for any other systems use special materials suitable for the duty as recommended by their manufacturer.

2.5 INSULATING FITTINGS

- A. Except that no dielectric fitting shall be installed in connections between copper or brass and sanitary cast iron waste, drain and vent lines, wherever an interconnection is made between ferrous pipes or vessel and copper tubing or brass pipe, or vice versa, install a dielectric fitting.
- B. In lines assembled with screwed or soldered joints, use insulating couplings (unions) suitable for the intended service and where flanged connections are required, use insulating gasket material between flange faces, insulating grommets between bolts and holes in flanges and insulating washers under both bolt heads and nuts.
- C. PVC couplings of any kind shall not be acceptable for insulating couplings.
- D. Insulating fittings shall be suitable for the service medium, operating pressure and temperature. Fittings shall be rated for 1.5 times the normal system operating temperature and pressure in which installed.
- E. Insulating fittings shall be as manufactured by EPCO, Watts, Zurn or Mueller Streamline.

2.6 VALVES

- A. All valves of any one type shall be of the same make throughout and insofar as practicable all valves in a given category shall be of the same make.
- B. All valves shall be so located as to be readily accessible for operation and maintenance.
- C. Furnish and install all valves indicated on the Drawings, specified herein, and required to control the flow of water to and from various parts of the systems and to isolate various pieces of machinery and equipment and to isolate various parts of the systems.
- D. Each valve for installation in a line to be insulated shall have sufficient clearance between the valve body and the operating handle or device to accommodate the insulation.
- E. All valves shall be designed for re-packing under pressure when fully opened and shall be equipped with packing suitable for the service.
- F. Valves shall generally be installed with stems up; but, in no case, less than horizontal and whenever possible shall be grouped together in a uniform manner.
- G. Except where special valves are specified elsewhere herein or as required by special conditions or class of work, valves shall be equivalent to the following Crane Co. valve numbers listed herein.
- H. All gate valves 2" and smaller shall be Class 125SWP and 200 PSI CWP rated for up to 200 Deg.F. and be bronze construction. All valves 2-1/2" and larger shall be Class 125SWP and 200WOG rated for 200 degrees F., be of the flanged design, be made of cast iron with bronze trim, and have an outside screw and yoke design.
 - 1. Valves shall have rising stem, screwed bonnet or union bonnet, solid wedge and manufactured in accordance with MSS-SP-80.
 - 2. Body, bonnet and wedge shall be manufactured of ASTM B-62 alloy for valves 2" and smaller and ASTM A126, Class B, cast iron for valves 2-1/2" and larger.
 - 3. All valves shall have ductile or malleable iron handwheels.
 - 4. Stems shall be made of dezincification resistant silicon bronze ASTM B-371 or low zinc alloy B-99.
 - 5. All valves shall be supplied with non-asbestos packing, amarid fibers or approved equal.
 - 6. Where higher operating pressures approach 150 psi, Class 150 Union bonnet valves of similar construction shall be used.
 - 7. Class 125 valves 2" and smaller shall be one of the following:
 - a. Nibco - T/S111.
 - b. Crane - 428/1330.
 - c. Jenkins - 810J.
 - d. Hammond IB640.

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- e. Milwaukee 148.
- 8. Class 125 valves 2-1/2" and larger shall be one of the following:
 - a. Nibco - F-617-0.
 - b. Crane - 465 1/2.
 - c. Jenkins - 454J.
 - d. Hammond IR1140.
 - e. Milwaukee 2885A.
- 9. Class 150 valves shall be one of the following:
 - a. Nibco - T/S134.
 - b. Crane - 431UB.
 - c. Jenkins - 47CUJ.
 - d. Hammond IB629/IB648.
 - e. Milwaukee 1169/1151.
- I. Where cocks are required, they shall generally be brass, screwed pattern up to 2" and cast iron flanged pattern 2-1/2" and larger plug cocks suitable for the system pressure. Also provide and install all special cocks required such as pet cocks, gauge cocks, etc.
- J. Check valves in pump discharge lines shall be flanged non-slam type silent check valves. Valves shall have a cast-iron body and be bronze fitted with stainless steel springs. Valves shall be rated for 125 PSIG WOG and be one of the following products:
 - 1. Nibco - F-910-B Series.
 - 2. Combination Pump Valve (CPV) Manufacturing, Inc.- 20D Series.
 - 3. APCO - 600 Series.
- K. Swing Check Valves 2" and smaller shall be the Y-pattern swing-type manufactured in accordance with MSS-SP 80, and be Class 125 rated to 200 Deg.F. or below, have bronze ASTM B-62 bodies with bronze discs. Swing check valves 2" and smaller shall be of the following:
 - 1. Nibco - T/S-413-B.
 - 2. Crane - 37 or 1340.
 - 3. Jenkins - 4037J or 997AJ.
 - 4. Hammond - IR1124.
 - 5. Milwaukee - 2974A.
- L. Swing Check valves 2-1/2" and larger shall be the swing-type manufactured in accordance with MSS-SP71, be Class 125 rated for 200 Deg.F. or below, be flanged, have ASTM A126, Class B, cast iron bodies with bronze trim, and have non-asbestos gaskets. Swing Check valves 2-1/2" and larger shall be one of the following:
 - 1. Nibco - F-918-B.
 - 2. Crane - 373.
 - 3. Jenkins - 588J.
 - 4. Hammond - IB904.
 - 5. Milwaukee - 509.
- M. Contractor may furnish butterfly valves in lieu of gate valves, where gate valves are indicated, and shall furnish them elsewhere as indicated on the Drawings. Generally, all isolation valves in chilled and heating water lines 2-1/2" and larger shall be the butterfly type.
 - 1. They shall have ductile iron bodies with aluminum bronze discs, 416 stainless steel shafts and shall be generally as specified for plug valves above as to materials, trim, tightness of closing, etc.
 - 2. Liner shall generally be resilient EPDM with brass bushings and collar. Liner and seats shall be rated for 225 Deg. F at 150 PSIG.
 - 3. Valves 2-1/2" and larger shall have lug bodies and resilient seating or have a resilient faced plug.
 - 4. Valves shall be rated for end of line service, without the need for a downstream flange, and be bubble tight to a minimum of 150 PSI with bi-directional flows.
 - 5. Where butterfly valves are used for balancing, only where shown, use infinite position lever lock handles with memory stops similar or equal to Nibco LD/WD 2000/3000. Valves shall be able to have the handles padlocked in the open, closed or balanced positions. Handles shall be polymer coated iron with lever lock and throttling plates made with zinc plated steel. No aluminum die cast lever handles allowed.

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6. Valves 6" and over shall be provided with heavy duty cast iron hand wheel gear operator with indicator. Where these valves are also used for balancing provide with a memory stop. Provide with babbitt sprocket (and chains) only where specified elsewhere herein. Operators shall be suitable for all weather conditions and shall be the self-locking worm gear type.
 7. Provide two inch (2") extension necks for insulated lines.
 8. Butterfly valves shall be as manufactured by
 - a. Nibco LD Series in 2" - 12" sizes and LD1000-5 Series for 14" - 24" sizes.
 - b. Dezurik (or SMG) BRS-C1-EPDM-EPDM-BZ-S4.
 - c. Demco NE-C Series in 2" - 12" sizes and NF-C Series for 14" - 24" sizes.
 - d. Keystone AR2 Series.
 - e. Grinnell Series 8000.
 - f. Apollo LD 141 Series.
 - g. Milwaukee ML233E in 2"-12" sizes only; larger valves not allowed.
- N. Where shown on the Drawings, Contractor shall provide ball valves. In lieu of gate valves, where shown, unless indicated otherwise, the Contractor may furnish ball valves. In chilled and heating water lines 2" and smaller, Contractor shall furnish ball valves without exception as follows:
1. Ball valves shall be on the following products (All bronze bodies only):
 - a. Nibco T-585-70-66 or S-585-70-66.
 - b. Apollo 77C-140 Series or 77C-240 Series.
 - c. Hammond 8303-A or 8311-A.
 - d. Milwaukee BA400 or BA4505 (Not allowed on chilled water systems).
 2. Ball valves may also be used in lieu of plug valves for balancing purposes for lines 2" and smaller and only when provided with memory stops.
 3. Ball valves shall be full port design with stainless steel ball and stem.
 4. All ball valve body pieces and stems shall be manufactured from a dezincification resistant material with less than 15% zinc.
 5. All ball valves shall have a threaded packing gland. Each ball valve will not require the handle and handle nut to be installed in order to keep the valve packing in place.
 6. Provide memory stops where used for balancing or as shown and where detailed.
 7. Provide extended lever handles for all valves installed in insulated lines.
 8. Ball valves installed on chilled water piping shall be provided with an extended "T" handle with insulation insert and collar that creates a vapor seal to prevent condensation while allowing adjustment of memory stops and valve packing maintenance without disturbing the insulation. Insulated "T" handles shall be equal to Nib-Seal as manufactured by NIBCO. No extended metal handles are allowed.
- O. All valves, valve packing material, gaskets, pipe threading compound, etc., shall be compatible with ethylene glycol, without exception. Typically, use PTFE (Teflon) or EPDM valve packing materials. Indicate packing materials used for compliance on submittals.
- 2.7 PIPE HANGERS
- A. Pipe hangers, except for fire protection types, shall be as manufactured by Anvil International, Inc. and be of a type suitable for each use. Approved equals by Mason Industries, Inc., B-Line, Erico Caddy, and PHD Manufacturing, Inc. will be considered.
 - B. For cast-iron pipes up to three inches (3") in size, use Anvil Fig. 104 malleable iron, adjustable, split ring, swivel hanger, or Anvil Fig. 590 steel clevis hanger. For cast iron plumbing piping four inches (4") and larger, use only Anvil Fig. 590 steel clevis hanger.
 - C. Heating and air conditioning piping (chilled and heating water piping) 3/4" in size up to and including twelve inches (12"), shall be Anvil Fig. 260, adjustable clevis hangers. Hangers shall be sized to be on the outside of the insulation.
 - D. Where several pipes are routed parallel to each other and at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where rollers are called for elsewhere by these specifications.
 - E. For bare copper pipes (uninsulated only) up to and including three inches (3") in size, use Anvil Fig. CT-109 malleable iron, copper plated, split ring, hangers or Anvil Fig. CT-65 copper plated clevis hangers. For uninsulated copper pipes larger than three inches (3"), use Anvil Fig. CT-65 copper-plated clevis hanger.

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- F. Hanger rod sizes shall conform to the following schedule:

Pipe up to, and including 2"	3/8" rods
Pipe 2-1/2", 3", and 3-1/2"	1/2" rods
Pipe 4" and 5"	5/8" rods
Pipe 6"	3/4" rods

- G. Unless shown otherwise on the Drawings, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following maximum spacing:

Pipe up to, and including 1-1/4"	8 feet
Pipe 1-1/2" and 2"	10 feet
Pipe 2-1/2" and 3"	12 feet
Pipe 3-1/2" and 4"	14 feet
Pipe 5" and 6"	* 8 feet
* Maximum 8 foot spacing for pipe supports for pipes 5" and larger due to structural considerations.	

- H. Unless shown otherwise on the Drawings, all horizontal runs of copper piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following maximum spacing:

Pipe up to 3/4" in size	6 feet
Pipe 1" and 1-1/4"	8 feet
Pipe 1-1/2" and 2"	10 feet
Pipe 2-1/2" and larger	12 feet

- I. There shall be a hanger within two feet (2') of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps. Vertical pipes within a space shall have not less than two (2) supports. Where the vertical run of pipe in a space exceeds 14 feet then three (3) supports shall be required.
- J. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting; nor shall it be supported from equipment connections.
- K. Inserts shall be used where piping or equipment is to be hung from concrete construction. Inserts shall be Anvil Fig. 281, wedge type, concrete inserts. All inserts shall be pre-treated to prevent rusting. After the forms are removed, clip off all nails flush with the exposed surface of the inserts.
- L. Expansion bolts shall be Ackerman-Johnson.
- M. Beam clamps suitable for the use with the type of steel construction involved shall be an Anvil product or an approved equal as indicated elsewhere herein.
- N. No perforated straps shall be used to support any mechanical equipment item or piping of any kind.
- O. Chilled water, heating water, condensate drains, shall be sized to go around the insulation with shields being provided to protect the insulation. Shields shall be Anvil Fig. 167.
- P. All steel hangers, base plates, supports, nuts, bolts, and all thread rod located outdoors, in crawl spaces, and exposed to the weather, shall be made of galvanized steel or equally suitable corrosion resistant steel alloy or aluminum. Where steel components are allowed and used under these conditions they shall be painted with an equivalent protective coating similar to a two-part epoxy.
- Q. For pipe sizes 8" and under use Anvil Fig. #93 and 94 beam clamps.

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2.8 SLEEVES AND ESCUTCHEONS

- A. Generally where pipes pass through interior building walls or floors above the first floor (out of the ground), 22 gauge galvanized sheet metal sleeves shall be used. Sleeves shall extend a minimum one inch (1") above a floor or beyond the wall, as applicable.
- B. All pipes penetrating grade beams, exterior walls, concrete structural members, or concrete slabs of mechanical equipment rooms on the first floor shall generally use standard weight galvanized steel pipe as the sleeving material.
- C. For concrete or masonry walls, sleeves shall be inserted into the masonry, decking or form work prior to the pouring or placement of concrete or masonry units to create a leave out.
- D. The sizes of all sleeves shall be such as to permit the subsequent insertion of the intended pipe of the proper size with adequate clearance for movement due to expansion and contraction. In the case of insulated lines, the diameter of the sleeves shall be at least 1/2" greater than the outside walls of the pipe with specified thickness of insulation. This will require that the inside diameter of galvanized steel pipe sleeves be at least 1/2" greater than the outside diameter of the service pipe with insulation. Galvanized steel pipe sleeves set in floors shall project two inches (2") above the floor.
- E. After the pipes are installed, fill the annular space between the pipe, and insulation as required, and its sleeve with an approved mastic or caulk. Use loose fibrous insulation packing as required to accomplish this. In all cases the annular spaces around the pipes within the sleeved openings shall be filled with loose fibrous insulation and then sealed with an approved caulking or expanded foam insulation.
- F. Escutcheons, except as specifically noted or specified, shall be installed on all pipes passing exposed through floors, walls, or ceilings. Escutcheons shall be equal to the Crane No. 10, chrome plated sectional floor and ceiling plates, and shall fit snugly and neatly around pipe or pipe insulation or insulated lines. Solid chrome plates with set screws shall be used if sectional plates do not fit properly or stay in place. Where multiple pipes penetrate floors or walls in close proximity in concealed areas, shop made sheet metal escutcheons may be used.
- G. Pipes sleeved through grade beams open to basements, crawl spaces or void spaces below grade shall additionally receive "Link Seal" or equal closures made of interlocking synthetic rubber links. Seals shall provide for absolute water tightness. Seal shall be constructed to insulate electrically pipe from wall. Install as recommended by manufacturer. Provide Century-Line sleeves with water stop and anchor collar for pipes penetrating grade beams designated to be anchored.

2.9 ACCESS DOORS

- A. Wherever access is required above inaccessible ceilings, in walls, furrings, chases or soffits to physically reach concealed piping, ductwork, fire/smoke dampers or mechanical equipment installed under Division 23, provide access doors of sufficient size to maintain, repair, replace or suitably access devices intended to be adjusted as indicated herein.
- B. Provide an access door or panel for each of any valves, group of valves, damper pull rods, splitter dampers, manual volume dampers, actuators or other controlling mechanism installed under Division 15 which would otherwise be concealed in the building construction with no access.
- C. All access doors in toilet rooms, locker rooms, showers, kitchens, or other similar wet areas shall be the flush mounted type and be made of brush or satin finish stainless steel as manufactured by Milcor.
- D. All access doors shall be minimum 12" x 12" in size unless otherwise approved in writing in advance by the Engineer. Doors shall be increased in size as required to allow for a person to reasonably access, adjust, maintain, service, inspect or replace the largest single component concealed. Provide special sizes of access doors as required.
- E. Coordinate the final location of all concealed equipment and devices requiring access with the final location of the required access panels or doors. Allow ample space for the removal of all parts and equipment that require replacement or servicing.
- F. Where mounting heights are not detailed or dimensioned, install mechanical piping and overhead equipment to provide the maximum headroom possible while maintaining reasonable access and service to those items being accessed.
- G. Extend all equipment grease fittings to an accessible location which shall be within reach (maximum of 18") from the access door.
- H. Install all access doors in locations to suit the intended purpose but have each location reviewed and approved by the Architect. In no case shall access doors be located such that the intended purpose is rendered useless.
- I. Access doors shall all have spring concealed hinges, screwdriver operated cam latches, be the flush mounted type, open up to, but not more than, 175 degrees, be made of steel, or stainless steel to suit the application, be fire rated (U.L. rated) to match the rating of the surface where the door is placed, and have

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a powder coated electrostatic primer paint on all steel doors. Furnish the following access door types as described below:

1. Milcor Style DW - Flush drywall type with frame made of 16 gauge steel, panel door made of 14 gauge steel, galvanized steel drywall bead on frame, and removable hinge pins for removal of panel door. Provide minimum of two hinges (12" x 12" and larger) up to 24" x 24" in size and three hinges on access doors above this size. Provide one cam for access doors 14" x 14" and smaller and a minimum of three cams on larger sizes.
2. Milcor Style K - Flush plaster wall or ceiling type made similar to Style DW except with a 22 gauge expansion casing bead, one hinge on 12" x 12" access doors, two hinges on larger doors with either side no larger than 24", three hinges on doors with any dimension of 24" or larger, minimum one cam on doors with no dimension larger than 18" and two or more cams on larger access doors.
3. Milcor Style M or MS - Flush drywall, masonry or tile type made similar to Style DW except with 14 gauge steel frame and doors (16 gauge when made of stainless steel-satin finish), one hinge on access doors up to 18" x 18" in size, two hinges on sizes 20" x 24" and 22" x 22", three or more hinges on sizes 24" x 24" and larger, and the number of cams as standard with the manufacturer.
4. Provide other types of access doors suitable for the application to include surface mount, double leaf for access doors exceeding 36" in any dimension, louvered where indicated on the Drawings, fire rated, recessed or security/detention types as required and compatible with the surface penetrated.

2.10 STRAINERS

- A. Strainers shall be of the "Y" pattern type bodies, unless shown or specified otherwise. Body ends shall be screwed or flanged to match the type of joints in the piping in which the strainers are installed. Strainers shall have a 125 lb. ANSI pressure rating except that steam and steam condensate, gravity or pumped, system strainers shall be rated for 250 lb.
- B. Each strainer, screen, or mesh shall be of Type 304 Stainless steel, brass, or monel construction. Screen or mesh sizes shall be as scheduled below:

Pipe Size	Screen/Mesh Size
1/2" - 2"	20 Mesh
2-1/2" - 3"	0.045 Perforations
4" - 12"	0.125 Perforations

- C. Where vertical space does not permit the installation of the "Y" strainer, install an equivalent basket strainer.
- D. Where strainers are used in domestic water supply systems they shall be coated (all wetted parts) with an FDA approved epoxy coating.
- E. Strainers for screwed piping shall be Sarco Type IT (cast iron body) with optional bronze plug for steel piping or Sarco Type BT (cast bronze body) for copper piping; for flanged piping shall be Sarco Type CI-125 or F-125 and CI-250 or F-250 (cast iron bodies) as suitable for the pressures and temperatures encountered. Equivalent as manufactured by the following will be considered:
 1. Grinnell.
 2. Crane.
 3. Lesley.
 4. McAlear.
 5. Keckley.
 6. Mueller.
 7. Nibco.

2.11 GAUGES AND GAUGE COCKS OR NEEDLE VALVES

- A. Provide the following pressure gauge cock or needle valve connections:
 1. At the suction and discharge of each water pump.
 2. At the inlet and outlet of each water coil.
 3. At water balance stations and any other points indicated or detailed on diagrams on the Drawings.
- B. Where gauge connections are installed in insulated lines, install gauge cocks or needle valves on a nipple of sufficient length that the gauge cock or needle valve handle will be free of the pipe insulation. Position

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each gauge cock in relation to surrounding piping and equipment so that the gauge may be easily read and so that a gauge having a 4-1/2" diameter dial can be screwed into and out of the piping nipple where the gauge cock or needle valve is installed. All gauge cocks shall be of the tee-handle type. Needle valves shall be a Weksler AV32, AV34, or BBV4.

- C. Install gauge cocks or needle valves at pumps at the pump suction and discharge flange connections at the pre-drilled and tapped gauge connections as provided by pump manufacturer.
- D. Furnish and install a pressure gauge suitably calibrated at each of the following locations:
 - 1. The suction and discharge of each water pump.
 - 2. At other points indicated on the Drawings.
- E. Gauges shall be of the bourdon tube type, and shall be selected to operate at about the midpoint of their full range, i.e., for a 50 PSI operation, select a gauge of 0 to 100 psi. Accuracy shall be +/- 1%. Each gauge shall be provided with a brass lever handle union cock or brass handle needle valve. Cases shall be Phenol or Steel, not less than four and one-half inches (4-1/2") in diameter.
- F. Pressure gauges shall be equal to Weksler "Regal" series Industrial gauges with an aluminum safety case with bottom or lower connection, phosphor bronze bourdon tube with brass socket and all 300 Series stainless steel movement, 4-1/2" white enameled aluminum dial with black graduations and numbers on a 270 degree arc, 1/4" male NPT thread size; and be equipped with a geared micrometer adjustment pointer (balanced). Provide each gauge with scale range suitable for the duty. Gauges shall be Weksler Model BA14 or equal.
- G. Provide pulsation dampeners, adjustable snubbers, or piston type pressure snubbers in line with all pump gauges.
- H. Cocks and gauges shall be manufactured by:
 - 1. Weksler.
 - 2. Terice.
 - 3. Weiss.
 - 4. Miljoco.
 - 5. Marsh.
 - 6. Crosby.

2.12 THERMOMETERS AND THERMOMETER WELLS

- A. Furnish and install brass or stainless steel closed separable thermometer wells for all thermometer and controller bulbs which are designed for liquid measurements. Whenever a thermometer or controller bulb is inserted in a pipe for either remote or local temperature indication or control, locate the thermometer well so that it will be completely surrounded by flowing fluid. Such thermometer locations as are shown on the Drawings are diagrammatic only. Install thermometer wells for maximum effectiveness and in the case of locally indicating instruments, for easy readability.
- B. Supply each brass test well for use with the stem thermometers, a threaded brass plug and keeper chain. Install these test wells in the following locations such that they can be filled with oil to facilitate temperature measurements:
 - 1. At the inlet and outlet of each water coil.
 - 2. At the inlet and outlet of each heat exchanger, evaporator and condenser.
 - 3. At other locations as specified herein or shown on the Drawings.
- C. Where thermometer wells are called for, furnish and install brass wells with the tip of the well extending into the water stream. The well shall have a plug attached to it with a short length of chain. The wells shall be installed in the vertical or at 45 degree angle up.
- D. Thermometers shall be of the industrial type with red spirit filled liquid (no mercury allowed), bronze enameled aluminum cases, glass fronts, 9" scales, separable sockets; straight or angle pattern so selected that they can be read from the floor. Straight type equal to Weksler Type 105 and angle type equal to Weksler Type 115, Type 125, or Type 135, depending upon the angle and aspect. Furnish thermometers with 2-1/2" stem extensions where they are installed in insulated lines. Select scale ranges for maximum readability at the design temperature of the medium being measured.
- E. Thermometers shall be installed in the following locations:
 - 1. At the discharge of each pump.
 - 2. At the inlet and outlet of each heat exchanger, evaporator and condenser.
 - 3. At other locations as specified herein or shown on the Drawings.
- F. Thermometers and thermometer wells shall be as manufactured by:
 - 1. Weksler.
 - 2. Terice.
 - 3. Marsh.

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4. Taylor.
5. Miljoco.
6. Weiss.

2.13 TEMPERATURE AND PRESSURE TEST PORTS

- A. Temperature and Pressure Test Ports, or Pete's plugs, shall be dual valve type with valve pocket between valves, retaining cap with gasket and cap "saver" connector.
- B. These ports may be used at water coil connections in lieu of gauge cocks or needle valves and thermometer test wells.
- C. Pete's plugs shall have the pipe nipple extended to beyond the insulation thickness to make the plug fully accessible and a minimum of one inch (1") above the pipe insulation.
- D. Ports shall be as manufactured by:
 1. Pete.
 2. Autoflow.
 3. Flowset.

2.14 AUTOMATIC FLOW CONTROL VALVES

- A. Valves shall be rated for up to 200 psi and 200 Deg.F.
- B. Body shall be of wrought copper, brass or ductile iron construction with AISI Type 300 series passivated stainless steel parts, electroless nickel plated brass, and 17-7 PH spring.
- C. Provide label on body to indicate flow rate, model number, PSID range and flow rate. Information shall be on minimum 3" x 3" aluminum tag.
- D. Flow shall automatically be controlled within + 5% of rated flow.
- E. Provide Y-Type strainers with blowdown valve upstream of all flow control valves made of bronze or cast iron with a bronze or cast iron cap rated for temperature and pressure same as valve. Screen shall be stainless steel with 0.055 inch diameter holes. Refer to Para.2.9, Strainers.
- F. Provide brass P/T ports with extensions for insulated piping for each flow control valve.
- G. Automatic flow control valves shall be as manufactured by:
 1. Griswold Controls.
 2. "Autoflow" by Flow Design, Inc.
- H. It is the intent of this article to specify single devices which will be field piped per Schematics shown on the Drawings. Pre-piped assemblies of multiple piping accessories are not allowed, unless otherwise indicated elsewhere herein.

2.15 RELIEF VALVES

- A. All closed water systems shall be protected with a relief valve. Valves shall be spring operated, all brass, and shall meet A.S.M.E. requirements for discharge capacities. Discharge lines shall be piped to the nearest floor drain.
- B. Relief valves shall be as manufactured by Watts, Klipfel, McAlear, or McDonnell and Miller.
- C. Provide atmospheric relief piping routed to the outdoors as required by local code for all steam and natural gas systems.

2.16 AIR VENTS

- A. Provide and install air vents, air eliminators, where shown and at any high points or traps in water circulating lines where air might collect.
- B. Each such air vent shall be installed with a valve at its inlet and shall discharge through an integral check valve. The waste lines from the discharge from air vents shall be collected and piped to the nearest floor drain in each case.
- C. All automatic air vents shall have cast or ductile iron bodies with corrosion resistant bolts, Buna-N or EPDM seating materials to meet system pressure and temperature requirements, and all stainless steel internal control components.
- D. Provide manual air vent cocks, or needle valve, for all water coils where not integral or supplied with coil by manufacturer.
- E. Automatic air vents shall be rated for a maximum working pressure of 150 psig and 250 Deg.F.
- F. Automatic air vents shall be as manufactured by:
 1. Hoffman Model No. 792.
 2. Armstrong Model No. AV.
 3. Bell & Gossett Model No. 107A.
 4. Or equivalent by Amtrol.

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PART 3 - EXECUTION

3.1 PIPING - GENERAL

- A. Where special classes of piping are involved and are not listed, the Contractor shall request instructions from the Owner's Representative as to the class of material involved and the method of fabricating it before ordering any material. All steel lines 2-1/2" and larger shall be assembled by welding. All steel lines 2" and smaller may be assembled either by welding or by screwed fittings as specified.
- B. Welding shall be done by mechanics who satisfy qualification requirements of the American Welding Society. The pipe ends to be welded shall be machine beveled wherever possible. Gas cuts shall be true and free from all burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no metal shall project within the pipe. Fully ream, to the full inside pipe diameter dimensions, the inside of all piping to be welded. Miter joints will not be allowed in any case. All headers, connections, elbows, reducers, flanges, and special flanges and special fittings shall be made using forged steel welding fittings of the same weight as the pipe to which they are attached. All unions and connections to valves 2-1/2" and larger shall be made by the use of welded flanges.
- C. Branches in lines where the branch side is equal to 2/3 of the size of the main or smaller may be connected by using Weldolets or Thredolets; where the sizes are greater than 2/3 of the main, standard weight seamless tees as manufactured by Tube-Turns or Grinnell, A.S.T.M. Standard A-234 shall be used.
- D. The location, direction, and size of all lines are generally indicated on the drawings. Branch connections in general are indicated and shall be so installed as to provide proper grades.
- E. All lines shall be made up straight and true at proper grades. All water filled and condensate drain lines shall grade down to drains.
- F. Piping shall follow as closely as possible the routes shown on the plans and take into consideration conditions to be met at the site. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
- G. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- H. All headers shall be assembled as indicated using welding fittings throughout.
- I. All screw joints shall be made with taper threads, properly cut. Joints shall be made tight with graphite and oil applied to the pipe threads only and not to the fittings.
- J. Dielectric couplings shall be installed where ferrous pipe joins copper lines and shall be rated for the intended medium pressure and temperature or service.
- K. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of systems. No unions will be required in welded lines or lines assembled with solder joint fittings except at equipment items or coils, machinery items and other special pieces of apparatus. Unions in 2" and smaller lines shall be ground joint and unions 2-1/2" and larger shall be flanged unions. Unions shall be the same material and strength as other fittings in the lines. Companion flanges on lines at various items of equipment, machines, and pieces of apparatus shall serve as unions to permit removal of the particular item.
- L. All piping shall be supported by hangers independently of equipment connections. The weight of the piping and its contents shall not be imposed on the equipment in any way.
- M. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
- N. Swing joints or expansion loops shall be provided wherever shown on the Drawings or wherever else necessary to allow for the expansion and contraction of piping. This shall be accomplished in an approved manner and this Contractor shall be responsible for any damage which may occur as a result of expansion and contraction of his piping.
- O. Nipples shall be of the same size and material as the piping in the system in which the nipples are installed, except that "close", or "all thread" nipples shall not be used.
- P. Keep all open ends of piping in each system plugged or capped to prevent dirt or other debris from entering the pipe at any and all times during construction and before fixtures or equipment is connected. All piping shall be flushed clear prior to connection to the central building systems.
- Q. The ends of all piping furnished and installed in all systems shall be thoroughly reamed to the full inside diameter of the respective pipe.
- R. Exposed and concealed lines shall be run parallel with, and perpendicular to building lines and wherever possible shall be grouped together for easy service and identification. Whenever possible, horizontal and vertical runs shall be held as close as possible to the walls, ceilings, struts, members, etc., so as to occupy the minimum space consistent with the proper installation requirements for insulation, conduit, ductwork, lighting fixtures, etc., and the expansion requirements of each of these items and the building

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proper or the removal of the respective or adjacent pipes, conduits, and ductwork, and to allow for necessary access to valves, other pipes, conduits, dampers, etc.

- S. Valves required for control or isolation of any part of the various systems shall be provided and shall be located in approved or accessible positions or made accessible through removable panels, etc., and where several valves are related as to function, they shall be grouped in a battery. Request approval from Owner's Representative for proper location of all access panels required for valves, etc.
- T. All automatic control valves shall be installed such that the valve stem is pointed upwards, vertical, and in no case shall it be mounted at less than a 45 degree angle from the vertical position unless specifically approved by the Engineer prior to installation. There will be no exception for chilled water type systems.
- U. All shut-off and isolation valves shall generally be installed with valve stems pointed vertically upwards. In no case shall valve stems be pointed downwards or less than in a horizontal position. Chilled water system valve stems shall not point less than 45 degrees below vertical in any case.
- V. Where new lines are indicated to connect into existing lines, careful coordination shall be exercised to determine exact elevations and locations of existing lines, to establish grades of interconnecting new lines, to establish procedures to interconnect lines, and to establish other details.
- W. Pre-assembled water coil piping assemblies are not allowed unless specifically indicated otherwise elsewhere herein. The intent of these Specifications is to have individual piping valves and specialties field assembled per the Schematic Diagrams illustrated on the Drawings and to meet all other installation requirements indicated elsewhere herein.

3.2 GROOVED PIPE AND FITTINGS

- A. Where grooved piping and fittings are specified elsewhere herein follow the installation guidelines specified below:
 - 1. Assemble all grooved joints with coupling and gasket, lubricant, and bolts.
 - 2. Roll grooves (cut grooves not allowed) in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness used. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
 - 3. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
 - 4. All grooved components (couplings, fittings, valves, gaskets, and specialties) shall be of one manufacturer (Victaulic), or others as specified elsewhere herein, or approved equals only.
 - 5. Grooved manufacturer shall provide on-site training for contractor's field personnel by a factory trained representative in the proper use of grooving tools, application of groove, and product installation. Factory trained representative shall periodically visit the job site and inspect the installations.
 - 6. Contractor shall remove and replace any improperly installed products.
 - 7. All fittings shall be insulated with pre-molded insulation per system requirements and be as specified in other sections of these specifications.
- B. Victaulic's Commissioning Service shall be hired by the installing contractor to provide visual examination of all installed Victaulic couplings when deemed necessary by the Consultant/Owner. Installation review will be conducted in accordance with Victaulic Pipe Joint Visual Examination Standard ES 1091. A report confirming the visual examination results shall be provided to the Contractor and the Consultant/Owner's representatives.

3.3 CROSS CONNECTION AND INTERCONNECTIONS

- A. No plumbing fixtures, device, or piping shall be installed which will provide a cross connection or interconnection between a distributing water supply for drinking or domestic purposes and a polluted supply such as drainage system, or a soil or waste pipe which will permit or make possible the backflow of sewage, polluted water, or waste into the water supply system.

3.4 EXCAVATION AND BACKFILLING

- A. Provide necessary excavating and backfilling for the installation of work specified in this Division as specified in Section 23 05 00.

3.5 PIPE INSULATION INSERTS AND SHIELDS

- A. Provide a section of Foamglas insulation, calcium silicate, or urethane of thickness specified at hanger support locations and provide No. 16 gauge galvanized steel protection shield minimum 12" long. Shield shall be full half cylinders equal to Grinnell Fig. 167.
- B. Refer to Section 23 07 00, Insulation.

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3.6 UNDERGROUND PIPING PROTECTION

- A. Protect the entire surface of all underground steel piping against rust and corrosion.
- B. For piping and nuts and bolts, such as those on mechanical joint piping systems, not specified elsewhere to be furnished with factory applied pipe corrosion resistant wrapping, the piping and fastener surfaces shall be cleaned of rust, dirt, etc., with a wire brush and shall be free of oil and grease and be completely dry.
- C. Brush on, or otherwise apply as recommended by the manufacturers, a heavy full coating of TC Mastic (Tape Coat Company, Evanston, Illinois) or Reilly Protective Tar Enamel No. 3302 (Reilly Tar and Chemical Company, Indianapolis, Indiana). Dry coating shall be not less than twelve 12 mils thickness. Protect freshly covered surfaces from dirt or moisture for at least 12 hours as recommended by the manufacturer to allow it to dry before backfilling. Depending on the weather the systems may be carefully backfilled as determined by the Owners representative.

3.7 SAFETY GUARDS

- A. Furnish and install all safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction.
- B. All belt driven equipment, projecting shafts and other rotating parts shall be enclosed or adequately guarded.

3.8 TESTING AND REPAIRING

- A. During the progress of each portion of the work or upon its completion, make such tests of this work as herein specified, or as required by the Architect, or by State or Municipal Bureaus having jurisdiction and under their supervision.
- B. Provide all apparatus, temporary piping connections, or any other requirements necessary for such tests. Take all due precautions to prevent damage to the building and its contents incurred by such tests as will be required to repair and make good, at no cost to the Owner, any damage so caused. Testing of piping to be insulated shall be done before insulation is applied.
- C. Perform any other tests as may be required by the Owner's Representative to indicate the fulfillment of specification requirements.
- D. All water piping shall be hydrostatically tested to a pressure of 150 psig or to 1-1/2 times the operating pressure, whichever is the greatest, for six (6) hours.
- E. Systems shall be tested in portions as required by the construction schedule and the portions being tested shall be effectively isolated and sealed off. When previously tested sections are connected into other sections, tests shall be rerun to include the new connections.
- F. Partial systems shall be tested prior to connecting into existing lines.
- G. Leaks in screwed joints shall be repaired by tightening the joint until the leak has stopped, or by remaking the joint if tightening fails to stop the leak. Leaks in welded joints shall be repaired by chipping out the weld around the leak and rewelding until it is stopped. Leaks in caulked joints shall be completely stopped by additional caulking of the joint, but, if that fails, the joint shall be re-made. A leak in a compression joint shall be repaired by remaking the joint using a new seal, compression ring, coupling, etc., as required. Leaks in soldered joints shall be repaired by remaking the joint and no soldering or brazing over existing joints will be permitted. Any defective piping shall be replaced.
- H. Additional testing shall be as specified in the individual Sections of these Specifications.
- I. During testing and cleaning of piping systems, use a fine mesh, 20 mesh or smaller, start-up strainer screen for all strainer pipe sizes. After piping system is cleaned each strainer shall be taken apart, cleaned, and final strainer mesh shall be placed back in strainer for normal operating conditions.

3.9 SEALING PENETRATIONS

- A. Seal all pipe and duct penetrations through walls run to structure, ceilings, floors and roofs. Fill the annular space between the insulation on the pipe, or the pipe only where uninsulated, or duct and its sleeve, with neoprene or non-hardening sealant.
- B. No pipe or duct shall be allowed to contact its surrounding sleeve or the wall, floor, or ceiling. Effective isolation shall be provided as described in Section 23 05 48 to the end that no vibration or direct noise transmission shall be transmitted. Vibration transmission limits shall be as established in Section 23 05 48. Use special materials as may be required to comply.
- C. Firestop pipe and duct floor and wall penetrations as specified in Section 07 84 00 and 23 05 00.

3.10 CONTROLS AND INSTRUMENTATION

- A. Section 23 09 00, Controls and Instrumentation, requires thermowells, pete's plugs, and test ports for water temperature and pressure measurement and monitoring purposes for temperature controls and for

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verification purposes by the Testing, Adjusting and Balancing Firm (TAB), which shall be installed under this section of the specifications. These devices shall be located as verified by the TAB Firm.

- B. Temperature control valves shall be furnished as specified in Section 23 09 00, and installed as a part of this Section of the Specifications.
- C. Where pressure gauge cocks and pressure/temperature test ports are shown on the Drawings and allow for TAB firm verification additional devices are not required. It is not the intent to provide redundant test ports. However, where sensors are installed in thermowells or other mounting devices separate test ports are required such that sensors do not have to be removed to calibrate or test.

3.11 PAINTING

- A. All equipment specified in Division 23 shall be delivered to the site with suitable factory finishes as specified elsewhere herein.
- B. Items with factory applied finishes shall be protected during installation and other construction work. Damaged factory applied finishes shall be refinished to match the original finish appearance.
- C. Field painting of items specified and installed in Division 23 shall be as specified in Section 09 90 00.
- D. All ferrous metals that are not galvanized or made of a corrosion resistant alloy shall be painted. This shall include steel pipe hangars, trapeze supports, pipe stands, all thread hangar rods and other miscellaneous systems.

END OF SECTION 232113

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SECTION 232123 - CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with all other Division 23 Sections, as applicable. Refer to other Divisions for coordination of work with other portions of work.

1.2 SYSTEM DESCRIPTION

- A. Provide water circulating pumps of the type, rotational speed, and arrangement indicated.
- B. Each pump shall be rated to deliver the capacity indicated in the tabulation on the Schedule against the head of the system in which it operates.
- C. Pumps specified in this section of specifications shall handle chilled, heating or condenser water at no higher than 250 Deg. F. or lower than 10 Deg. F.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the best quality.
- B. All equipment and materials shall be installed in a workmanlike manner by experienced mechanics and as recommended by the pump manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions together with pump curves and head calculations. Head calculations required when piping installation and equipment utilized is significantly different from that shown as determined by the Engineer.
- B. Shop Drawings: Submit in accordance with Section 23 05 00.
- C. Submittals to include pump and motor efficiencies at full load and at 60 Hertz. For variable speed applications submit on the same at 15 Hertz, 30 Hertz and 45 Hertz.

1.5 PRODUCT HANDLING

- A. Cover and protect pumps in transit and at site. Pumps not properly protected and stored and which are damaged or defaced during construction shall be rejected.
- B. Cover suction and discharge openings to prevent entrance of dirt and debris until final piping connections are made.
- C. Storage and protection of materials shall be in accordance with Section 23 05 00.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The head capacities indicated in the schedules are listed for bidding purposes only. Calculate the operating head at each pump, taking into consideration the actual routing of the various lines, pressure drops in heat exchangers and coils, exact lengths of pipe, fittings, etc. Submit these calculations, together with copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.
- B. Motors shall be constant speed, open drip proof type and shall be so sized with relation to the pump impeller that the required brake horsepower shall not exceed the rated motor horsepower at any point on the pump curve. Pumps operating in parallel shall not cavitate when operated alone.
- C. Provide each pump with a constant speed motor wound for the electrical characteristics indicated on the Drawings. Motors shall be of the nominal starting torque, low starting current, ball bearing, horizontal, 40 Deg. C. ambient, drip-proof squirrel cage induction type. Motors over 1 H.P. shall be high efficiency type equal to G.E. Energy Saver, Baldor Super "E" or A.O. Smith "E" Plus III. All motors on all pumps shall be of the same manufacture. Refer to Section 23 05 13.
- D. Provide each centrifugal pump with an enclosed impeller whose diameter is 90% or less of the maximum impeller which the manufacturer shows in their published curves for that pump.
- E. Provide pump casings and mechanical seals suitable for operation under static and dynamic heads for that pump.

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- F. Pump baseplates shall be constructed of welded structural steel shapes. Provide with raised lip drip pans with threaded drain connection where handling fluids with operating temperatures below 60 Deg. F., such as chilled water. Furnish baseplates with 1/8" thick steel drain pan of sufficient width to extend under, and a minimum of two inches (2) beyond, and catch any drip from connecting flanges. Removable attachments will not be acceptable. Cover pans with rust inhibitive paint.
 - G. Coupling shall be of the flexible type, capable of withstanding shock, misalignment and end float as manufactured by "Woods".
 - H. Motor and pump alignment shall be field adjustable, but shall be factory aligned on a common base plate. Supplier shall furnish adequate shims or other alignment accessories necessary to complete field alignment.
 - I. Coupling Guard: Coupling guard shall be all metal and fastened to baseplate. Guard shall be removable. All exposed moving parts shall be guarded from all sides.
 - J. Name Plates: Furnish stainless steel data plates permanently secured to the pump.
 - K. Bearings shall be the heavy duty ball type on both ends of frame and be regreasable.
 - L. Provide 1/4 inch gauge tappings, fitted with pipe plugs, at each pump flange.
 - M. Provide minimum 1/2 inch tappings, fitted with pipe plugs, for a casing air vent and drain on the pump volute.
 - N. Provide extended lubrication lines with universal grease gun stop check fittings for greasing bearings without requiring disassembly of the pump, guards, or other auxiliary devices.
 - O. All pumps and materials of construction shall be compatible with ethylene glycol.
- 2.2 DOUBLE SUCTION PUMPS
- A. Double suction pumps shall be bronze fitted, horizontally split case type with flanged inlet and outlet. Flanges shall be rated at 125 PSI. Pumps shall be designed to allow complete removal of the impeller, shaft, and bearings.
 - B. Each pump and motor shall be mounted on a common baseplate, and shall be connected through a spacer type flexible coupling.
 - C. The casing bearing bracket, bearing cover and gland shall be of cast iron, ASTM A-48, Class 25A.
 - D. The shaft shall be of stainless steel construction.
 - E. The impeller shaft sleeve and casing wearing rings shall all be made of bronze (bronze fitted).
 - F. Seals shall be John Crane, Type 21, or equivalent, mechanical shaft seals.
 - G. Bearings shall be grease lubricated ball type, selected to the carry radial and thrust loads required based on the scheduled requirements.
 - H. Pumps shall be as manufactured by Aurora, PACO, Bell & Gossett, or TACO.
- 2.3 END SUCTION PUMPS (CENTRIFUGAL PUMPS)
- A. End suction pumps shall meet all requirements same as Double Suction Pumps. Pumps shall be frame mounted type.
- 2.4 IN-LINE CIRCULATING PUMPS
- A. Pumps shall be of the in-line, direct coupled, single stage design with attached motor. Pump models shall be furnished as shown on the Plans and installed in accordance with the manufacturer's recommendations. Each pump shall be capable of delivering the scheduled gallons per minute when operating at the scheduled total developed head of feet. The pump shall be capable of operating continuously at temperatures from 5 Deg. F. to 250 Deg. F. (-15 Deg. C. to 121 Deg. C.) with working pressures of 145 psi (10 Bars). Pump shall have flanges and be ANSI B16.1, 125 pound flat face, rated.
 - B. Pump body shall be of Class 30 cast iron, rated 175 psi working pressure, with gauge ports at nozzles, and with vent and drain ports.
 - C. Impeller shall be non-ferrous material, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking cap screw or nut.
 - D. The liquid cavity shall be sealed off at the motor shaft by an internally-flushed mechanical seal with ceramic seal seat, and carbon seal ring, suitable for continuous operation at 225 Deg. F. A non-ferrous shaft sleeve shall completely cover the wetted area under the seal.
 - E. Pump bearing bracket shall have oil lubricated bronze journal and thrust bearings. Bracket shaft shall be alloy steel having ground and hardened thrust bearing faces. A flexible coupling to dampen starting torque and torsional vibration shall be employed.
 - F. Motor shall meet NEMA specifications and shall be the size, voltage, and enclosure called for on Plans.
 - G. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high grade machinery enamel prior to shipment.

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2.5 TWO-STAGE VERTICAL TURBINE PUMPS

- A. Vertical turbine pumps shall be bronze fitted and be water lubricated with an enclosed impeller. These pumps shall be designed for deep well line shaft applications with an above ground discharge flanged connection.
- B. Pumps shall have a vertical line shaft turbine with suitable galvanized steel clip-on basket strainer. The strainer free area shall be 5 times that of the flow area of the pump.
- C. The column assembly shall be 6" x 1" for a total approximate pump length of eight feet (8'). The column assembly shall be made of threaded and coupled pipe with type 416SS line shaft with no intermediate line shaft bearings required.
- D. All discharge connections shall be rated for 150 psi and be flanged cast iron. Discharge head shall be water lubricated, be complete with seal housing and mechanical seal, head shaft and motor coupling. Line shaft bearings shall be lubricated by the water being pumped which shall require a suitable driver and accessories. The water being pumped is condenser water which by its nature will have a significant amount of particulate.
- E. Pump and motor shall be a common assembly to be mounted on the floor or concrete pad extension covering the basin. Motor shall be 1770 RPM with vertical hollow shaft motor with WP-1 (weatherproof) enclosure. Motors shall be the heavy duty premium efficiency type, NEMA design B, and have a 1.15 service factor. Motor shall have a non-reversing feature to prevent reverse rotation of any rotating element. A suitable thrust restraint shall be incorporated in the upper end of the motor to protect the installed assembly from the hydraulic thrust load of the pump and the weight of all rotating parts. Refer to Section 15131 for general motor efficiency and construction requirements.
- F. Pump construction shall comply with the following:
 - 1. Intermediate bowls, suction bowl, and discharge adapter shall be the flanged type constructed from close grained cast iron and shall conform to ASTM designation A48, class 30. They shall be free from sand holes, blow holes, or other faults and must be accurately machined and fitted to close tolerances. Intermediate bowls shall have vitra glass lined waterways for maximum efficiency and wear protection. All intermediate bowls shall be of identical design for interchangeability. A discharge adapter shall be used to connect bowls to the discharge column. Threaded connecting bowls will be allowed on bowl sizes 8" and smaller.
 - 2. Impellers shall be constructed from ASTM B584 Silicon Bronze and shall be the enclosed type. They shall be free from defects and must be accurately cast, machined, balanced, and filed for optimum performance and minimum vibration. Impellers shall be the standard product of the pump manufacturer and not contain special workmanship to temporarily increase efficiency. Securely fasten impellers to the bowl shaft with taper locks of type 416 stainless steel. Impellers shall be adjustable by means of a top shaft adjusting nut.
 - 3. Suction bowl shall be provided with a non-soluble grease packed bronze bearing, and a bronze sand collar shall be incorporated in the pump design to protect this bearing from abrasives. Bearing housing shall have a sufficient opening at the bottom for easy removal of the bearing.
 - 4. Wear rings on pumps 6" and larger shall not be fitted with replaceable wear rings of bronze material in the suction bowl and intermediate bowls. Wear rings shall have the minimum practical clearance to the mating cylindrical surface of the impeller to provide adequate sealing independent of vertical positioning of the impellers.
 - 5. Bowl shaft shall be constructed from ASTM A582 type 416 stainless steel. It shall be precision turned, ground and polished and shall be supported by water lubricated bronze bearings.
- G. Water Lubricated Column Assembly shall have the following features:
 - 1. Pump speeds up to 3600 RPM shall have intermediate column lengths and line shaft bearing spacing not to exceed 5 feet.
 - 2. The column pipe shall be grade "A" steel pipe with the ends machined with 8 threads per inch with 3/16" taper and faced parallel to butt against the centering spiders. Inside diameter of the pipe shall be such that the head losses shall not be over 5 feet per 100 feet of pipe and shall be Schedule 40 pipe. Pipe shall be connected with threaded sleeve type steel couplings.
 - 3. Line shaft shall be of ample size to operate the pump without distortion or vibration. Diameter of the shaft shall be such that it does not exceed the scheduled horsepower limitations. Shaft shall be furnished in interchangeable sections not over ten feet in length, and shall be coupled with extra-strong threaded steel couplings machined from solid bar steel. Line shaft shall be type 416 stainless steel.
 - 4. Bronze centering spiders of the drop-in type shall be furnished for shaft stabilization at each column pipe coupling. Bearings shall be fluted rubber retained in the spider by a shoulder on each end of the bearing.

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- H. Water Lubricated Discharge Head Assemblies shall have the following features:
 - 1. Discharge head shall be of the high profile type and be a suitable base of high grade cast iron, ASTM A48-30, or fabricated steel. It shall be provided for mounting the motor with a discharge elbow having an above ground flanged discharge outlet. The design shall have sufficient capacity to carry the combined weight of the column assembly. The design shall allow the top shaft to couple above the stuffing box. The head shall have a 1/2" NPT connection for a pressure gauge.
 - 2. The stuffing box shall be cast iron and shall contain a minimum of five rings of packing. It shall have a pressure relief connection. The packing gland shall be a bronze split type secured in place with non-corrosive studs and nuts. The bearing shall be SAE660 bronze. A rubber slinger shall be secured to the shaft above the packing gland.
 - I. Acceptable manufacturers:
 - 1. Bell & Gossett, or
 - 2. Flowserve, or
 - 3. Peerless.
- 2.6 SPARE PARTS KIT
- A. Furnish one (1) spare parts kit for the pumps furnished under this section of specifications.
 - B. Spare parts kit shall be as standard with the manufacturer but shall include the following as a minimum:
 - 1. Shaft Sleeve Ring
 - 2. Wear Out Brass Rings
 - 3. One (1) Bronze Impeller.
 - 4. Gaskets and 'O' rings (one (1) set)

PART 3 - EXECUTION

- 3.1 INSTALLATION - BASE MOUNTED PUMPS
- A. Prior to performing any installation work inspect pumps to confirm that no damage has occurred from shipping or handling.
 - B. Compare the motor nameplate electrical information to the power supplied to the pump to confirm the proper power supply is provided. Confirm that the overload relays and fuses or circuit protection rating provided for each pump is proper based on the motor nameplate full load amperage.
 - C. In mounting pumps verify alignment of driver to pump (horizontal pumps only) and confirm there is no strain on the suction and discharge pipe connections (flanges should meet squarely).
 - D. Manually turn coupling to insure free rotation of the pump and motor.
 - E. Insure system is free of foreign matter which could damage pump.
 - F. Level all frame base mounted pumps by using various thickness steel shims or steel wedges on each side of each mounting bolt set beneath the baseplate on top of the foundation, or inertia base, as per the manufacturer's instructions, without exception.
 - G. After the baseplate is bolted down, erect forms around the foundation and fill with approved grout. Exercise care to be sure that the entire space under the baseplate is filled with grout. After grout is thoroughly hardened, remove wedges and fill holes with non-shrinking grout. Tighten bolts.
 - H. Check levelling and alignment and correct, if necessary, with shims under pump or motor feet.
 - I. Make final connections of piping to pump and support piping independently of the pump. It is imperative that piping be installed in such a manner as not to impose any strain on the pump casing.
 - J. Connect gauge cocks and gauges to gauge tapings.
 - K. Connect a gauge cock to the volute air vent connection.
 - L. Pipe a drain to the drip pan and volute drain and route to the nearest floor drain.
 - M. Connect power supply and control wiring to disconnect and motor controller.
 - N. After each unit has been run under actual operating conditions, shut it down and again check its alignment and adjust as necessary.
 - O. Follow all manufacturer recommended installation instructions to include following and completion of all recommended Pre-start and Post-Start checklists.
- 3.2 IN-LINE PUMPS
- A. Suspend or support in-line pumps from structure as required, independent of the piping with pump installed level and motor upright (vertical).

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3.3 VERTICAL TURBINE PUMPS

- A. Mount as recommended by the manufacturer. Secure floor covering basin with bolts to suitable anchors.

END OF SECTION 232123

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SECTION 232513 - HVAC WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with all other Division 23 Sections as applicable. Refer to other Divisions for coordination of work with other portions of work.

1.2 SYSTEM DESCRIPTION

- A. Install closed chilled and heating water piping systems complete including water distribution lines, compression tanks, pumps, strainers, air control fittings, flow and pressure regulating valves, relief valves, specialties, insulation, hangers and supports, and appurtenances as shown on the Drawings, as specified herein, and as specified in other Sections of these Specifications.
- B. Provide water treatment equipment, chemicals and treatment testing services to treat the closed water piping systems to be cleaned, flushed, and chemically inhibited from corrosion.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the best quality.
- B. All equipment and materials shall be installed in a suitable manner by technicians experienced in the work described.
- C. All piping cleaning, flushing, and chemical treatment work shall be performed by the piping system installer as specifically directed and supervised by trained and qualified representatives of the firm providing the chemicals and as specified elsewhere herein.
- D. Chemical treatment companies providing chemicals, supervision, cleaning, and flushing instructions and chemical testing and adjustment services shall have a minimum of ten (10) years experience in the local area, located within a 25 mile radius of the project site, in the performance of these services for projects of this size and type. Acceptable firm shall be one of the following:
 - 1. Garratt Callahan.
 - 2. Nalco.
 - 3. Betz.

1.4 SUBMITTALS

- A. Product Data: Submit complete manufacturer's descriptive literature for each item specified herein, instructions for water piping flushing and cleaning, and chemical treatment procedures.
- B. Include Material Safety Data Sheets on all chemicals to be used.
- C. Shop Drawings: Submit in accordance with Section 23 05 00.

1.5 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall be rejected.
- B. Storage and protection of materials shall be in accordance with Section 23 05 00.

PART 2 - PRODUCTS

2.1 WATER PIPING AND FITTINGS

- A. Refer to Section 23 21 13, Hydronic Piping.
- B. All chemical treatment, make-up water and expansion piping shall be Type "L" hard drawn copper with wrought fittings using 95-5 solder. Use dielectric unions where connected to dissimilar materials.
- C. All piping and isolation valves of every kind required for application of the chemical treatment system shall be furnished and installed by the piping system installer. Refer to Specification Section 23 21 13.

2.2 VERTICAL PRESSURIZED BLADDER TANKS

- A. Vertical pressurized bladder type compression tanks for chilled and heating water piping systems shall be furnished and installed in the sizes and where indicated on the Drawings.
- B. Tanks shall be made of carbon steel with ASME Boiler and Pressure Vessel Code Section VIII, Division 1 stamp, rated for a minimum 240 Deg.F. design temperature and 125 PSIG design pressure.

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- C. Bladder shall be made of a heavy duty butyl rubber or full volume flexible elastomer, and shall be replaceable. Bladder material shall be suitable for use in glycol systems.
- D. Each tank shall be primed and painted.
- E. Provide each tank with floor support ring base, lifting rings, 3/4" drain tapping, air charger valve assembly, and 1", 40 gallon or smaller tanks, or 1-1/2", over 40 gallon tank capacity system connection.
- F. Acceptable Manufacturers shall be:
 - 1. Bell and Gossett Type Series "B" Pressurized Vertical Tank,
 - 2. TACO,
 - 3. AMTROL,
 - 4. Or the John Wood Company.

2.3 COMPRESSION TANKS

- A. Compression Tanks for chilled and heating water piping systems shall be of the size and type as indicated on the Drawings.
- B. Tanks shall be made of carbon steel with an ASME Boiler and Pressure Vessel Code Section V111, Division 1 stamp, rated for a minimum 240 Deg.F. design temperature and 125 PSIG design pressure.
- C. Each tank shall be primed and painted.
- D. Provide each tank with a site glass, angle valves, mounting saddles, drain tapping, drain air charger valve assembly, Airtrol tapping and tank air control fittings.
- E. Acceptable Manufacturers shall be:
 - 1. Bell and Gossett Type ATF.
 - 2. TACO.
 - 3. AMTROL.

2.4 BUFFER TANKS, VERTICAL CHILLED WATER TYPE

- A. Vertical chilled water buffer tanks shall be furnished in the sizes, gallons of storage capacity and approximate diameter, and locations where shown on the Drawings.
- B. Each tank shall be manufactured of minimum 1/4" thick plate steel with 1/4" thick ASME Code 80:10 heads. The shell and heads shall be constructed from SA-516, Gr 70, steel. All pipe couplings and flanges shall be made from SA-105 steel. Each manway shall be made from SA-106C steel.
- C. Tanks shall be supported on a minimum six inch (6") high steel skirt welded to the bottom of the tank.
- D. The tank inlet and outlet nozzles shall have Type RFSO 150# Series flanges in the sizes to match the pipe sizes shown on the Drawings. Each nozzle shall be centered on opposite sides of the tank near the top of the shell (as high as possible).
- E. Each tank shall have a Pressure Relief tapping centered at the top of the tank, minimum 3/4" in size, and shall be a Type FC, Series 3000#, coupling.
- F. Each tank shall have two (2) drains, one (1) on each side of the internal baffle, with each drain being a minimum 1- 1/ 2" in size, located approximately centered on each side of the baffle at the low point of each half side. Tank drains shall be a Type HC, Series 3000#, coupling, each made of Type 304L stainless steel.
- G. Each tank shall include one manway for access to the inside of the tank. Manways shall be made from minimum 3/4" thick steel, be 12" x 16" (oval) in size and be rated for 300 pounds.
- H. All tanks shall be constructed to meet ASME Section VIII, Division 1, requirements and be rated at 125 PSI at 300 Deg.F. Each tank shall be hydrostatically pressure tested to no less than 160 PSI. Each tank shall bear the ASME stamp/label. Tanks shall not require radiograph testing.
- I. All tanks shall be provided with two (2) lifting lugs for use in shipping and installation of each tank.
- J. Tanks shall be coated on the outside with a red primer suitable for painting. The inside of all tanks (all steel surfaces) shall receive a two part tnebec epoxy coating. In lieu of providing this coating provide a bottom shell, and the bottom 12" of the baffle connecting to the shell, both to be made from Type 304L stainless steel.
- K. Each tank shall include a minimum 3/16" thick steel internal baffle plate that extends to the top of the tank and which extends to near the bottom of shell (within 12"). The baffle plate shall be perpendicular to the nozzles. The plate design shall force water to flow through the entire tank without short circuiting.
- L. Completely factory insulate the exterior of each steel tank, to include the shell, heads, manway, couplings, and nozzles with minimum two inch (2") thick heavy density fiberglass insulation board, cut and contoured to the shape of the tank. Fully jacket insulation with either a minimum 14 gauge metal jacket finished with a primer coating or use a 0.016 inch thick aluminum jacketing neatly cut and contoured to the shape of the tank. Seal all insulation and jacketing seams and joints to be water and vapor proof. Loose fibrous insulation is not acceptable. Make couplings and nozzles fully accessible for making field connections without damaging insulation and jacketing system.

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- M. Buffer tanks shall be as manufactured by:
1. Wendland Manufacturing Corporation.
 2. The John Wood Company.
 3. Or approved equals only.

2.5 IN-LINE AIR SEPARATORS

- A. In-line type centrifugal air separators shall be furnished for each of the chilled and heating water systems where indicated on the Drawings.
- B. Separators shall be line size as a minimum and have 150 pound ANSI Standard flanged connections on the inlet and outlet connections on sizes 2-1/2" and larger, NPT on sizes 2" and smaller. Separators shall be sized as follows:

Pipe Size	Maximum System Flow	B&G Separator Size (Model RL)
2"	45 GPM	2
2-1/2"	72 GPM	2-1/2
3"	130 GPM	3
4"	240 GPM	4
5"	425 GPM	5
6"	680 GPM	6
8"	1250 GPM	8
10"	2100 GPM	10
12"	3000 GPM	12

- C. Separators shall have internal stainless steel air collector tubes to direct air to the top of the separator which shall include a NPT vent, air release connection; minimum size of 1-1/4".
- D. Provide a NPT blow down connection at the base of each separator to facilitate blow down of debris from within the separator; minimum size of one inch (1").
- E. Tanks shall be primed and painted carbon steel same as compression or pressurized bladder tanks.
- F. Air separators shall be designed, constructed, and stamped for a minimum 125 PSIG design pressure at 350 Deg.F., design temperature, in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.
- G. Maximum pressure drop of each separator shall not exceed 2.0 feet of water and the air elimination rate shall be a minimum of 50% on one pass. Submit data to verify compliance with all requirements specified herein.
- H. Acceptable Manufacturers shall be:
1. Bell & Gossett Rolairtrol Model RL (No Strainer),
 2. TACO,
 3. The John Wood Company, or
 4. American Wheatley.

2.6 PRESSURE REDUCING VALVES

- A. Pressure reducing valves shall be furnished at the make-up water connection to each of the chilled and heating water systems where indicated on the Drawings.
- B. Valves shall have an adjustable range of 10 to 25 PSIG. TAB Agency to determine final setting.
- C. Valve size shall be a minimum of 3/4" in size.
- D. Valves shall have a brass body, low inlet pressure check valve, and integral strainer, which must be removable without system shut down.
- E. Acceptable Manufacturers:
1. Bell and Gossett,
 2. TACO.
 3. American Wheatley.

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2.7 PRESSURE RELIEF VALVES

- A. Furnish and install individual pressure relief valves at the make-up water connections for each of the chilled and heating water systems where indicated on the Drawings. Combination valves are not acceptable.
- B. Valves shall have brass bodies with brass internal parts designed for a maximum operating pressure of 125 PSIG, at a maximum operating temperature of 225 Deg.F.
- C. Valves shall be equipped with an EPDM diaphragm to assure positive operation of the valve and to protect non-wetted parts from system fluid.
- D. Valves shall be minimum one-half inch (1/2") in size, and have a relief pressure setting of 30 PSIG.

2.8 CHEMICAL SHOT (BYPASS-FILTER) FEEDERS

- A. Provide and install one shot type chemical feeders for each of the chilled and heating water systems where indicated on the Drawings.
- B. Feeders shall be complete with wide mouth (minimum 3-1/2 inch) secured cap, inlet and outlet taps, and drain tapping, as detailed on the Drawings. Provide a dome shaped top and bottom on all feeders.
- C. Shot feeders shall have a minimum five (5) gallon capacity, and be made of cast iron or carbon steel with a 200 PSIG rating at 200 Deg.F. Body shall be painted with an enamel finish.
- D. Feeders shall include accommodations for the insertion of filter bags. Provide one (1) initial set of filter bags for each feeder and five (5) additional replacement filter bags per feeder. Filters shall be rated for 25 microns.
- E. Feeders and filter bags shall be furnished by the chemical treatment services firm and installed by the piping system installer
- F. Acceptable Manufacturers shall be:
 - 1. Garratt-Callahan,
 - 2. Nalco,
 - 3. J. L. Wingert Co.,
 - 4. or Neptune.

2.9 AIR VENTS

- A. Refer to Section 23 21 13, Hydronic Piping.
- B. All air vent purging systems shall be furnished and installed by the piping system installer.

2.10 WATER TREATMENT CHEMICALS

- A. Chemical treatment service provider shall furnish one (1) year's supply of the recommended formulas for scale and corrosion protection for all closed system chilled and heating water systems. This shall commence at Substantial Completion, wherein, the project is complete and operational and the Owner has taken over beneficial occupancy or use of the facility. Once the water system is filled, circulated, flushed, and cleaned, additionally provide sufficient chemicals for treatment up to the period of Substantial Completion. This will result in chemical quantities sufficient to treat the system over a 15-18 month period. Include this cost in the Base Bid Amount.
- B. All closed chilled and heating water systems shall be chemically cleaned with an alkaline, phosphate formulation, containing dispersants, iron sequestrants, and surface- active materials that remove excess oil, lift solids from metal surfaces and suspend solid particles, and then be thoroughly flushed. After flushing is complete, each closed system shall be treated with a liquid nitrite-borate and/or silicate corrosion inhibitor based formulation, with 600-800 Parts Per Million (PPM) nitrite levels in the chilled water systems and 800-1200 PPM in the heating water systems. For systems with high make-up water flow rates use a molybdate/silicate blend of chemicals and maintain a molybdenum residual range of 48-60 PPM. Once the recommended chemical residual is achieved and documented, provide additional chemicals as required to retreat the system due to water loss on a monthly basis as indicated above (over 15-18 month period).
- C. The glycol chilled water loop shall be treated with an addition of a 25%, by volume, of ethylene glycol. The glycol-chilled water system shall contain a glycol mixture of a maximum of 25% Dow SR-1 or Union Carbide UCAR-17 ethylene glycol with corrosion inhibitors. Insure all new system materials are compatible with this mixture. Furnish anti-foaming agent with glycol. Install corrosion inhibitors in the glycol system as recommended by the chemical supplier.
- D. All flushing and cleaning and feeder filter bag replacement work shall be performed by the piping system installer at the direction of the chemical treatment firm.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Piping system Installer shall lay chilled and heating water piping on an even slope throughout to insure freedom from air locks and traps. Grade each system downward to low points. At each such low point provide a service drain, discharging above a floor drain, where reasonably practical, to permit the complete drainage of the system. Where it is impractical to route such drain to a floor drain, hub drain, or janitor sink, then provide a valve with hose connection with brass cap and label as "Drain". Such drains, where not routed to a floor or similar drain, shall only be allowed where approved by the Owner's Representative, or where indicated on the Drawings.
- B. Automatic air vents shall be provided at all high points in the piping system and where air might collect in closed water systems on a recurring basis. Each automatic vent shall have a valve at its inlet, a valved bypass and discharge line to the nearest floor drain or janitor sink. At all other locations in the piping system where air might collect and need purging on system fill, and where deemed necessary by the Test and Balance Firm, provide a manual valve or pet cock, with removable cap, for manual venting.
- C. Piping system Installer shall provide drains from each pump base, air separator, backflow preventors, compression tanks, and other system components with drain connections to the nearest floor drain in each case. Provide any other drain lines indicated on the Drawings in conjunction with the water circulating system or specified elsewhere herein.
- D. Piping system Installer shall install valves where required to segregate individual items of equipment or sections of the piping systems as required for project phasing, partial system pressure testing, for temporary bypasses and where indicated on the Drawings.

3.2 FLUSHING, CLEANING, AND CHEMICAL TREATMENT

- A. The chilled and heating water systems, existing and new, shall be flushed and pre-cleaned after successful completion of pressure tests and all leaks discovered are repaired.
- B. System flushing shall encompass filling the entire system with water, purging all air from the system at high points of the piping and at equipment; and, then, circulating water throughout the entire piping system with all isolation and control valves open to full flow through their respective coils and equipment. Operate multiple system pumps, primary and secondary, as required, to insure water flow throughout all parts of the system. Once water has been circulated for a minimum of 24 hours, the piping system installer shall, starting at the most remote location of the system, quickly open and close coil and equipment drain and strainer blow-down valves, to flush all silt, dirt, sediment, scale, grease, solder, debris, weld slag, and foreign material out of the main and run-out piping, coils, and equipment. Once all such system valves are blown-down, the system water shall be completely drained at each item of equipment and low point drains.
- C. Once the system is flushed, refill with fresh water, and purge of air; same as the procedure utilized before initial flushing, as described above. Then, add the specified solution of alkaline, or approved equal, pipe cleaner as provided by the Chemical Treatment Supplier, to be submitted for review for equivalency (to include detailed written cleaning and flushing instructions). This solution shall be circulated in each system for a minimum of 72 hours. During this 72 hour period flush the system by opening and closing each blow down and low point drain valves in the entire system to be cleaned for at least three (3) minutes once every eight (8) hours but not less than eight (8) times total. Following cleaning the system, crack open the blow-down valve at the circulating pump strainer to gradually bleed off the cleaning solution at a rate of approximately 1 gallon per minute which should not exceed the make-up rate while providing make-up water to the system and keeping the system air free. Continue to bleed off the cleaning solution until the discharged water alkalinity, at a remote point in the system, is approximately equal to that of the make-up water. Iron content should be less than 0.1 parts per million (ppm) and total dissolved solids should be within 10% of the make-up water. Testing for these levels shall be performed by the Chemical Treatment Service firm. Additional flushing may be required by the piping system installer should these levels not be accomplished. All strainer screens at pumps and water coils, existing and new, shall be removed and cleaned at completion of this flushing and cleaning process.
- D. After system cleaning and flushing is complete, the Chemical Treatment Company shall provide and apply an initial system treatment of corrosion inhibiting chemicals as specified herein, for all closed chilled and heating water systems, existing and new, consistent with system operating temperature and piping materials installed based on local water analysis.
- E. During the construction period after initial system treatment, up until "Substantial Completion" and for the one (1) year warranty period following "Substantial Completion", the Chemical Treatment Company shall provide a continuing water treatment service to include a monthly system analysis and addition of

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chemicals, as required, to maintain adequate protective treatment concentrations. Log all analysis and chemical additions, during this period.

- F. The Chemical Treatment Company shall provide a two (2) hour training session on operation and maintenance to Owner's maintenance personnel beyond normal system start-up.
- G. All chilled and heating water system chemicals shall be compatible with the existing system treatment as the new system is an extension of an existing Central Plant System and will be directly connected to the same. Field verify compatibility.
- H. Piping System Installer shall physically remove and clean all existing system pump and water coil strainer screens from their bodies at the completion of system flushing and cleaning. Reinstall screens in strainer bodies. Opening and closing of blow-off, drain and blow down connections is not a satisfactory substitute for this requirement. All are required.
- I. The glycol-chilled water system shall be charged with a 3-part water and 1-part glycol solution, mixed thoroughly in a separate tank or container before it is put into the system. Test the glycol solution concentration with a refractometer or equivalent after the system has been filled and circulated for 24 hours. If the solution's glycol concentration is less than 25% (or above 11 Deg.F.), draw off a sufficient amount of mixture and add pure glycol to achieve a 25% concentration.
- J. Provide a full 50 gallon drum of the specified 75% water and 25% glycol mixture in a chemical drum after the system is filled and fully charged with the same mixture for future use by the Owner.

3.3 COMPRESSION TANKS

- A. Support horizontal compression tanks from the overhead structure using Unistrut, Fahmet channels (back-to-back channels welded to tubing), or steel angles suitable for the expected component weights. These supports shall span not less than three (3) joists and rest on the bottom chord of steel joists using adequately sized support rods with double nuts. Tanks shall rest on sections of Unistrut, Fahmet channel or angles on specified saddles.

END OF SECTION 232513

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SECTION 233000 - HVAC AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with all other Division 23 Sections as applicable. Refer to other Divisions for coordination of work with other portions of work.

1.2 SYSTEM DESCRIPTION

- A. The scope shall include the furnishing and installation of all ductwork as shown on the Drawings; acoustical and thermal linings; flexible ducts and connections; duct access doors; air diffusers, grilles and registers; air volume control devices; hangers and supports; plenums and casings; turning vanes; air filters; installation of temperature control dampers, and other appurtenances necessary for a complete and operational system.
- B. All work shall be preceded by taking measurements at the job site, fully coordinating all work with other trades, verifying available spaces for ductwork, and developing Shop Drawings illustrating such.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the quality as specified herein. All work shall comply with the most recent Local Building Code, Mechanical Code, Fire Code, and all other applicable National, State and Local Codes or ordinances.
- B. All equipment and materials shall be installed in a workmanlike manner by trained and experienced sheet metal technicians and mechanics as recommended by the manufacturers of the products installed.
- C. Where the standards and requirements of this specification exceed those of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) the requirements herein shall govern. As a minimum all ductwork shall be constructed to meet all functional criteria defined in Section 11 of the 2005 SMACNA "HVAC Duct Construction Standards, Metal and Flexible," Third Edition. However, all ductwork shall comply with all code requirements noted above to include meeting deflection limits established in the local Mechanical code.
- D. The work shall be guaranteed for a period of one (1) year from and after the date of acceptance of the job, "Substantial Completion", against noise, chatter, whistling, or vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall either be removed and replaced or reinforced as directed by the Owner's Representative.
- E. Air quantities shown on the Drawings, or specified, are based on air at 75 Deg.F. dry bulb, 50 percent relative humidity, and 29.92 inches H.G. barometric pressure.
- F. Except where specified otherwise, all sheet metal used shall be constructed from prime galvanized steel sheets or coils up to 60 inches in width. Each sheet shall be stenciled with manufacturer's name and gauge. Coils of sheet steel shall be stenciled throughout on 10 foot centers (fabricate with stencils to the outside of the ductwork so they are visible when installed) with manufacturer's name and gauge tolerances in inches:

Gauge No.	Nominal Thickness	Minimum Thickness
26	0.0217	0.0187
24	0.0276	0.0236
22	0.0336	0.0296
20	0.0396	0.0356
18	0.0516	0.0466

- G. Contractor shall comply with this specification section in its entirety. If during a field observation, the engineer of record finds changes have been made without prior written approval, the contractor shall make the applicable changes to comply with this specification at the contractor's expense.

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- H. At the discretion of the Engineer of Record, sheet metal gauges and reinforcing may be randomly checked to verify all duct construction is in compliance with this specification section.
- I. All ductwork and fittings shall have a computer generated label affixed to each section detailing all applicable information including the duct dimensions, gage, reinforcement type/class, and connector type of the systems manufacturer. In addition, galvanizing thickness and country of origin shall be clearly stenciled on each duct section.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions in all items specified herein in accordance with Section 23 05 00.
- B. Shop Drawings shall be submitted on all items of sheet metal work specified herein. Shop drawings of ductwork shall be submitted at a minimum scale of 1/4" equal to one foot except that the Congested Areas and all Air Handling Unit Mechanical Rooms shall be submitted at a minimum scale of 1/2" = 1'-0". Provide sections for all Congested Areas and Mechanical Room Plans.
- C. Shop Drawings shall include the reflected ceiling plan, screened back, overlaid onto the floor plan indicating the proposed installation of all light fixtures; ductwork layout; duct fittings; duct connection details; offsets; bottom of duct elevations; all sheet metal dimensions (sizes); overall air device sizes, air device neck sizes, air device air flow quantities, and device type; duct pressure classifications; all mechanical piping; any conflicts discovered and unresolved through the use of transitions and offsets in the available space; turning vanes; manual volume dampers; automatic control dampers; smoke and fire dampers; duct access doors; flexible connections; and all mechanical fans and equipment.
- D. Sheet metal shop drawings shall be overlaid on piping shop drawings and other shop drawings for other portions of work specified in other sections of these specifications for complete coordination of all work prior to commencing with any installation. These Shop Drawings shall not be prepared directly on the Shop Drawings of other trades; they will be separate from all other shop drawings. Coordination Drawings shall be prepared in accordance with Specification Sections 01 30 00.
- E. Shop Drawings shall be based on actual field measurements taken at the job site and shall take into consideration all obstacles and be fully coordinated with all piping, conduits, structure, equipment, and general construction features.
- F. Shop Drawings shall be generated by a computer aided design and drafting (CADD) system as a CADD drawing. CADD files with Architectural Backgrounds and Mechanical design drawing files will only be provided when requested, if this privilege has not been previously abused, after a Release of Liability Form has been completed.
- G. Include a brochure, with individually assembled cut sheets, and details of all sheet metal fittings, duct construction standards proposed for each system, air volume control devices, and other accessories proposed to be used for job duct construction standards. This shall be done prior to submission or preparation of any sheet metal shop drawings.
- H. Should any ductwork installation commence without approved ductwork shop drawings or written approval by the Engineer of Record, the Contractor assumes all liability, to include all costs, in revising any portion of the sheet metal work that is deemed unacceptable by the Owner's Representative to include any conflicts discovered in installation that could have been resolved through the Shop Drawing process.

1.5 GUARANTEE

- A. The work shall be guaranteed for a period of one (1) year from and after the date of acceptance of the job, "Substantial Completion", against noise, chatter, whistling, or vibration, and be free from pulsation under all conditions of operation. This guarantee shall include defects in material, equipment and workmanship.
- B. After the system is in operation, should these defects occur, they shall either be removed and replaced or reinforced as directed by the Owner's Representative. This shall include repair of damages to building materials related to these deficiencies.

1.6 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored, which has been damaged or defaced, or which has gotten wet during storage or construction shall be rejected.
- B. Prior to ductwork being installed the roof system, or floor above the ductwork, must be sufficiently installed to protect ductwork from rain water entering ductwork. All openings in the ductwork shall be covered with minimum three (3) MIL thick plastic during construction. All open ends shall be covered in plastic at the end of each construction day. Whenever the system is operated with the ducts open the open ends must be covered with a pleated media fabric fastened to the open end (use MERV11 for these filters and only remove the filters to make final tie-ins).

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- C. Storage and protection of materials shall be in accordance with Section 23 05 00.

PART 2 - PRODUCTS

2.1 DUCTWORK

A. General:

1. All ductwork shown on the Drawings, specified or required for the heating, ventilating, and air conditioning systems, shall be constructed and erected in a first-class workmanlike manner by trained and skilled sheet metal workers.
2. All ducts shall be erected in the general locations shown on the Drawings, but must conform to all structural and finish conditions of the building. Before fabricating any ductwork, Contractor shall check the physical conditions of the job site, and shall make all necessary changes in cross sections, offsets, etc., whether they are specifically indicated or not.
3. Before starting shop drawings or fabrication of any ductwork, the Contractor must have an approved reflected ceiling plan with which he can coordinate location of air outlets, lights, tile patterns, etc.
4. The sizes of ducts indicated on the Drawings are the required net internal air stream dimensions, and where ducts are lined, the sheet metal sizes shall be increased three inches (3") in both dimensions to accommodate the linings (1-1/2" thick lining, unless indicated otherwise). Assume all rectangular ducts are lined (one inch (1") thick) unless noted otherwise.
5. Ductwork shall be classified, for construction standards, as follows:
 - a. All constant volume ductwork (supply, return relief and outside air) served by split DX A/C units and Roof-Top units, and all transfer air and exhaust air ducts shall be constructed to meet one inch (1") W.G. standards.
6. Except as noted otherwise, ducts, plenums, and casings shall be constructed of new lock forming quality galvanized prime grade steel sheets. The gauges of metal to be used, duct construction details, and the construction and bracing of joints shall be in accordance with the latest edition of the published standards of the ASHRAE Handbook or in accordance with the latest editions of Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) "Duct Construction Standards Manual, Metal and Flexible".
7. Plenum chambers shall be constructed of 18 gauge sheets thoroughly braced with 1-1/2 inch angle irons. All duct panels in rectangular galvanized steel ducts which are 12 inches and wider and which are not lined shall be crossbroken.
8. Make square elbows where shown or required, with factory fabricated double thickness turning vanes. Job fabricated vanes will not be acceptable. Except as otherwise specified or indicated on the drawings, make all other changes in direction with rounded elbows having a centerline radius equal to 1-1/2 times the width of the duct in the plane of the bend.
9. Make transformations in duct shape or dimension with gradual slopes on all sides. Normally, make increases in dimension in the direction of air flow, with a maximum slope of one inch (1") in seven inches (7") on any side. Where conditions prevent the normal slope specified above, a maximum slope of one inch (1") in four inches (4") will be allowed only where conditions necessitate.
10. Where a transition must be made with less slope than that noted above, install single thickness guide vanes to insure proper air flow, and to minimize air pressure drop. Transitions that require less slope than that noted above shall be noted on Shop Drawings, and require review and approval by the Engineer prior to installation.
11. Ducts shall be routed in conjunction with all types of pipes, electrical conduits, ceiling hangers, etc., so as to avoid interferences insofar as possible. When duct penetrations are unavoidable, provide streamline-shaped sleeves around such material penetrations, made airtight at duct surfaces, except that such sleeves are not required at tie rods. When the Contractor believes such penetrations are unavoidable, notify the Owner's Representative for approval prior to commencing with such work. Otherwise all such penetrations are not expected to occur and are not allowed. Such penetrations will not be allowed for the convenience of, or lack of coordination by, the Contractor. Where obstructions necessitate, are approved by the Owner's Representative, and are of a size exceeding 10% of the total duct area, the duct shall be transformed to maintain the same original duct area.
12. Where each duct passes through a fan room wall, it shall be wrapped with not less than 1/2" thick closed cell neoprene tightly fitted to the outer surface of the duct all around and sealed. In lieu of this method, completely fill the annular space between the duct and penetration by packing with fibrous insulation and seal the perimeter of the penetration around the duct, on both sides of the penetration, with a flexible non-hardening sealant, to be fire rated when applicable.

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13. All outlets or grilles in ceilings shall be supported rigidly from ceiling construction with suitable adapters or bucks installed as necessary and as shown to insure outlets and grilles will be accurately trued up with ceiling.
 14. Ductwork shall be fabricated in a manner to prevent the seam or joints being cut for the installation of grilles or diffusers.
 15. All sheet metal ductwork shall be securely hung from the building construction. All ducts shall be hung adjacent to the seam in the duct and shall be secured in a suitable manner to both the duct and the building construction. All vertical riser ducts shall be supported at each floor with angle iron secured to the ducts and set on the structure members. These angles shall be the same size as specified for bracing.
 16. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for any length of time. All panels of uninsulated ducts twelve inches (12") and larger shall be crossbroken. In general, sheet metal screws shall not be used in duct construction unless the point of the screw is in the air stream unless specifically indicated otherwise elsewhere herein.
 17. Manual dampers shall be installed as shown and as required to afford complete control of the air flow in the various duct systems. In rectangular supply ducts, a splitter damper shall be installed at each point where a branch is taken off and additional volume dampers shall be installed where shown or required to achieve the final air balance. No splitter dampers shall be installed in medium pressure ductwork, unless specifically shown on Drawings.
 18. Splitter dampers and volume dampers of the "butterfly" type, installed in rectangular ducts, shall be constructed of 16 gauge galvanized steel riveted or welded to square operating rods. Dampers shall have brass, bronze, or approved plastic bearings. The length of any splitter damper blade shall be 1-1/2 times the width of the smaller split in the duct, but shall be not less than twelve inches (12"). Where splitter dampers exceed 12 inches in height two (2) pull rods shall be used. Splitter dampers 12 inches (12") in height or less shall have one (1) pull rod.
 19. Butterfly damper blades in round ducts shall be the full width of the duct in which they are installed. Dampers shall be constructed of a minimum 22 gauge metal. Dampers over twelve inches (12") in diameter shall be constructed of 20 gauge metal, have a continuous rod with end bearings opposite the damper handle, and a quadrant type locking handle.
 20. The operating rods of all dampers shall be fitted with Young Regulators and the operating head shall be securely fastened in place so as to be accessible in the finished building unless shown otherwise. Operators shall be attached to duct where regulator occurs above a lay-in ceiling. Use a Ventlock No. 555 locking quadrant on accessible concealed splitter dampers. Where dampers occur above or behind plaster or other inaccessible ceilings, walls, chases or furrings, the regulator shall be the concealed type with adjustable cover plate equal to Young Regulator Company Type 315 with maximum 2-1/2" diameter cover plate and required accessories. Young Regulator bearings shall also be provided on the opposite end of each operating rod.
 21. Behind each ceiling supply outlet, provide and install a turning vane or approved equalizing grid, where noted or scheduled. Where adjustable air pick-ups are indicated at points branch ducts meet trunk ducts, they shall be Titus AG-45 or approved equal with operator adjustable from the duct exterior.
 22. Rectangular opposed blade volume dampers shall be as manufactured by American Warming and Ventilating or Ruskin. Blades shall not exceed 48 inches in length or twelve inches (12") in width, and shall be the opposed interlocking blade type. The blades shall be of not less than No. 16 gauge steel supported on one-half inch (1/2") diameter rustproofed axles. Axle bearings shall be the self-lubricating ferrule type.
- B. Low Pressure Ductwork:
1. Rectangular low pressure ducts, for systems designated to be operating at up to one (1) inches W.G., shall be constructed of the following gauges:

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Largest Dimension of Duct	U.S. Gauge of Metal	Maximum Reinforcement Spacing
Up to 36"	26	5'-0"
37" to 48"	24	5'-0"
49" to 60"	24	4'-0"
61" to 72"	22	4'-0"
73" to 84"	20	4'-0"
85" to 96"	18	4'-0"
Over 96"	18	2'-6"

The above rectangular ducts shall be constructed in accordance with Section 1 the latest edition of the "Duct Manual" published by the Sheet Metal and Air Conditioning Contractors National Association. However, the gauge thickness of the ductwork shall meet that as scheduled above.

2. Round low pressure ducts shall be spiral wound as manufactured by United Sheet Metal Company or have grooved seams with flat snaplock longitudinal seams. Spiral seam round duct gauge thicknesses shall be that standard by the manufacturer for the pressure rating of the system. Gauges for snaplock shop fabricated ducts shall be as follows, without exception:

Largest Dimension of Duct	Gauge of Metal	Gauge of Longitudinal Seams and Fittings
Up thru 8" in Diameter	26	26
9" to 14"	26	24
15" to 26"	24	22
27" to 36"	22	20
37" to 50"	20	18
51" to 60"	18	16

Elbows shall have a centerline radius of 1-1/2 times duct diameter or width and for round ducts may be smooth elbows or 5 piece 90 degree elbows and 3 piece 45 degree elbows. Joints of round ducts shall be slip type with a minimum of three (3) sheet metal screws.

3. All low pressure ductwork shall be externally sealed using water based products to include, United McGill Corporation United Duct Sealer, Hardcast "Iron-Grip 601", Foster 32-19 or Polymer Adhesive Sealant Systems, Inc. "Air Seal No. 11" duct sealer installed in the joints after closure. All sealants shall be U.L. rated. Externally seal all transverse and longitudinal joints, all fitting connections, and all accessories. Do not seal control or manual balance damper control rods. All systems shall meet a Class "A" Seal.
4. Low Pressure Duct Supports:
 - a. All horizontal ducts up to and including 40 inches in their greater dimension shall be supported by means of No. 18 U.S. gauge band iron hangers attached to the ducts by means of screws, rivets or clamps, and fastened above to inserts, toggle bolts, beam clamps or other approved means. Duct shall have at least one pair of supports 8'-0" on centers. Clamps shall be used to fasten hangers to reinforcing on sealed ducts.

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- b. Horizontal ducts larger than 40 inches in their greatest dimension shall be supported by means of hanger rods bolted to angle iron trapeze hangers. Duct shall have at least one pair of supports 8'-0" on centers according to the following:

Angle Length	Angle	Rod Diameter
4'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
6'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
8'-0"	2" x 2" x 1/8"	5/16"
10'-0"	3" x 3" x 1/8"	3/8"

- c. Vertical ducts shall be supported where they pass through the floor line with 1-1/2" X 1-1/2" X 1/4" angles for ducts up to 60". Above 60" the angles must be increased in strength and sized on an individual basis considering space requirements.
5. All low pressure ductwork shall be reinforced to maintain a maximum reinforcement spacing as scheduled with the rigidity classification as needed to meet the specification construction standard. Reinforcement spacing shall be reduced as required to meet the construction standard specified using the gauge thickness scheduled.
- C. Round Flexible Insulated Ductwork:
1. All round flexible insulated ducts, low and high pressure type, shall be factory fabricated and insulated as manufactured by Therma Flex or Flexmaster USA, Inc. Flexible ducts shall be equal to Thermaflex factory insulated type "MK-C" or Flexmaster "Type 3M".
 2. Flexible duct thermal conductance shall be based on a 75 Deg.F. mean temperature and an aged condition (not out of the box value). Flexible duct insulation shall be a minimum nominal two inches (2.0") in thickness with a minimum 0.75 lb. density. The completed duct assembly shall have a minimum R-value of 6.0. To verify compliance with the Energy Conservation Code in effect, the minimum R-value of 6.0 will need to be documented on the outside of the jacket to allow field verification of compliance with this requirement.
 3. The core liner of the flexible duct system shall be a tri-laminate aluminum foil, made with fiberglass and aluminized polyester, or a PVC coated fiberglass cloth. The outer liner shall be a polyester reinforced aluminized foil jacket.
 4. Flexible ducts shall be U.L. Listed in accordance with U.L. 181 as a Class I insulated air duct, and shall comply with NFPA Standard 90A and 90B. Flexible ducts shall have a maximum flame spread of 25 and maximum smoke developed rating of 50.
 5. Flexible ducts shall be suitable for operating temperatures of -20 up to 250 Deg.F.
 6. Flexible ducts shall be suitable for negative pressures of minus one inch W.G. in sizes up to 16" in diameter; and positive pressures up to 10 inches W.G. for sizes up to 16" in diameter. Maximum operating duct velocity rating shall be a minimum of 4,500-5,500 feet per minute.
 7. Maximum vapor transmission rating shall be 0.05 Perms as rated in accordance with ASTM-E-96.
 8. Unless otherwise noted, the maximum length of flexible duct shall be limited to five feet (5').
 9. Securement of flexible ducts to air devices shall consist of sliding the duct onto the air device collar or connector and securing it with plenum rated nylon or teflon panduit band on the inner liner which shall be U.L. rated for the application. Fold insulated outer vapor barrier jacket liner over the first band and secure with a second plenum rated panduit band. Make connection vapor tight with a vapor barrier seal using polyester reinforced aluminized duct tape that is two inches (2") wide, wrapped 2 times around the duct, or by the use of a fiberglass mesh wrapped in a similar fashion and coated with a vapor barrier coating, Foster's Vapor Safe 95-90 or 95-96 mastic or Childers CP-38. Coating must adhere to MIL-PRF-19565C with a permeance rating of less than 0.02 perms per ASTM-E-96, procedure B. No cloth backed duct tape is allowed. All duct tapes used shall be acrylic based. All fasteners, adhesives, and duct tape used shall be U.L. rated for the application.

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2.2 FLEXIBLE CONNECTIONS

- A. Where ducts connect to fans, including roof exhausters, flexible connectors shall be made that are fire-resistant, (up to 200 Deg. F.), waterproof, mildew-resistant and essentially airtight, and shall weigh approximately thirty ounces (30 oz.) per square yard.
- B. There shall be a minimum of one-half inch (1/2") slack in these connections, and a minimum of two and one-half inches (2-1/2") distance between the edges of the ducts for a total of three inches (3"). There shall also be a minimum of one inch (1") of slack for each inch of external static pressure on the fan system for medium pressure systems.
- C. Acceptable Manufacturers:
 - 1. Vent Fabrics "Ventglas", or approved equals by:
 - 2. Duro-Dyne.

2.3 ACCESS DOORS

- A. Furnish and install hinged, low leakage access doors in ductwork or plenums to provide access to all fire, smoke and combination fire - smoke dampers, mixed air plenums, automatic dampers, coils, filters, and elsewhere as detailed on the Drawings.
- B. Where the ducts are insulated, the access doors shall be double skin doors with a minimum one inch (1") of insulation in the door. The insulation shall have a minimum R-value of 6.0. Increase the thickness of the insulation as needed to comply. Where the access door is installed in non-insulated ductwork the access door shall be unlined sheet metal of the same gauge thickness as the duct.
- C. In no case shall access doors be smaller than eight (8") by eight inches (8"). Access doors shall be sized to permit testing or servicing of duct mounted components, such as, for coil cleaning, installation of control devices, resetting of fusible links, filter replacement, etc., as applicable and suitable for the application.
- D. Where duct access doors are above a suspended, normally non-readily accessible ceiling, such as plaster, gypboard or spline type ceilings, Contractor, under this Section of Specifications, shall be responsible for the proper location, and furnishing of, ceiling access doors, or panels, to make duct access doors easily accessed through the ceiling system. Ceiling access doors, or panels, shall be rated, where applicable, to match the fire rating of the ceiling system penetrated. Ceiling access doors, or panels, shall be installed under other Sections of these Specifications. Ceiling access doors, or panels, shall be centered directly beneath duct access doors or immediately adjacent thereto when duct access is through the side of the duct.
- E. In rectangular grease exhaust ducts, install access doors every twenty feet (20') maximum, center to center, and at all 90 degree elbows, when the total developed length exceeds forty feet (40'). Install access doors at every other floor level for vertical grease exhaust duct risers.
- F. All access doors shall be fully double gasketed, door to frame and frame to duct, and include a sash type or compression latches for sizes under eighteen inches (18") by eighteen inches (18"). Use one (1) sash type latch per twelve inches (12") of height or width. Access doors 18" x 18" and larger shall have quarter turn handle latches; provide one handle per 24" section, height or width, of door. As an example, provide two (2) handle type latches for a 48" tall access door.
- G. Provide a minimum of two (2) heavy loose pin hinges for each access door unless indicated otherwise herein. Piano style hinges will be an allowed substitute.
- H. Where the installation conditions prohibit suitable access with hinged access doors, then non-hinged access doors may be used in conjunction with a corrosion resistant cable or chain, of suitable length, attached to the access door and duct.
- I. For duct systems constructed to 2 inches W.G standards, or less, provide standard access doors meeting all requirements specified herein, which have a tested air leakage rating of less than 4.0 CFM at a test pressure of 2 inches W.G., and as manufactured by:
 - 1. Ventlok with hinges and No. 90 or No. 99 latches (less than 18" x 18"), or No. 100 or No. 140 latches (18" x 18" and larger), as applicable, or approved equals by:
 - 2. Ductmate, or
 - 3. Duro Dyne DDIAD-0806, or
 - 4. NCA Manufacturing ADH-T-1, or
 - 5. Pottorff HAD or CAD, or
 - 6. Nailor 08SH with HP Seal, or 0890, or
 - 7. Cesco Products HDG, or
 - 8. Ward Sandwich Style Access Doors, DSA or DDA, for round ductwork.

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2.4 DUCT LINER

- A. Where indicated on the Drawings or specified herein, all rectangular transfer ducts; except kitchen grease hood, kitchen dishwasher and fume hood exhaust ducts; shall be lined with Fiberglass mat faced duct liner in the thicknesses, type, and locations as indicated elsewhere herein.
- B. Kitchen grease hood exhaust, kitchen dishwasher exhaust, kitchen hood make-up air, and fume hood make-up air and other industrial type exhaust air ducts shall not be lined. Line all other general building exhaust air ducts within 10'-0" on each side of each in-line exhaust fan with one inch (1") thick liner. Roof mounted exhaust fan ductwork shall also be lined, one inch (1") thickness, but only for the first 10'-0" of ductwork from the roof curb toward the occupied space.
- C. All transfer air ducts shall be lined with one inch (1") thick duct liner.
- D. The liner insulation system shall be one and one-half inches (1.5") in thickness on all conditioned air, heated or cooled, as well as outside air intake ducts, and mixed air plenums to obtain a minimum R-value of 6.0 thereon.
- E. All ductwork systems are required to meet the most recent version of the International Energy Conservation Code.
- F. All duct liners shall comply with NFPA 90A and 90B and ASTM C 1071, Type I, for ducts and Type II for plenums (rigid liner). Liner shall consist of flexible, matt faced insulation made of inorganic glass fibers bonded by a thermosetting resin with an encapsulant edge coating, and shall be a rotary style duct liner product with a water repellant ingredient on the mat face to help keep moisture from penetrating the air stream surface. Other technical requirements shall include:
 - 1. Be suitable for temperatures up to 250 Deg.F. per ASTM C 411.
 - 2. Be suitable for air velocities up to 6,000 FPM per ASTM C 1071 for Type I products and 5000 FPM for Type II products.
 - 3. Water vapor sorption shall be less than 3% by weight per ASTM C 1104.
 - 4. Air stream surface mat facing shall be tested with an EPA registered anti-microbial agent to aid in the prevention of fungal and bacterial growth. Mat face, as treated, shall not support the growth of mold, fungi, or bacteria per ASTM C 1338, ASTM G 21 and ASTM G 22.
 - 5. Does not exceed a Flame Spread of 25 and Smoke Developed and Fuel Contributed of 50 per ASTM E 84, NFPA 225, and UL 723.
 - 6. Conductance of 0.24 (R-value of 4.2) for a 1.5 PCF or 2.0 PCF duct liner at a 75 Deg.F. mean temperature per ASTM C177 for a one inch (1") thick product.
 - 7. Greenguard Compliant (Greenguard Environmental Institute).
 - 8. Noise Reduction Coefficient (NRC) of 0.70 or higher for a one inch (1") thick product and 0.80 for a two inch (2") thick product per ASTM C 423, type A mounting.
- G. All duct liners shall be able to be cleaned in accordance with the North American Insulation Manufacturers Association (NAIMA) "Cleaning Fibrous Glass Insulated Air Duct Systems Recommended Practices".
- H. Liner shall be applied to the inside of rectangular ducts and plenums with fire-resistant adhesive, Fosters 85-60, or 85-65, or Childers CP-127, Hardcast "Seal-Tack" or Ward "Premium Duct Liner Adhesive", or equal, complying with ASTM C 916, completely coating the clean sheet metal. All joints in the insulation shall be "buttered" and firmly butted tightly to the adjoining liner using fire resistant adhesive. Where a cut is made for duct taps, etc., the "raw" edge shall be accurately and evenly cut and shall be thoroughly coated with this same fire resistant adhesive.
- I. On ducts over twenty-four inches (24") in width or depth, the liner shall further be secured with mechanical fasteners. Fasteners shall be Graham or Gemco weld pins. "Stick Clips", "Sheet Metal Clips", or other fasteners secured to the ducts by adhesive are not allowed. Fasteners shall be placed on a maximum spacing of eighteen inches (18") and shall be pointed up with fire-resistant adhesive. Fasteners shall not compress the insulation more than 1/8".
- J. Liner shall be accurately cut and ends thoroughly coated with adhesive so that when the duct section is installed, the liner shall make a firmly butted and tightly sealed joint. Provide metal nosings securely installed over transversely oriented liner edges facing the air stream at all fan discharges, at access doors, and at any interval of lined duct preceded by unlined duct.
- K. Where rectangular ducts are lined and adjoins externally insulated rectangular ducts, the two insulations shall be overlapped not less than twenty-four inches (24").
- L. Dimensions given on the Drawings are inside air stream, free area, dimensions only and sheet metal sizes shall be increased in size to maintain these free area dimensions when liner is installed.
- M. All exposed ductwork shall be internally lined unless specifically indicated otherwise.
- N. Refer to Section 23 07 00, Insulation, for further related requirements.
- O. Acceptable liner manufacturer shall be:
 - 1. Certainteed, Tough Gard R with enhanced surface.

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2. Knauf, Rotary Duct Liner E-M with Hydrosshield.
3. Owens Corning, Quiet R Acoustic Duct Liner, Type 150 or equivalent Duct Liner Board.
4. Johns Manville, Linacoustic RC or R-300.

2.5 GRILLES, REGISTERS, AND DIFFUSERS

- A. Grilles, registers, ceiling outlets, diffusers and other air devices shall be as scheduled on the Drawings and shall be suitable for the intended use.
- B. Provide air devices with sponge rubber or soft felt gaskets at flanges where the devices mate up to a ceiling or wall surface.
- C. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level or criteria, face velocity, throw, drop, pressure drop, air diffusion, etc., before the submittal is made. Selections shall meet the manufacturers' own published data for the above performance criteria. The throw shall be such that the terminal velocity will be not more than 50 FPM or less than 25 FPM at the point of penetrating the occupancy zone. The occupancy zone is defined as six feet (6') above the finished floor and six inches (6"), or farther, from the walls.
- D. Noise levels shall not exceed those published in current ASHRAE Standards and Guidelines for the type of space being served (N.C. level) or that scheduled.
- E. Locations of outlets on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be governed by the established pattern of the lighting fixtures, structure and Architectural Reflected Ceiling Plan (RCP). Air devices shall have margins, frames, and sizes to be compatible with the ceiling and wall systems installed. All color and finishes are subject to final approval by the Architect.
- F. Where called for on the schedule, grilles, registers, ceiling outlets, diffusers and other air devices shall be provided with deflecting devices and manual dampers.
- G. Where indicated on the Drawings, provide a fire rated blanket on the back side of steel ceiling mounted air devices (supply, return, exhaust, etc.).
- H. Where indicated on the Drawings, provide an insulation blanket on the back side (all surface area) of ceiling mounted supply air devices to prevent condensation.
- I. All air devices shall be the standard product of the manufacturer, subject to review by the Architect. Acceptable manufacturers are:
 1. Titus, or approved equals only by:
 2. Krueger.
 3. Nailor.
 4. Metal-Aire.
 5. Carnes.
 6. Price Industries.

2.6 AIR FILTERS

- A. Provide appropriately sized and number of air filters for each piece of individual air handling equipment to include, but not be limited to, the following:
 1. Roof-Top Units.
 2. Split DX A/C Units
 3. Elsewhere as required to protect air type heat exchangers, such as warm air furnaces, or coil surfaces, such as duct mounted direct expansion coils.
- B. Medium efficiency air filters shall generally be two inches (2") thick, unless indicated otherwise and shall be the pleated media, disposable type, listed by Underwriters Laboratories as Class 2, with the following features:
 1. Air filters shall be rated in accordance with the most recent version of ASHRAE Standards 52.1 and 52.2, test methods as indicated herein, and shall conform to Section 7.4 of ARI Standard 850.
 2. Filter media enclosing frame shall be constructed of rigid, heavy duty, high wet-strength resistant, "beverage" board with diagonal support members on the air entering and air exiting sides. Expanded diamond grid media support, integral with frame, shall be chemically bonded to filter media at each pleat, to insure pleat spacing and stability. Pleated media shall be bonded to the inside of the frame to eliminate air bypass.
 3. Filter media shall be high performance, non-woven, reinforced cotton-poly, synthetic blend fabric formed in a V-shape.
 4. Filters shall have the following performance data:

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THICKNESS	SQUARE FEET MEDIA AREA TO ONE SQUARE FOOT FACE AREA	MINIMUM PLEATS PER LINEAL FOOT	INITIAL AIR RESISTANCE (INCHES W.G.)	RESISTANCE BASED ON AIR FLOW OF
One Inch (1")	2.4	16	0.25 (350 FPM)	1400 CFM
Two Inch (2")	4.3	15	0.28 (500 FPM)	1500 CFM

5. Filters shall be suitable for operation with varying velocities of up to 500 feet per minute (FPM) for 2" filters and 350 FPM for 1" filters.
 6. Filters shall have a minimum efficiency of 30% with an average arrestance of 90 to 92% minimum dust holding capacity which shall be no less than 170 grams as tested in accordance with ASHRAE Standard 52.1. Filters shall also have a MERV rating of 11 as tested in accordance with ASHRAE Standard 52.2-2007.
 7. Acceptable Manufacturers:
 - a. Camfil Farr, Inc., Model AP-Eleven, or approved equals by:
 - b. Environmental Filter Corporation.
 - c. Eco-Air.
 - C. All filters shall be standard sizes that are readily and locally available, in stock, through multiple over the counter sources without requiring special order. Standard acceptable sizes shall be 16" x 20" and 16" x 25".
- 2.7 ADHESIVES AND SEALANTS
- A. All adhesives and sealants used on this project must have a Volatile Organic Compound (VOC) content less than that listed in the current South Coast Air Quality Management District (SCAQMD) Rule 1168, and all sealants and fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
 - B. All adhesives and sealants shall meet the most current Leadership in Energy and Environmental Design (LEED™) requirements.
- 2.8 TURNING VANES
- A. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct.
 - B. Turning vane front and back panels shall be securely locked together with adequate crimping to prevent twisting of vane. Vanes shall be capable of withstanding 250 pounds of tensile load when secured according to the manufacturer's instructions.
 - C. Rails for mounting vanes shall have self locking, friction fit tabs designed to facilitate proper alignment of vanes. Tab spacing shall be as specified in Figure 4-3 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible", Third Edition standard. Rail systems with non-compliant tab spacing shall not be accepted.
 - D. Acoustical Turning Vanes shall be used in applications that require quiet operating systems. Mounting rails shall have friction insert tabs that align the vanes automatically. These shall only be required where designated on the Drawings.
 - E. Approved Manufacturers:
 1. Ductmate Industries PRO-Rail Turning Vane or approved equals.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- A. Install all ductwork and equipment as indicated on the Drawings in full accordance with these specifications including foundations, hangers, supports, etc.
 - B. Seal all ductwork as specified, pressure test and repair leaks.
 - C. Install all air intake hoods on continuous neoprene strips set level on top of wood nailers of the specified roof curbs. Hoods shall be secured at 8" O.C. to the curbs with corrosion resistant screws if not secured

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by other fasteners as specified. Flash and counterflash to prevent water leakage through the overall roofing system.

- D. Install all duct mounted components such as heating coils, electric or water type, sound attenuators, air terminals, etc. in accordance with the manufacturers recommendations.
- E. Should defects or installation deficiencies become apparent, or are observed, after the systems have been in operation, the deficient components shall be removed and replaced or reinforced as directed by the Owner's Representative.

3.2 CLEANING OF DUCT SYSTEMS

- A. Before the grilles or diffusers are installed, all fans and air conditioning units shall be operated and all debris and foreign matter shall be removed from the ducts.
- B. The air conditioning units shall be thoroughly cleaned, and the drain pans shall be thoroughly cleaned and flushed out with a hose; the filters shall be thoroughly cleaned and the grilles shall then be installed.
- C. Insure all duct openings are capped and sealed during construction when additions are not being made.

3.3 AUTOMATIC CONTROL DAMPERS

- A. Refer to Section 23 09 00, Controls and Instrumentation.
- B. Install all temperature control modulating dampers under this section of the specifications, furnished in Section 23 09 00.

3.4 FILTERS

- A. No air moving equipment may be operated at any time without filters being fully installed in equipment.
- B. Provide a minimum of three (3) spare sets of two inch (2") thick, medium efficiency, pleated media filters for all air handling and fan coil units, as well as for filter return air grilles where scheduled, in addition to manufacturer furnished filters specified elsewhere herein. Where other sections of these specifications require one inch (1") thick filters, or other types of filters, provide spare sets of matching thickness and type.
- C. Additionally replace filters during construction as directed by the Owner's Representative.
- D. Install one (1) new complete set of filters, as directed by the Test and Balance (TAB) Firm, just prior to performance of TAB work.
- E. Install one (1) new set of filters at "Substantial Completion" of the project.
- F. Where the minimum number of filter sets are not used for the aforementioned purposes, provide the left over filters to the Owner for maintenance stock.
- G. Document, in writing, when each filter change-out occurs.

END OF SECTION 233000

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SECTION 233410 - HIGH VOLUME LOW SPEED (HVLS) CIRCULATION FANS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with all other Division 23 Sections, as applicable. Refer to other Divisions for coordination of work with other portions of work.

1.2 SYSTEM DESCRIPTION

- A. Ceiling mounted HVLS fans of the diameter and air flow rates indicated on the equipment schedule.
- B. Provide high efficiency motors as specified in Section 230513 for motors one (1) horsepower and larger.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the best quality.
- B. All equipment and materials shall be installed by factory trained installers or mechanics as recommended by the manufacturer.
- C. All fans shall bare an AMCA label. Capacity ratings shall be based on tests performed in accordance with the latest version of ANSI/AMCA Standard 230-07 – Laboratory Methods of Testing Air Circulating Fans for Rating.
- D. All fans shall be ETL certified and bare a UL label to indicate the fan is constructed to the guidelines set forth in UL Standards 507, 746C, 1004, and 1917.
- E. Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, by a certified testing agency and marked for the intended location and application.

1.4 SUBMITTALS

- A. Submit product data to include the manufacturer's descriptive literature, performance information, and installation instructions.
- B. Submit a color chart for the Architect and Owner to select or confirm the desired color scheme for the fan.
- C. Submit wiring diagrams for electrical power and control wiring.
- D. Submit Shop Drawings in accordance with Section 230500.
- E. When equipment, other than specified, is proposed, the Contractor shall be completely responsible for electrical revisions necessitated. Submit listing of electrical feeder and conduit sizes, breaker sizes, and motor starter sizes for each item of equipment where motor sizes are required to be larger than specified to meet scheduled capacities.

1.5 WARRANTY

- A. Manufacturer shall provide a twelve year limited warranty to repair or replace defective parts, components, and control panels.
- B. Manufacturer shall provide a lifetime warranty for the airfoils, hub, and support frame.
- C. Warranty information and terms shall be clearly indicated in the Operation and Maintenance manuals provided to the Owner.

1.6 PRODUCT HANDLING

- A. Deliver fan materials and components to the site in the manufacturer's shipping container. Fans not properly protected and stored and which are damaged or defaced during construction shall be rejected.
- B. Storage and protection of materials shall be in accordance with Section 230000.

PART 2 - PRODUCTS

2.1 HIGH VOLUME LOW SPEED (HVLS) CIRCULATION FANS

- A. Airfoils
 - 1. The fan shall be equipped with a minimum of five (5) airfoils and shall have no more than eight (8) airfoils.
 - 2. The air foils shall be made from 6061 Extruded Aluminum with a powder coat finish. The finish colors shall be selected by the Architect/Owner from the fan manufacturer's color chart.

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- B. Motor and Drive Assembly
 - 1. Provide a gearless direct drive motor assembly.
 - 2. The motor shall be a totally enclosed, fan cooled (TEFC) with an IP42 NEMA classification. The motor shall be rated for continuous operation and shall have Class F insulation rating.
- C. Frame and Mounting System
 - 1. All mounting bolts shall be SAE Grade 8.
 - 2. The frame and mount shall be welded construction using ASTM A36 steel.
 - 3. The frame and mount have a powder coat finish and the finish color shall be selected by the Architect/Owner from the fan manufacturer's color chart.
 - 4. The standard universal I-Beam clamp will be utilized for connection to the building structure.
- D. Safety Cables/Guy Wires
 - 1. The fan shall have four 1/8" diameter, galvanized steel, braided cable guy wires attached to the building structure. The guy wires shall be installed per the manufacturer's installation instructions to control lateral movement.
 - 2. A 1/4" diameter, galvanized steel, braided cable shall be utilized as a secondary means to connect the HVLS fan to the building structure.
- E. Remote Wall Mounted Control System
 - 1. Provide a wall mounted control panel to control each fan separately.
 - 2. The control panel shall control the following operations.
 - a. On/Off.
 - b. Increase/decrease fan speed.
 - c. Forward/reverse fan direction.
- F. Fire Alarm System Interface
 - 1. The fan shall be capable of receiving a stop command from the Fire Alarm System, and Aspirating Smoke Detection (ASD) device, smoke, flame or heat detectors.
 - 2. The fan shall be capable of ceasing operation when water flow is detected in the fire sprinkler system.
 - 3. The fan shall meet the air velocity requirements of FM Global for ESFR sprinklers.
 - 4. Upon detection of a fire by the means described above the HVLS fans shall coast to a stop as stated in the NFPA guidelines.
- G. Acceptable Manufacturers:
 - 1. Hunter Fans
 - 2. Macro Air Fans
 - 3. SkyBlade Fans
 - 4. Big Ass Fans (BAF)

PART 3 - EXECUTION**3.1 DELIVERY AND PROTECTION**

- A. Deliver all equipment to the site as indicated in Division 1.
- B. Contractor to perform installation and start-up to include installation of all accessories as required to make a complete and operating system.
- C. All equipment shall be handled carefully to avoid damage and be protected from exposure to the weather. All equipment shall be examined upon delivery to the site and evidence of abuse, damage, or exposure to weather and dirt shall be grounds for refusal to accept individual pieces of equipment. Rejected items shall be replaced promptly at no cost to the Owner.

3.2 INSTALLATION

- A. Securely anchor fans suspended from the structure in accordance with the manufacturer's installation instructions.
- B. Install all safety devices, safety cables, and guy wires prior to operating the fan.
- C. Confirm the operating parts move freely prior to operating the fan.
- D. Confirm there are no obstructions in the fan blade path prior to operating the fan. The vertical clearance from the fan blades to a fire sprinkler head deflector shall be a minimum of 3'-0".
- E. Adjust fan components as required for balanced operation in accordance with the manufacturer's installation instructions.

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- F. In buildings equipped with a sprinkler system confirm that a signal from the Fire Alarm system immediately ceases the operation of the HVLS fans when water flow is detected in the fire sprinkler system.

3.3 CLEAN-UP

- A. Clean all fans and components after installation is complete.
- B. Dispose of any construction debris.

END OF SECTION 233410

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SECTION 236400 - PACKAGED WATER CHILLERS, OUTDOOR AIR COOLED (36-200 Tons Capacity)

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Comply with General Requirements in Division 1, and all referenced documents.
- B. Comply with all other Sections as applicable. Refer to other Divisions for coordination of this work with other portions of work specified therein.

1.2 SYSTEM DESCRIPTION

- A. The work shall include installing microprocessor controlled packaged air cooled reciprocating water chilling units.
- B. Contractor shall connect piping, all required controls, factory furnished field installed accessories, appurtenances, insulation, hangers, supports, foundations, etc., for the water chilling units.

1.3 QUALITY ASSURANCE

- A. Unit performance shall be rated and certified in accordance with American Refrigeration Institute (ARI) Standard 590, latest edition.
- B. Unit construction shall comply with the latest editions of the National Electric Code (NEC), Underwriters Laboratory (U.L.), American Society of Mechanical Engineers (ASME) applicable codes, and American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 15.
- C. Cooler shall be tested and stamped in accordance with ASME Code for a minimum refrigerant working side pressure of 278 psig, and a minimum water side pressure of 150 psig.
- D. Air-cooled condenser coils shall be leak tested at 150 psig and pressure tested at 450 psig.
- E. Unit shall be fully tested at the factory prior to shipment.
- F. Factory authorized service personnel and routine repair parts shall be available within 24 hours of a trouble call.
- G. All equipment and materials shall be new and unused.

1.4 SUBMITTALS

- A. Product Data: Submit complete manufacturer's descriptive installation instructions for the configuration of equipment proposed to include:
 - 1. Chilled water piping arrangement.
 - 2. Equipment sizes, dimensions and weights.
 - 3. Accessory installation methods.
 - 4. Complete field and factory power and control wiring diagrams.
 - 5. Equipment capacities at design parameters scheduled and specified.
 - 6. Equipment installation methods.
 - 7. Sound Power Levels at full load for each of the eight octave bands with and without sound attenuation package installed.
- B. Shop Drawings: Submit in accordance with Section 23 05 00.

1.5 PRODUCT HANDLING

- A. Equipment to be installed shall be delivered to the site where it shall be covered and protected. Material not properly protected and stored, and which is damaged or defaced during construction, shall be replaced at no cost to the Owner.
- B. Storage and protection of materials shall be in accordance with Section 23 05 00.

PART 2 - PRODUCTS

2.1 AIR COOLED PACKAGED WATER CHILLER(S)

- A. Provide single piece factory assembled units to meet the capacities scheduled which shall be rated to handle the listed water quantities without excessive pressure drops and without exceeding the manufacturer's rating on water velocities through the tubes.
- B. Ratings shall be with a 0.0001 fouling factor on the water side of the cooler at 105°F ambient air temperature. Chillers shall meet scheduled efficiency ratings.
- C. Each unit shall include complete factory wiring, refrigerant piping, controls, operating refrigerant and oil charge (R-134a or R-410a), and special features as required prior to field startup.

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- D. Unit cabinet shall consist of a galvanized steel casing, zinc phosphatized, with an electrostatically applied baked enamel finish. Cabinet shall be capable of withstanding Federal Test Method Standard No. 141, Method 6061, 500 hour salt spray test.
- E. Full load operation of each motor shall not exceed respective name plate ratings.
- F. Compressors:
 - 1. Compressors shall be hermetic scroll or a single semi-hermetic rotary screw type.
 - 2. Each compressor shall be equipped with suction and discharge service valves, insert type factory sized oil crankcase heater, suction strainer, oil strainer, oil sight glass, and oil charging connection.
 - 3. Reciprocating compressors shall have a force feed lubrication system with automatically reversible oil pump and operating oil charge.
 - 4. Compressor motors shall be refrigerant suction gas cooled, high torque, semi-hermetic induction type, maximum 1750 RPM for reciprocating compressors and 3600 RPM for screw compressors, with inherent thermal protection in all three phases.
 - 5. Each individual compressor shall be mounted on spring or neoprene pad vibration isolators, without exception, to minimize noise and vibration transmissions to obtain an isolation efficiency of 95%, or greater. Submit data to verify compliance.
 - 6. Cycles per hour for each compressor shall not exceed six (6).
 - 7. Screw compressors shall be individually enclosed by an acoustic sound blanket suitable for outdoor conditions. Sound blankets shall be made of one layer of acoustical absorbent textile fiber, minimum 5/8 inch thickness; one layer of anti-vibrating heavy material with a minimum thickness of 1/8"; and both of these layers enclosed with two (2) outer sheets of welded PVC or vinyl coated polypropylene reinforced fabric suitable for exposure to high ambient temperatures, be oil and water resistant, and be treated for ultra-violet resistance. Enclosures shall be factory or field mounted.
 - 8. Scroll compressors shall have the ability to modulate and shall have a minimum of four steps of capacity. Provide scroll temperature protection, reverse phase protection, short cycle detection and low control voltage protection for each scroll compressor.
- G. Evaporator (Cooler):
 - 1. Evaporator shall be direct expansion shell and tube type with carbon steel barrel, polypropylene water baffles, and high efficiency internally enhanced seamless finned through copper tubes rolled into heavy carbon steel tube sheets.
 - 2. Shell and tube heat exchanger heads shall be removable.
 - 3. The evaporator and all cold surfaces, and adjacent surfaces, as required to prevent any sweating, shall be insulated with 3/4 inch thick closed cell foam insulation sheet, maximum K factor of 0.28, fitted and cemented in place, then painted with a resilient vinyl base paint to resist cracking.
 - 4. The evaporator shall be designed, constructed, inspected, and stamped in accordance with ASME Code requirements.
 - 5. Provide factory, or field installed, weld neck flanged water piping connections. Victaulic couplings not acceptable.
 - 6. Equip with electric heat trace along the shell under the insulation to protect against cooler freeze-up down to -10°F ambient.
 - 7. Design shall include two independent refrigerant circuits such that failure of one circuit will not cause a total loss of capacity.
- H. Air Cooled Condenser Coils:
 - 1. The condenser coils shall be constructed of 3/8" O.D. seamless copper tubes mechanically bonded into plate type aluminum fins. Alternative micro-channel aluminum technology coils will be allowed. A sample will need submitted for review and approval by the Engineer.
 - 2. A sub-cooling coil shall be an integral part of the main condenser coil.
 - 3. Tubes shall be cleaned, dehydrated, and sealed.
 - 4. Provide manufacturer furnished, field installed coil air inlet, hail and vandal type, guard made of galvanized steel, PVC coated steel or painted steel to resist corrosion. Guard shall have rigid border for reinforced support and securement to equipment frame. Flat expanded metal is not acceptable. Guards shall protect condenser coils, compressors, and other refrigerant piping and specialties.
- I. Condenser Fans and Motors:
 - 1. Condenser fans shall be propeller type arranged for vertical air discharge and shall be direct drive fan motors, 3 phase type, with Class B insulation.
 - 2. Each fan shall be protected by a heavy gauge steel wire fan guard with ultra-violet inhibited PVC coating.
 - 3. Fans shall have permanently lubricated bearings.

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4. Fan shafts shall be inherently corrosion resistant.
 5. Fans shall be statically and dynamically balanced.
 6. Condenser fans, motors, and accessories shall include a factory installed sound reduction option to result in a nominal 2-4 dba reduction in overall sound power levels, versus, a standard unit operating without this option.
- J. Each refrigerant circuit shall be completely independent of each other and include a factory insulated suction line, a hot gas muffler, high side pressure relief device, liquid line shut-off valves, suction and discharge manual shut-off valves, replaceable core filter drier, moisture indicating sight glass, liquid line solenoid valve, stepper motor actuated electronic expansion valve or thermostatic expansion valve, and complete operating charge of refrigerant R-22, R-134a or R-410a and compressor oil.
- K. Controls:
1. Unit controls shall include the following minimum components.
 - a. Microprocessor
 - b. Power and control circuit terminal blocks
 - c. External on/off control switch (inside cabinet) with indicating lights.
 - d. Replaceable solid-state relay panel
 - e. Leaving chilled water setpoint and control panel
 - f. Thermistors and potentiometers.
 2. Capable of performing the following functions:
 - a. Recycling pump down control. Pump-out to occur at beginning and end of every circuit cycle. Each time the unit is energized, the oil pump shall be energized if all safety protective devices are satisfied.
 - b. Unit controls shall provide recycling pump down protection at all times, including time clock system shutdowns on nights and weekends.
 - c. Capacity control based on leaving chilled water temperature and compensated by rate of change of return water temperature.
 - d. Limit the chilled water temperature pull-down rate at start-up to 1°F per minute to prevent excessive demand spikes (charges) at start-up.
 3. Unit shall be provided with automatic head pressure controls that permit satisfactory operation under low ambient conditions to 10°F, by cycling condenser fans or fan speed reduction in response to head pressure.
 4. During part load operation, the unit's refrigerant circuits shall be alternately unloaded in steps by providing automatic lead-lag control from accessory or standard cylinder unloaders and compressor staging to automatically alternate the lead circuit to ensure even compressor wear. Units shall have as their last step of unloading a hot gas bypass for stability at low capacity if units do not have unloading capability down to 15% of total capacity. Provide a minimum of two (2) stages of capacity for machines 50 tons and smaller in size. For units over 50 tons in size, provide one (1) additional stage of capacity for each incremental increase in capacity of 25 tons. Provide at least three (3) stages of control for units up to 75 tons in capacity, four (4) stages for units up to 100 tons capacity, with up to eight (8) stages of capacity control for units up to 200 tons in size.
- L. Safeties:
1. Unit shall be equipped with thermistors and/or potentiometer and all necessary components in conjunction with the control system to provide the unit with the following protections:
 - a. Loss of refrigerant charge protection
 - b. Low water flow protection.
 - c. Low chilled water temperature protection
 - d. Low and high superheat protection
 - e. Low oil protection for each compressor circuit.
 - f. Low control voltage (to unit) protection.
 - g. Ground current protection for each compressor which shuts down compressor when no more than 2.5 supply amps are measured to prevent formation of acids.
 - h. High pressure switch.
 - i. Visual alarm signal (Light).

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2. Compressors shall be equipped with the following manual reset-type protections:
 - a. Thermal overload or individual compressor circuit breaker or solid state device overload protection.
 - b. Pressure overload
 - c. Electrical overload through the use of definite-purpose contactors and calibrated, ambient compensated, magnetic trip circuit breakers. Circuit breakers shall open all three phases in the event of an overload in any one phase, or single phasing condition. Motor overloads that provide single phasing protection as well as overload protection will be acceptable, in lieu of circuit breakers.
 3. Fan motors shall have inherent overcurrent protection.
 4. Provide a factory installed and wired non-fused disconnect.
- M. Diagnostics:
1. Diagnostic display module shall be capable of indicating the safety lockout condition through displaying a two-number code for which a legend shall be provided in control panel. Protections included for display shall be:
 - a. Compressor lockout
 - b. Loss of charge
 - c. Low water flow
 - d. Low oil pressure
 - e. Cooler freeze protection
 - f. High or low suction superheat.
 - g. Thermistor or potentiometer malfunction.
 - h. Entering and leaving water temperature.
 - i. Evaporator and condenser pressure.
 2. Module must also be capable of performing a run test to verify operation of every switch, thermistor, potentiometer, fan, and compressor before chiller is started.
- N. Operating Characteristics:
1. Unit shall be capable of starting and running fully loaded at outdoor ambient temperatures from 10°F up to 115°F per maximum load criteria of the most recent edition of ARI Standard 590, without special controls.
 2. Unit shall be capable of starting up with 95° entering water temperature to the cooler.
 3. Electrical Requirements:
 - a. Unit primary electrical power supply shall be connected to a single point.
 - b. Unit shall operate on three phase, 60 cycle power at the voltage shown in the equipment schedule.
 - c. Field power connection, control interlock terminals, and unit control systems shall be centrally located.
 - d. Power and starting components shall include separate fusing for the control circuit, fan circuits, starting contactors per compressor, solid-state compressor sequence start timers, adjustable 0 to 6 minute lockout timer anti-recycle protection on compressors, solid-state or suitable alternate compressor overload protection in all three phases, and unit power terminal blocks suitable for field connection from a single power supply.
 - e. A field supplied 115 volt control power supply, with fusing and disconnect, shall be utilized to supply the control circuit and cooler heat trace system.
 - f. Unit controls and power wiring shall be pre-wired and completely factory installed and labeled for ease of service and replacement.
 4. Panel access doors shall key lock to prevent unauthorized access. Dead front panels shall protect service personnel against accidental contact with the line voltage components. Field install a key lock device on panels if not factory installed. Provide two (2) sets of keys for all locks.

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O. Special Features:

1. Unit shall be capable of starting and running at outdoor ambient temperatures down to 10°F with the addition of brine in the cooler circuit, wind baffles, and two-fan cycling solid state pressure switches with condenser coil temperature sensor.
2. Unit shall be equipped with electrically actuated suction cutoff type cylinder unloaders on both lead compressors and automatic lead-lag control.
3. Unit shall be field or factory equipped with refrigerant suction and discharge gauges with shut-off valves for each refrigerant circuit. An LCD Control Panel read-out will be acceptable in lieu of the specified gauges.
4. Unit shall have externally mounted field installed, factory furnished, chilled water flow switch which shall prove sufficient flow before the unit can operate. Use only differential pressure type switches rated for outdoor installation equal to a Johnson Controls, Inc. Model F61MG-1C or approved equal by McDonnell & Miller. Flow switch shall be vapor-proof SPDT, NEMA 4X switch, rated for 150 PSIG differential water pressure, rated for ambient temperatures from -20°F to +250°F. Switch shall have 1" NPT connection for upright mounting in horizontal pipe. Alternately, a thermal dispersion flow switch standard with the chiller manufacturer may be used. Paddle type switches are not allowed.
5. Unit shall be equipped with an oil pressure safety switch to protect each compressor from loss of lubrication.
6. Provide corrosion resistant vandal /security grilles, with fasteners, for protection of all compressors, cooler, refrigerant piping and other components not otherwise protected.
7. Control compartment shall be equipped with a 115 volt convenience duplex receptacle outlet.
8. Sound attenuation shall be provided if necessary to be reduced to the following maximum sound power levels (A-weighted sound pressure):

100% = 91 dbA	50% = 66 dbA
75% = 68 dbA	25% = 63 dbA

P. Provide an additional four 4 year warranty on the compressors after the one (1) year guarantee has expired. The first year of Warranty shall include all parts and labor.

Q. Provide factory authorized equipment manufacturer representative to perform field start-up and check-out services to include adjustment of controls, recording of operating conditions, and direction to the installing contractor of any corrective actions necessary for proper operation due to installation deficiencies.

R. Acceptable Manufacturers:

1. Trane
2. Carrier
3. York
4. Daikin

PART 3 - EXECUTION

3.1 DELIVERY AND PROTECTION

- A. All equipment shall be handled carefully to avoid damage and be protected from exposure to the weather and dirt.
- B. All equipment shall be examined upon delivery to the site and evidence of abuse, damage, or exposure to weather and dirt shall be grounds for refusal to accept individual pieces of equipment. Rejected items shall be replaced promptly at no cost.

3.2 AIR COOLED PACKAGED WATER CHILLER INSTALLATION

- A. Install chiller including accessory components, auxiliary devices, water piping connections, external wiring, and controls required for chiller operation in accordance with manufacturer's instructions.
- B. Verify that machine has a full charge of refrigerant and lubrication oil. Add as necessary and seal any leaks when discovered.
- C. Locate chiller to provide the minimum required service and operating clearance. This shall include clearance for proper condenser airflow, cooler tube pull space, and service access to compressors and control compartments.
- D. Provide an externally mounted flow switch for the chilled water piping. Locate each chiller flow switch indoors and across the chilled water piping of the respective primary chilled water pump, suction to discharge, dedicated to the chiller. Use differential pressure type switches.

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- E. Verify height of machine, top of fan discharge, is equal to the height of any surrounding screening material to prevent air recirculation into the condenser coils.
- F. Provide factory authorized agent start-up services as specified herein to include submission of the start-up service record, typed for legibility. Handwritten reports are not acceptable.

3.3 OPERATING PROCEDURES AND REQUIREMENTS

- A. Operating and service instructions in illustrated and bound form shall be furnished by the manufacturer, three copies, within 30 days of "Substantial Completion".
- B. At startup, the equipment manufacturer shall furnish skilled personnel to supervise, check out performance, make any required adjustment, place the unit in service, and instruct the Owner's personnel for a full period of four (4) hours. Start-up of chillers shall be performed by a service representative of the unit manufacturer.
- C. The manufacturer of each item of equipment shall provide complete wiring diagrams to the Electrical and Temperature Controls Contractor and shall provide drawings indicating all required external wiring and arrangements of connections.

3.4 WARRANTY

- A. Transfer the full Warranty to Owner to include all parts and labor for a full one year period after the cooling system is put into sustained operation to obtain building cooling effect and accepted as a completed installation by the Owner which shall begin at "Substantial Completion".
- B. Transfer any and all other warranties as applicable over to the Owner at the completion of construction, "Substantial Completion", including the extended four (4) year compressor warranties.

END OF SECTION 236400

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SECTION 237323 - AIR HANDLING EQUIPMENT

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Conditions of the Contract and Division 1 - General Requirements are hereby made a part of this section.
- B. Comply with all other Division 23 Sections as applicable. Refer to other Divisions for coordination of work with other portions of work, as required.

1.2 SYSTEM DESCRIPTION

- A. Scope of Work includes the furnishing and installation of all air handling units, fan coil units, roof mounted air handling units, hangers, supports, and appurtenances as indicated herein.
- B. All items of equipment shall meet or exceed scheduled capacities and shall be provided in quantities indicated.
- C. Equipment shall be purchased and installed by the Contractor who shall install the equipment with field installed accessories and make connections to other components to make a complete and operating system.

1.3 QUALITY ASSURANCE

- A. All air handling unit electrical equipment shall be U.L. Listed.
- B. All water coils shall be rated for the application listed in accordance with the Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standard 410.
- C. All fans shall be rated in accordance with the Air Moving Council Association (AMCA), and bear the label thereof.

1.4 SUBMITTALS

- A. Submit complete submittals and Shop Drawings in accordance with Section 23 05 00.
- B. Submittals shall include manufacturer's descriptive literature, material types, sizes, finishes, treatments, quantities, required accessory descriptions, capacities, fan curves, installation details, wiring diagrams, and any other descriptive literature necessary to fully evaluate the submittals for compliance with these Specifications.

1.5 INSTALLATION, OPERATION, AND MAINTENANCE BROCHURES

- A. Furnish all installation manuals required by a qualified mechanic for proper installation of equipment. Manuals shall be provided with equipment and be attached thereto.
- B. Complete bound Operating and Maintenance Brochures shall be retained by the successful equipment supplier for submittal, in triplicate, a minimum of 30 days prior to completion of construction.

1.6 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall and will be rejected.
- B. Storage and protection of materials shall be in accordance with Section 23 05 00.

PART 2 - PRODUCTS

2.1 CENTRAL STATION AIR HANDLING UNITS

- A. Each unit shall be of the horizontal or vertical type, have the performance capabilities as scheduled and be arranged as indicated on the Drawings.
- B. The sections which constitute the completed unit shall each be completely assembled at the factory in a double wall sheet metal housing appropriately furnished, and shipped as a complete unit or in sectionalized units suitable for field assembly. They shall be factory assembled, or be capable of job site assembly, into a complete unit having physical characteristics as indicated. All side and end panels shall be removable without reducing structural integrity of the unit.
- C. Each air unit shall be constructed of heavy gauge reinforced steel panels lined with one inch (1") thick mat faced glass fiber insulation not lighter than 3 lb. density. Alternately use two inch (2") thick 1.5 lb. density insulation. Such lining shall be cemented to the inside portion of the unit casing and additionally be secured with sheet metal binding strips. The lining material shall be waterproof and have a flame spread rating of less than 25 and shall comply with the requirements of NFPA Bulletin 90-A. This

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insulation shall be covered with the metal inner wall as described herein. As a second alternate to the above, air handling units may have casing construction consisting of a high density foam type insulation sandwiched between inner and outer galvanized steel panels with a minimum overall R-value of 13.0. Minimum inner and outer steel panel thickness shall be as standard with the manufacturer for that style of construction. Structural members shall be minimum 16 gauge in thickness.

- D. Provide factory-installed base rails on each air handling unit. Alternately provide an external support kit on the base of the unit to effect base rail support. External support kit or base rails shall be used for ceiling suspension, external isolation, or with housekeeping pads. Contractor shall be responsible for adjusting the height of housekeeping pads when unit is not of sufficient height to properly trap unit. The housekeeping pad height designated on the Drawings may be reduced when sufficient P-trap depth, with insulation, can be obtained with a lesser pad height. Approval must be obtained through the Engineer. Unit mounting devices not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel.
- E. All access doors, where specified herein, shall be of double wall construction with inner metal liners and have Ventlock 100 or 140 safety type latches. Alternately, quarter turn 5/16" Allen wrench operated integral latches will be acceptable. Provide tool for each air handling unit for operation of latches. Provide Ventlock 220 door pulls, or equal, on doors larger than 30" x 30". Screw attached doors are not acceptable. All access doors shall have continuous vinyl type bulb seals for a low leakage rate. Hinges shall be either continuous corrosion resistant metal piano hinges or consist of multiple heavy duty corrosion resistant metal or fiber reinforced nylon hinges.
- F. Condensate drain pans shall have double wall construction with threaded drain connection on one end. Condensate drain pans shall be insulated with one inch (1") thick fiberglass cemented between a heavy gauge galvanized steel outer pan and minimum 16 gauge type 304 stainless steel inner pan (exposed to air stream). Inner pan shall be coated with corrosion resistant elastomeric based material. Insulation and adhesive shall comply with NFPA Bulletin 90-A flame spread and smoke generation requirements. Drain pan shall be sloped in two directions for positive drainage.
- G. Fan Section:
 - 1. Fan sections shall be double wall construction and be made of minimum 18 gauge G-90 galvanized steel or 18 gauge chemically cleaned phosphatized steel given a protective enamel finish. The inner liner shall be perforated, minimum, 20 gauge galvanized steel. Fan sections shall have a formed channel base for mounting of fan and casing panels. Each unit shall have either a Class II airfoil fan wheel and scroll or forward curved type as scheduled, and as required to meet scheduled capacities for stable operation. Fans shall be double width, double inlet type for forward curved fan wheels and backward curved airfoil blades with double inlet for air foil fans. Wheels shall be bonderized steel painted with baked enamel, galvanized steel, or welded aluminum. For sandwiched foam panel casing construction, the minimum outer casing steel panel thickness shall be as standard with the manufacturer. Sandwiched foam panel construction with a total capacity over 6,500 CFM will require one inch (1") thick fibrous insulation perforated metal liners in the fan section for enhanced acoustical attenuation.
 - 2. Fan shafts shall be solid steel C1040; turned, ground, and polished.
 - 3. Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at the maximum rated fan speed and motor horse power. Fan wheels and shafts shall be selected to operate at least 25% below the first critical speed, and shall be statically and dynamically balanced as an assembly. The entire assembly shall be IRD 245 2 plane balanced to 1.0 mil or less total displacement as measured at each bearing pad.
 - 4. Fan bearings shall be self-aligning, pillow block regreasable ball type selected for an average life of 200,000 hours at design operating conditions, and a L-50 life, per ANSI Code B3.15. Provide extended lube lines to one single location on the unit exterior, at the coil connection side, for regreasing bearings without shutting down unit or disassembling components.
 - 5. Vibration isolation of the entire fan, motor, and drive assembly to be by use of 2 inch deflection springs internally mounted at the factory, together with fan discharge neoprene flexible connection and thrust restraint springs. All fans 6,500 CFM, or larger, shall be internally isolated.
 - 6. Fan motors shall be factory mounted inside the fan section casing, on slide rails having 2 adjusting screws. Motors shall be the open drip proof (ODP) type. Motor speed shall be 1750 RPM. Motors over one horsepower in size shall be NEMA (premium) efficiency type similar to Baldor Super-E, Century E Plus III, General Electric "X\$D Ultra" or U.S. "NEMA Premium" as specified in Section 23 05 13.
 - 7. Fan drives shall be factory mounted and aligned with final alignment and belt adjustment to be made by the contractor after installation. Belt drives shall be variable pitch type for motors 10 HP and below and fixed pitch above 10 HP. Drive design shall provide a 1.5 service factor.

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8. Provide a minimum of one (1) 60" X 18" access door to each fan casing, and any factory fabricated plenum sections. Doors shall have continuous vinyl jamb seals for an airtight seal. Fan sections or plenums too small to accommodate this size access door shall have an access door as large as the casing or plenum size will allow.
- H. Coils:
1. Coils installed in air units shall be of the type that is standard with the unit manufacturer and shall be complete with continuous heavy-duty supporting structure. Coils shall be the slip-in and slip-out type for ease of replacement from the coil connection side. The type and capacity of each coil assembly shall be as scheduled on the Drawings and as specified elsewhere herein. Coils shall be erected and connected in the arrangements shown. Generally, unless indicated otherwise, heating coils shall be located in the pre-heat position.
 2. Coil performance shall be rated and certified in accordance with AHRI Standard 410.
 3. Chilled and Heating water coils shall have aluminum plate fins, minimum 0.006 inch thickness, maximum 144 fins per foot, with belled collars bonded to 1/2 inch minimum OD, minimum 0.016 inches thick wall, copper tubes by mechanical expansion. Coil sections shall have casings manufactured the same as the fan casings, except the inner liner shall consist of a 20 gauge galvanized steel solid panel section. Coil working pressure shall be 200 PSIG at 200 Deg.F. for chilled water and 175 PSIG at 400 Deg.F. for heating water. Coils shall be drainable and have non-trapping circuits. No turbulence promoting devices shall be permitted inside the tubes. Coils shall have seamless copper tube, headers with threaded, 2" and smaller, or flanged connections, 2-1/2" and larger. Alternately, install flanges on site. Headers shall have drain and vent connections. Provide minimum six (6) rows for cooling coils and two (2) rows for heating coils. Use maximum 12 fins per inch for cooling coils and 10 fins per inch for heating coils.
 4. Direct expansion (DX) coils shall be proof tested to 250 PSIG and leak tested to a minimum of 3000 PSIG air pressure under water. Coils shall be dried after testing and filled with a 10 PSIG holding charge of nitrogen. Coils shall be provided with a minimum of two (2) vertical brass distributors to ensure that each coil circuit receives the same amount of refrigerant liquid. Circuiting shall be as required for the application. Locate all DX coils downstream of water filled coils.
 5. All coil connections shall have right hand connections looking downstream of unit, unless scheduled or indicated otherwise. Refer to Drawings.
 6. Provide a minimum of one (1) 60" X 18" access door panel to each coil section casing or the maximum size possible to be installed thereon whenever the casing size cannot accommodate the specified size. All units shall have access doors, unless full access is provided to both sides of the coil section through the fan and filter section access doors.
 7. Coil section inner wall, floor and ceiling panels shall all be minimum 20 gauge galvanized steel solid panels.
 8. Heating coils shall be in the pre-heat position unless indicated otherwise.
- I. Filter Sections:
1. Low Velocity (Angled) Filter Sections shall be provided by the air handling unit manufacturer for all air handling units, with the same casing construction as described for fan sections (solid or perforated metal inner wall). All units shall have angled filter sections, unless indicated otherwise on the Drawings. Filter racks, V-shaped, shall be capable of receiving 2" thick filters of standard sizes, and shall be constructed of heavy gauge galvanized steel slide rails. Filter sections shall have full size hinged access doors on each side of the casing. Doors shall include a minimum of two quarter turn fastening handles. Provide one (1) set of two inch (2") thick Farr 30/30 filters for each unit.
 2. Furnish flat, or high velocity, filter sections, only where indicated on the Drawings, with two inch (2") heavy gauge galvanized steel slide rail filter racks and a complete set of two inch (2") thick Farr 30/30 filters with unit. Filters shall be accessible through both sides of unit by use of hinged filter access doors with suitable fasteners.
 3. At the time of construction, before operating equipment, all filters shall be installed to fully protect coils and air distribution system from dirt and debris. Replace filters as specified in Section 23 30 00.
 4. Provide a differential pressure gauge including magnahelic gauge across each bank of filters. Provide set of contacts to notify remote monitoring system of maximum resistance. Range shall be from 0.0 - 1.0 inches W.G. unless indicated otherwise.
 5. Filter sections shall be double wall same as the fan and coil sections.
- J. Plenum sections shall be field or factory fabricated and shipped, as applicable, with other sections of the air handling unit, at the option of the Contractor.

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- K. Provide factory fabricated face and bypass damper sections as scheduled and as indicated on the Drawings. Construction shall be the same as for fan casings. Damper shall be provided inside the casing and be the opposed blade type. Face dampers shall be in front of the cooling coil and bypass dampers shall divert airflow around the cooling coil. Dampers shall be the low leakage type with blades secured to minimum 1/2 inch corrosion resistant steel rods, rotating in nylon bushings and mounted in a galvanized steel frame. Leakage shall be less than 2% at 4.0 In.W.G. of static pressure difference. Dampers shall not exceed 48 inches in width, and shall be sectionalized as required to meet this requirement. Provide jamb seals and vinyl blade edge seals on dampers.
- L. Acceptable Manufacturers:
 - 1. Carrier.
 - 2. Daikin.
 - 3. Trane.
 - 4. Temtrol.
 - 5. York.

2.2 FAN COIL UNITS

- A. Fan coil units shall have the characteristics indicated and be furnished completely assembled to include casings, enclosure, or plenums as indicated, finned tube coils, fan and motor sections, belt drive assembly, filter racks, and other specified accessories to meet scheduled capacities.
- B. Fan coil units shall be rated and certified by ARI and be U.L. approved.
- C. Water coils shall be standard coils furnished by fan coil unit manufacturer and rated for scheduled capacities. Coils shall be ARI rated and certified. Coils shall be made of 3/8" or 1/2" O.D. copper tubes, minimum 0.016 inches tube wall thickness, mechanically expanded into aluminum plate fins, rated at 250 PSIG and leak tested at 350 PSIG minimum air pressure. Provide manual type air vent with each coil. Coils shall have a minimum six (6) rows for cooling and two (2) rows for heating applications, and have a maximum of ten (10) fins per inch. Both heating and cooling coils shall be installed within the same cabinet. Coil piping connections shall be made in the side of the unit casing, with grommets, with unit penetrations being provided by the manufacturer. Generally the heating coil, when provided, shall be in the pre-heat position unless indicated otherwise.
- D. Fans shall be statically and dynamically balanced and be of indicated capacities. Fan wheels shall be constructed of a minimum of 22 gauge galvanized steel and be forward curved design. Furnish permanently lubricated long life heavy duty ball bearings. All motors shall be provided with thermal overload protection.
- E. Cabinets shall be made of minimum of 18 gauge G-90 galvanized steel or 18 gauge cold rolled steel primed and coated with a baked enamel paint. Cabinets shall be insulated with a minimum 3/4 inch thick, 1.5 pound density, coated glass fiber insulation complying with NFPA No. 90A. Provide supply and return duct collars. Condensate pan shall be made of 18 gauge galvanized, or Type 304 stainless, steel and be insulated to prevent condensation. Cabinet shall have four (4) support points for insertion of 3/8" round threaded hanger rods. Provide two (2) removable panels for access to and removal of internal components from both sides. Coil piping shall not obstruct access to internal components requiring removal or periodic servicing.
- F. Furnish side access flat filter racks, capable of accepting one or two inch (1" or 2") thick filters. Two inch (2") thick filters will be used in this application. Furnish filters and spare media same as for constant volume air handling units. All filters shall be standard filter sizes of all filter manufacturers.
- G. Acceptable Manufacturers:
 - 1. Magic-Aire Series BHW, or approved equals by:
 - 2. Daikin.
 - 3. Carrier.
 - 4. Trane.
 - 5. York.

2.3 ROOF MOUNTED AIR HANDLING UNITS

- A. Each unit shall have the performance capabilities as indicated on the Drawings and shall be provided with motors, starters, and control dampers.
- B. Unit Performance:
 - 1. Unit cooling and heating coil capacities shall be rated in accordance with, and tested to, AHRI Standard 410.
 - 2. Coils shall carry the AHRI compliance sticker.
 - 3. Blower assemblies shall be A.M.C.A. rated and bear the label thereof.
 - 4. All electrical components used shall be U.L. listed.

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5. Unit shall be shipped completely assembled by the manufacturer, including all standard and optional items.
 6. Unit shall be 100% run tested by the manufacturer with a copy of the run test report shipped with the unit.
- C. Unit Construction:
1. Unit shall be completely factory assembled, piped and wired, and shipped in one piece.
 2. Unit shall be specifically designed for outdoor rooftop application with a fully weatherproof cabinet. Roof shall be sloped for complete drainage of rain water.
 3. Unit design shall be dedicated bottom supply and bottom return air style system for mounting on a full perimeter roof curb. Unit openings shall be the same size as, or equivalent to, the clear air stream dimensions shown on the Drawings. Provide suitable connecting duct collars.
 4. Cabinet shall be constructed entirely of G90 weight galvanized metal with the exterior panel construction being of 18 gauge, or heavier, material. All seams shall be welded or bolted and sealed with a rubber based mastic.
 5. Access to controls, filters, blower, heating coil, cooling coil, and other items needing periodic checking or maintenance shall be through hinged full size access doors with a minimum of two (2) quarter turn safety type latches (ventlock handles). Door fastening screws are not acceptable.
 6. Air side service access doors, exposed to ambient conditions, shall be fully gasketed with rain break overhangs.
 7. Filter sections, access doors, and fan section casings shall have an internal, minimum 18 gauge galvanized steel, perforated liner to internally protect the insulation and for sound attenuation.
 8. Unit exterior shall be painted with an epoxy-polyester paint over a wash primer and a paint lock type galvanized steel. Unit exterior shall be "Tan" in color, unless indicated otherwise.
 9. The interior air side of the cabinet shall be entirely insulated on all exterior panels with two inch (2") thick, not lighter than 1-1/2 pound (1.5 lb.) density, neoprene coated, fiberglass insulation cemented to the unit casing and further secured with sheet metal binding strips. The lining material shall have a flame spread rating of less than 25 and shall comply with the requirements of NFPA Bulletin 90-A.
 10. The entire fan cabinet, and other internal unit components, under a positive pressure and downstream from the supply air, and relief air where applicable, blower, shall be guaranteed to hold a static pressure of up to six inches (6") water column with less than 2% leakage.
 11. All openings through the base pan of the unit shall have upturned flanges of at least 1/2" in height around the opening through the base pan.
 12. Unit shall have decals and tags to indicate unit lifting - rigging, service areas, and caution areas. Wiring diagrams, installation and maintenance manuals shall be supplied with each unit.
 13. The floors of each unit shall be insulated and have a minimum 20 gauge galvanized steel inner panel.
 14. Condensate drain pans shall have double wall construction, sloped in all directions for positive drainage, with threaded drain connections. Condensate drain pan to be insulated with 5/8" thick isocyanurate foam, or equivalent, faced with an additional aluminum foil vapor barrier and cemented between the heavy gauge galvanized steel outer and inner pans. Inner pan shall be coated with corrosion-resistant elastomeric based material. Insulation adhesive and inner coating shall comply with NFPA Bulletin 90-A.
 15. Furnish a 115 volt convenience outlet mounted in the fan compartment and wired to a junction box on the inside of the fan unit casing.
- D. Blowers:
1. Shaft shall be solid steel, turned, ground, and polished. No hollow shafts allowed.
 2. Blowers, drives, and motors shall be statically and dynamically balanced as an assembly.
 3. Blower sections shall be constructed of galvanized steel, or chemically cleaned steel, phosphatized, and given a protective enamel finish; and shall have a formed channel base for mounting of fan and casing panels.
 4. Each unit shall have one fan wheel and scroll only for each supply and return air fan, where applicable. Fans shall be double width, double inlet type, with forward curved blades, or single width, single inlet air foil fans suitable for the application. Fan wheels shall be bonderized steel painted with baked enamel, galvanized steel, or welded aluminum.
 5. Provide full size, minimum 24" x 48" double wall fan access doors with ventlock quarter turn handles, located on the coil and motor drive side of the unit. Provide fasteners suitable for use of padlocks.
 6. The entire fan assembly shall be completely isolated from the unit bulkhead with neoprene gasketing and shall be mounted on two inch (2") double deflection spring isolators.

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7. Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected to operate at least 25% below the first critical speed.
 8. Fan bearings shall be self-aligning, pillow block, regreasable ball type selected for an average life of 200,000 hours at design operating conditions, per ANSI Code B3.15.
 9. Provide extended lube lines, with grease fittings, mounted in one single location on the exterior of the unit casing for regreasing bearings without shutting down unit, disassembling components, or accessing the interior of the unit.
- E. Motors and Drives:
1. Motors shall be of NEMA standard frame design and mounted with adjustable steel hinge type mount or shop fabricated slide rail mount with two (2) adjusting screws located in the fan section casing. Motors shall be open drip-proof, single speed, squirrel cage, 1750 RPM, induction type of high efficiency design equal to Baldor Super-E, Century E-Plus-III, U.S. "NEMA (premium)", or General Electric "XSD Ultra". Refer to Specification Section 23 05 13.
 2. Fan drives shall be factory mounted and are to be selected with a minimum belt horsepower capacity of 150% of the motor nameplate horsepower. Motor sheaves shall be variable pitch type for motors 10 horsepower, and below, and fixed type above 10 horsepower. Sheaves shall be as manufactured by Browning or Gates. Unit manufacturer shall furnish one sheave change-out as necessary to provide required fan performance for job site conditions.
 3. Fan sheaves shall be cast iron QD-type, tapered bushing style as manufactured by Browning or Gates.
 4. Provide open vibration springs and thrust restraints for internal isolation of motor and blower assembly.
 5. For units over 8,000 CFM in capacity, furnish return air fans for positive control of relief air, as scheduled.
- F. Outside air intakes shall be capable of bringing in from 0-100% outside air, economizer operation, with motor operated outside, return, and relief air dampers constructed of extruded aluminum hollow cores, air foil blades with rubber edge seals and aluminum end seals. Damper blades shall be pneumatically actuated and designed to have no more than 2% leakage when subjected to four inches (4.0") W.G. air pressure differential across the damper. Damper actuator shall be spring return type to insure closing of outdoor and relief air dampers during periods of unit shut down or power failure. Actuators shall be furnished and installed under Section 23 09 00, Controls and Instrumentation. Provide 1/2" x 1/2" galvanized steel birdscreen, and suitable rainproof hoods, with rain lip, over all openings to the outdoors.
- G. Chilled water coils shall be copper tube with aluminum fins mechanically bonded to the tubes, same as Central Station Air Handling Units.
- H. Hot water coils shall be copper tubes with aluminum fins mechanically bonded to the tubes, same as Central Station Air Handling Units.
- I. Filters:
1. Units shall be furnished with low velocity (angle) filter sections with heavy gauge galvanized steel filter racks suitable for two inch (2") thick filters. Provide unit with one (1) set of two inch (2") thick, 30% efficient, pleated, Farr 30/30 throw away air filters.
 2. Units shall be provided with a direct dial reading magnehelic gauge mounted in the control compartment, same as Central Station Air Handling Units.
 3. Filters shall be accessible from both sides of the unit through hinged and sealed access doors.
- J. Provide factory fabricated face and bypass damper sections as scheduled and as indicated on the Drawings. Construction shall be the same as for fan casings. Dampers shall be provided inside the casing and be the opposed blade type. Face dampers shall be in front of the cooling coil and bypass dampers shall divert airflow around the cooling coil. Dampers shall be the low leakage type with blades secured to minimum 1/2 inch corrosion resistant steel rods, rotating in nylon bushings and mounted in a galvanized steel frame. Leakage shall be less than 2% at 4.0 In.W.G. of static pressure difference. Dampers shall not exceed 48 inches in width, and shall be sectionalized as required to meet this requirement. Provide jamb seals and vinyl blade edge seals on dampers.
- K. Unit shall be provided with a factory installed and wired internal disconnect switch with fusing, magnetic across-the-line starter with 120 volt control transformer, and H-O-A Switch.
- L. Roof curbs shall be constructed of minimum 12 gauge galvanized steel with a treated wood nailer strip, minimum 1-1/2" thick internal curb insulation and be minimum 14" in height. Curb shall be shipped loose for field assembly. Curbs shall be provided with two inch (2") wide, 3/8 inch thick, neoprene gasketing for field mounting between the curb top and unit bottom with the curb providing full perimeter support, cross

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structure support, and air seal for the unit. Curbs shall be provided by unit manufacturer and be approved by the National Roofing Contractors Association (NRCA).

- M. All water piping, condensate piping, power and control wiring, and control tubing shall be routed within a pipe chase contained within the perimeter of the roof curb. Additionally, provide suitable space within each unit casing for field installed heating and chilled water piping to the coils. Provide full size access door to piping compartment. Piping compartment shall be outside the air stream.
- N. Acceptable Manufacturers:
 - 1. Temtrol, or approved equals by:
 - 2. Carrier.
 - 3. Trane.
 - 4. York.
 - 5. Daikin.

PART 3 - EXECUTION**3.1 DELIVERY AND PROTECTION**

- A. Deliver all equipment to each site as indicated in Division 1.
- B. Perform installation and start-up to include installation of all accessories as required to make a complete and operating system.
- C. All equipment shall be handled carefully to avoid damage and be protected from exposure to the weather and dirt. All equipment shall be examined upon delivery to the site and evidence of abuse, damage, or exposure to weather and dirt shall be grounds for refusal to accept individual pieces of equipment. Rejected items shall be replaced promptly at no cost.

3.2 CENTRAL STATION AIR HANDLING UNITS

- A. Install air handling units level on housekeeping pads, which shall extend four inches (4") larger than the unit in each dimension. Suspend fan coil units level from structure with all thread rod and vibration isolators.
- B. Provide for positive gravity drainage of coil condensate. Pipe condensate full size of unit connection as detailed on the Drawings to include a P-trap. Verify proper drainage is attained from each unit.
- C. Remove all shipping restraints and unfasten any hold down fasteners.
- D. Verify correct rotation of fan and proper wiring of motor to include verification of proper line voltage and insuring actual motor amps does not exceed name plate amps.
- E. Lubricate all greaseable ball bearings with manufacturers suggested lubricant.
- F. Adjust belt tension and align belts to eliminate wear and excessive vibration per manufacturers recommendations.
- G. Verify starter (motor controller) motor overload heaters are sized within the nameplate motor amp range, i.e., a heater range of 8.0 - 9.0 amps would only be suitable for a motor within that range. A motor nameplate of 9.1 amps would need a different heater.
- H. Adjust fan drives as required to obtain scheduled capacities as directed by the Test and Balance firm to include one sheave and belt replacement, as required thereby.
- I. Lubricate all greaseable ball bearings with manufacturers suggested lubricant.
- J. Replace filters as specified in Section 23 30 00. Keep the filter section loaded with filters at all times. Provide the new specified type just prior to the commencement of the Test and Balance work. Do not operate any unit without proper filters in place.
- K. Install emergency overflow condensate pans and drain piping as detailed on the Drawings for units suspended from structure.
- L. Make piping connections so as not to interfere with future coil removal work, access door operation, filter removal and maintenance, or motor and drive maintenance.
- M. Provide power to units for operation for system balancing in sufficient time to perform TAB work prior to Substantial Completion.

3.3 ROOF MOUNTED AIR HANDLING UNITS

- A. Install roof mounted air handling units level on roof on full perimeter roof curbs, in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Install and connect electrical devices furnished by manufacturer, but not specified to be factory mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical systems installer.
- C. Install and connect devices furnished b0079 manufacturer but not specified to be factory mounted.

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- D. Start-up units in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements.
 - E. Contractor shall adjust and align fan drives to obtain scheduled capacities as required by the Test and Balance Firm to include labor for one sheave and belt change-out to provide fan performance to meet job site conditions.
 - F. Refer to Paragraph 3.2 above.
- 3.4 CLEAN-UP
- A. Clean coils and condensate pans after installation of air handling units and fan coil units is complete.
 - B. Vacuum clean all debris from inside air handling units, fan coil units, other fan casings, and plenums with internal duct lining.

END OF SECTION 237323

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SECTION 260000 - ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This Division and all Electrical sections contained hereinafter are subject to the Contract Documents of Division 1 whether attached or not, the various Divisions of the General Construction specifications and Division 23 of the Construction specifications and respective plans.
- B. All drawings, material in other Divisions of these specifications, addenda, and other pertinent documents are considered to be a part of the technical requirements of this Division of the specifications insofar as they are applicable.
- C. The material contained in this section shall be applicable to other sections of the specifications under this Division.

1.2 DEFINITIONS

- A. The following definitions shall apply to all sections of this Division:
 - 1. "Owner" shall mean the Owner or his designated representative.

1.3 SCOPE OF WORK

- A. This Division and all electrical sections of the specifications include all labor and material to complete all electrical systems as specified or shown on the Drawings.
- B. All work shown and specified shall be completely installed and connected in a workmanlike manner by mechanics properly qualified to perform the work required. All work shall be left in a satisfactory operating condition as determined by the Owner.
- C. Provide all services and perform all operations required in connection with or properly incidental to the construction of complete and fully operating systems with all accessories as herein specified or shown on the Drawings.

1.4 GENERAL

- A. The accompanying plans show diagrammatically the location of the various light fixtures, devices, conduits and equipment items, and methods of connecting and controlling them. It is not intended to show every connection in detail or all fittings required for a complete system. The Contractor shall carefully lay out his work at the site to conform to the conditions, to avoid obstructions and provide proper routing of raceways. Exact locations of light fixtures, devices, equipment, and connections thereto shall be determined by reference to the accompanying Plans, etc., by field measurement at the project, and in cooperation with other Contractors and Sub-Contractors, and in all cases shall be subject to the approval of the Owner. Minor relocations necessitated by the conditions at the site or directed by the Owner shall be made without any additional cost to the Owner.
- B. These specifications and the accompanying drawings are intended to describe and illustrate systems which will not interfere with the structures, which will fit into available spaces, and which will insure complete and satisfactorily operating installations. The Contractor shall be responsible for the proper fittings of his material and apparatus into the building and shall prepare installation drawings for all critical areas illustrating the installation of his work as related to the work of all other trades. Interferences with other trades or with the building structures shall be corrected by the Contractor before the work proceeds. Should any changes become necessary due to failure to comply with these stipulations, the Contractor shall make such necessary changes at his own expense.
- C. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted on the Drawings.
- D. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide those details or special construction as well as to provide material and equipment usually furnished with such systems or required to complete the installation.
- E. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability and that he will install his work in a satisfactory manner which is up to the best standards of the trade, complete and in good working order. If any of the requirements of the Drawings and Specifications are impossible to perform, or if the installation when made in accordance with such requirements will not perform satisfactorily, he shall report such occurrences to the Owner promptly after discovery of the discrepancy.

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- F. No extra compensation will be allowed for extra work or changes caused by failure to comply with the above requirements.

1.5 INSPECTION OF THE SITE

- A. The Contractor shall visit the site, verifying all existing items indicated on the Drawings or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil, conditions, and local requirements. The submission of bids shall be deemed evidence of such visit.
- B. All proposals shall take these existing conditions into consideration, and the lack of specific information on the Drawings shall not relieve the Contractor of any responsibility.
- C. All site visits shall be coordinated and scheduled with the Owner.

1.6 CUTTING AND PATCHING

- A. When cutting or patching becomes necessary to permit the installation of any work under this contract, or should it become necessary to repair any defects that may appear in patching up to the expiration of the guarantee, such cutting shall be done under the supervision of the Architect by the trade or Contractor whose work is to be disturbed. After the necessary work has been completed, damage shall be repaired by the Contractor or trade whose work has been disturbed. The cost of all such cutting and patching shall be paid by the Contractor requiring it to be done.
 - 1. Refer to Division 1 requirements.
- B. The Contractor shall do all necessary cutting and drilling of present walls, floors, ceilings, etc. for the installation of new work or for modifications to the existing work, but no structural work shall be cut unless specifically approved by the Architect. Patching and painting of services as required shall be by the General Contractor unless specified otherwise hereinafter.
- C. Locations of the various existing services, walls, and equipment to be altered, removed or connected to have been taken from plans of the existing building and other substantially reliable sources and are offered as a general guide only, without guarantee as to their accuracy. This Contractor shall examine the site and shall verify to his own satisfaction the location of all existing work and shall adequately inform himself as to their relation to and effect on the work before entering into a contract. Submission of a bid shall constitute evidence that the submitting Contractor has inspected the site of the proposed work.
- D. The Contractor shall examine the existing building and plans for the new work and note the sizes of the openings available and shall be responsible for any cutting, patching, and alterations required to place new equipment in the building.
- E. Where walls, acoustical tile, suspended ceilings, etc., not scheduled to be re-worked or re-finished under the general contract are damaged during installation of new raceways, or other work, etc., such walls, tiles, etc., shall be replaced by the General Contractor at the expense of the Contractor.
- F. All damage done to the existing equipment, services, etc., incurred in the execution of this contract shall be repaired and restored to its original conditions by the Contractor.
- G. Holes through concrete shall be drilled with "Mole", or "Core-It", or equal diamond point hole saw.

1.7 DEMOLITION OF EXISTING EQUIPMENT

- A. Certain types of equipment will be retained by the Owner. The Owner will provide a list of all such salvage items. Before removal of any equipment, contact the Architect, who will determine the disposition. Equipment designated to be salvaged and remain the property of the Owner shall be carefully removed to prevent damage and delivered to a location on the site as directed by the Architect. Any equipment not retained by the Owner shall become the property of the Contractor and shall be removed from the premises.
- B. The Contractor shall visit the site and verify all outlets, devices, wall switches, light fixtures, etc., that are to be removed due to remodeling work and building additions.
- C. The attendant raceways, hangers, wiring, foundations, etc., of those items of existing equipment to be removed and not intended for reuse, shall also be removed in their entirety. No raceways, hangers, etc., shall be abandoned in place except those raceways concealed in existing walls or buried below grade.

1.8 CODE REQUIREMENTS

- A. All work shall comply with the provisions of these specifications, as illustrated on the accompanying drawings, or as directed by the Architect, and shall satisfy all applicable local codes, ordinances, or regulations of the governing bodies, and all authorities having jurisdiction over the work, or services thereto. In all cases where alterations to, or deviations from, the drawings and specifications are required by the authority having jurisdiction, report the same in writing to the Architect and secure his approval before proceeding. Upon completion of the work, furnish a statement from the inspecting authority stating that the installation has been accepted and approved. Provide complete utility service connections as

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directed, and submit, as required, all necessary drawings; secure all permits and inspections necessary in connection with the work, and pay all legal fees on account thereof. In the absence of other applicable local codes acceptable to the Architect, the National Electrical Code shall apply to this work.

1.9 RECORD DRAWINGS

- A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all locations of equipment, panels, and all deviations and/or changes in the work shall be recorded. All underground and overhead utilities provided under, or affected by, work of this Division shall be accurately located by dimensions. These "Record" drawings shall be delivered to the Architect in good condition upon the completion and acceptance of the work and before final payment is made.
 - 1. Refer to Division 1 requirements.

1.10 RECORDS AND INSTRUCTIONS FOR OWNER

- A. The Contractor shall accumulate, during the project's progress, the following sets, prepared in neat brochures or packet folders and turned over to the Architect for checking and subsequent delivery to the Owner:
 - 1. All warranties and guarantees and manufacturer's directions on equipment and material covered by the Contractor.
 - 2. Approved equipment brochures, wiring diagrams and control diagrams.
 - 3. Copies of reviewed Shop Drawings.
 - 4. Operating instructions for all systems. Operating instructions shall include recommended maintenance procedures.
 - 5. Any and all other data and drawings required during construction.
 - 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
- B. All of the above data shall be submitted to the Architect for review at such time as the Contractor makes application for final payment, but in no case less than two weeks before final observation.
- C. The Contractor shall also give not less than two (2) days of operating instructions, during the adjustment and testing period, to the Owner's operating personnel in order to familiarize them with the proper care and operation of the equipment. The written operating instructions referred to in above paragraphs shall be used as a basis for this on-the-job instruction.
 - 1. Refer to Division 1 requirements.

1.11 SHOP DRAWINGS AND SUBMITTALS

- A. The Contractor shall submit, to the Architect, shop drawings and catalog data on all equipment and materials designated on the Drawings and specified herein.
- B. The submittal will be reviewed for compliance with general requirements of design and arrangement only; it is not a contract document and acknowledgement of compliance does not relieve the Contractor from responsibility for performance of the work in compliance with all provisions and requirements of the Contract Documents. Job measurements and the coordination of all the dimensions for proper fit of all parts of the work and performance of all equipment supplies to meet specification requirements are and remain specific responsibilities of the Contractor.
- C. Shop Drawings shall be furnished by the Contractor for the work involved after receiving approval on the make and type of material and in sufficient time so that no delay or changes will be caused. This is done in order to facilitate progress on the job, and failure on the part of the Contractor to comply shall render him liable to stand the expense of any and all delays, changes in construction, etc., occasioned by his failure to provide the necessary detailed drawings. Also, if the Contractor fails to comply with this provision, the Architect reserves the right to go directly to the manufacturer he selects and secure any details he might deem necessary, and should there be any charges in connection with this, they shall be borne by the Contractor.
- D. The Shop Drawings submitted shall not consist of manufacturers' catalogues or tear sheet therefrom that contain no indication of the exact item offered. Rather, the submission on individual items shall designate the exact item offered.
- E. Shop Drawings submitted without indicating markings or Contractor's stamp shall not be reviewed and will be returned to the Contractor for correction of such discrepancies.
- F. The Shop Drawings are not intended to cover detailed quantitative lists of electrical specialties, and similar items, as the plans and specifications illustrate and describe those items, and it is the Contractor's responsibility to procure the proper sizes and quantities required to comply with the established requirements.

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- G. Any Shop Drawings prepared to illustrate how equipment can be fitted into available spaces will be examined under the assumption that the Contractor has verified all the conditions, and obtained any approval thereon shall not relieve the Contractor of responsibility in the event the material cannot be installed as shown on those Drawings.
 - H. Various material submissions of such as raceways, switches, panelboards, and related items shall be assembled in brochures or in other suitable package form and shall not be submitted in a multiplicity of loose sheets.
 - I. Each Contractor shall process his submitted data to insure that it conforms to the requirements of the plans and specifications and that there are no omissions, errors or duplications.
 - J. Shop Drawings shall be accompanied by certification from this Contractor that Shop Drawings have been checked by him for compliance with Contract Drawings.
 - K. Samples of various products or mock-ups of particular details or systems may be required by various sections of this Specification.
 - L. Refer to Division 1 requirements.
- 1.12 PENETRATIONS THROUGH FIRE-RATED ASSEMBLIES
- A. Seal voids around ducts and pipes penetrating fire-rated assemblies and partitions using fire-stopping materials and methods in accordance with provisions in Division 1.
- 1.13 CONNECTION OF EQUIPMENT FURNISHED BY OTHERS
- A. All equipment furnished under other Divisions of the specification requiring service connections shall be connected by this Contractor. Materials and labor required for the connection of this equipment shall be furnished under Division 26. The respective supplier shall furnish proper roughing-in diagrams for the installation of these items. All items shall be roughed-in and connected in strict accordance therewith. All equipment requiring connection may not be specified herein, but may be included in other Division documents. This Contractor shall ascertain for himself all equipment so specified is included as part of his work.
 - B. Refer to Section 26 05 23.
- 1.14 DRAWINGS
- A. The drawings show diagrammatically the locations of the various conduits, fixtures, and equipment, and the method of connecting and controlling them. It is not intended to show every connection in detail and all fittings required for a complete system. The systems shall include, but are not limited to, the items shown on the drawings. Exact locations of these items shall be determined by reference to the general plans and measurements at the building and in cooperation with other trades and, in all cases, shall be subject to the approval of the Architect. The Architect reserves the right to make any reasonable change in the location of any of this work without additional cost to the Owner.
 - B. Should any changes be deemed necessary in items shown on the contract drawings, the shop drawings, descriptions, and the reason for the proposed changes shall be submitted to the Architect for approval.
 - C. Exceptions and inconsistencies in plans and specifications shall be brought to the Architect's attention before bids are submitted; otherwise, the Contractor shall be responsible for the cost of any and all changes and additions that may be necessary to accommodate his particular apparatus.
 - D. Lay out all work maintaining all lines, grades, and dimensions according to these drawings with due consideration for other trades and verify all dimensions at the site prior to any fabrication or installation; should any conflict develop or installation be impractical, the Architect shall be notified before any installation or fabrication and the existing conditions shall be investigated and proper changes effected without any additional cost.
 - E. Titles of Sections and Paragraphs in these specifications are introduced merely for convenience and are not to be construed as a correct or complete segregation or tabulation of the various units of material and/or work. The Architect does not assume any responsibility, either direct or implied, for omissions or duplications by the Contractor due to real or alleged error in the arrangement of matter in the Contract Documents.
- 1.15 COOPERATION
- A. All work under these specifications shall be accomplished in conjunction with other trades on this project in a manner which will allow each trade adequate time at the proper stage of construction to fulfill his work.
 - B. Maintaining contact and being familiar with the progress of the general construction and the timely installation of sleeves and inserts, etc., before concrete is placed shall be the responsibility of this trade

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as will the installation of the required systems in their several stages, at the proper time to expedite this contract and avoid unnecessary delays in the progress of other contracts.

- C. Should any question arise between trades as to the placing of lines, ducts, conduits, or equipment, or should it appear desirable to remove any general construction which would affect the appearance or strength of the structure, reference shall be made to the Architect for instructions.

1.16 MATERIALS AND EQUIPMENT

- A. All materials purchased for this Project shall be new.
- B. Where specified product is not manufactured, manufacturer's current product meeting specification shall be substituted, subject to written approval of Engineer.
- C. Space allocations in electrical spaces are based on equipment scheduled in each case. Should the Contractor offer equipment of another make, he shall verify that such equipment will fit in the spaces allowed.
- D. Manufacturers' names are listed herein to establish a standard. The products of other manufacturers will be acceptable; if, in the opinion of the Architect, the substitute material is of a quality as good or better than the material specified, and will serve with equal efficiency and dependability, the purpose for which the items specified were intended.
- E. It is fully the Contractor's responsibility to assemble and submit sufficient technical information to fully illustrate that the material or equipment proposed for substitution is equal or superior as the Architect or his Engineer is under no obligation to perform the service for the Contractor. The proposal shall be accompanied by manufacturers' engineering data, specification sheet, and a sample, if practical or if requested. In no event shall a proposal for substitution be cause for delay of work.
- F. Should a substitution be accepted under the above provisions, and should the substitution prove defective or otherwise unsatisfactory for the intended service, within the warranty period, the Contractor shall replace the substitution with the equipment or material specified, and on which the specifications required him to base his proposal.

1.17 STORAGE AND PROTECTION OF MATERIALS

- A. The Contractor shall provide his own storage space for protection and storage of his materials and assume complete responsibility for all losses due to any cause whatsoever. All storage shall be within the property lines of the building site, or as directed by the Owner's representative. In no case shall storage interfere with traffic conditions in any public or project thoroughfare.
- B. All work and material shall be protected at all times. This Contractor shall make good any damage caused, either directly or indirectly, by his workmen. He shall be responsible for safe handling of all electrical equipment and shall replace, without charge, all items damaged prior to acceptance by the Owner.

1.18 FOUNDATIONS

- A. Provide bases and foundations for all equipment specified or shown, unless specifically noted to the contrary. Foundations are generally to be built in compliance with the equipment manufacturer's shop drawings which have been approved by the Architect, or as directed by the Architect. Vibration or noise created in any part of the building by the operation of any equipment furnished or installed under this portion of the work will be objectionable. Take all precautions against same by isolating the various items of equipment from the building's structure, and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed; install all foundations, supports, etc., for raceway system and equipment with this end in view.

1.19 EXCAVATION AND BACKFILLING

- A. The Contractor shall do all necessary excavating and backfilling for the installation of his work. Trenches for underground conduits shall be excavated to required depths with bell holes provided as necessary to insure uniform bearing. Care shall be taken not to excavate below depth, and any excavation below depth shall be refilled with sand or gravel firmly compacted. Where rock or hard objects are encountered, they shall be excavated to a grade six inches (6") below the lowermost part of the conduit and refilled to grade as specified. After the conduit has been installed and approved, the trenches shall be backfilled to grade with approved materials, well tamped or puddled compactly in place. Where streets, sidewalks, etc., are disturbed, cut, or damaged by this work, the expense of repairing same in a manner approved by the Architect shall be a part of this contract.
- B. The Contractor shall bear sole responsibility for design and execution of acceptable trenching and shoring procedures, in accordance with State of Texas Regulations. On trench excavations in excess of five feet in depth, contractor shall pay a qualified engineer to prepare detailed plans and specifications directing

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Contractor in the safe execution of trenching and shoring. It is understood that trench safety systems constitute a means and method of construction for which the Architect, Engineer, and Owner are not responsible. Accordingly, such documents when prepared, shall be separately issued by Contractor's Consultant, independent or project Contract Documents.

1.20 SCHEDULE OF WORK

- A. The work under the various sections must be expedited and close coordination will be required in execution of the work. The various Contractors shall perform their work at such times as directed so as to insure meeting scheduled completion dates, and to avoid delaying any other Contractor. The Architect will set up completion dates, schedule the times of work in the various areas involved, etc. This Contractor shall cooperate in establishing these times and locations and shall process his work so as to insure the proper execution of it.

1.21 CONTINUATION OF SERVICES

- A. The Contractor shall realize that the existing building must continue in operation during the construction period, except as the Architect and the Owner may direct otherwise.
- B. Under no conditions shall any work be done in the present building that would interfere with its natural use during the normal hours of occupancy, unless special permission is granted by the Owner. This is particularly applicable where new connections are to be made to present services or items of equipment in the building or where present equipment items in the building are to be relocated or modified in any way.
- C. Existing utility systems shall continue to function with a minimum of interruptions in service. This Contractor shall install any temporary lines, connections, etc., required to place and maintain the electrical systems in operation unless otherwise directed by the Architect.
- D. Arrange for and provide temporary electric and telephone services to the building where new construction conflicts with existing utility locations.

1.22 COMMISSIONING OF EQUIPMENT AND SYSTEMS

- A. The Contractor shall provide qualified personnel, as requested by the Owner and Architect, to assist in all on-site testing and commissioning of all equipment.

1.23 CLEANING UP

- A. The Contractor shall be responsible for cleaning up his work as specified in the General Requirements of these Specifications.

1.24 FINAL OBSERVATION

- A. Schedule: Upon completion of the Contract, there shall be a final observation of the completed installation. Prior to this observation, all work under this Division shall have been completed, tested, and balanced and adjusted in final operating condition and the test report shall have been submitted to and approved by the Owner.
- B. Qualified personnel representing the Contractor must be present during final observation to demonstrate the systems and prove the performance of the equipment.

1.25 CERTIFICATIONS

- A. Before receiving final payment, the Contractor shall certify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications.
- B. Furnish, at the completion of the job, a final Inspection Certificate from the local inspecting authority.

1.26 GUARANTEE

- A. The guarantee provision of this specification requires prompt replacement of all defective workmanship and materials occurring within one year of final job acceptance. This includes all work required to remove and replace the defective item and to make all necessary adjustments to restore the entire installation to its original specified operating condition and finish at the time of acceptance. The Contractor shall also guarantee that the performance of all equipment furnished and/or installed under this Division of the specifications shall be at least equal to the performance as called for in the specifications and as stated in the equipment submittals. Should there be indication that the equipment and installation is not producing the intended conditions, the Contractor shall make further tests as the Engineer may direct to demonstrate that the equipment installed meets the specifications. If there is indication that the equipment does not meet the specifications, the Contractor shall, at his expense, institute a program to demonstrate the adequacy of the installation. This program shall include all necessary testing and testing

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equipment. Should the Contractor not have the equipment or technical skill to perform the tests, it shall be his responsibility to provide recognized experts to perform the tests and shall provide certified laboratory tests, certified factory reports and work sheets, or other certified data to support results of any tests required.

- B. Refer to Division 1 requirements.

PART 2 - PRODUCTS

NOT USED

PART 3 - INSTALLATION

3.1 DEVICE MOUNTING REQUIREMENTS

- A. Mounting heights listed in Drawings shall be defined as measured from the centerline of the device or outlet box to finished floor elevation. Unless specifically noted otherwise on the Drawings. Device heights shall be in accordance with the Texas Accessibility Standards or the Americans with Disabilities Act.
- B. Where devices are grouped together, they shall be mounted at the same height.
- C. Coordinate all mounting dimensions with Owner's requirements and coordinate with architectural elevations and details.

3.2 HOUSEKEEPING PADS

- A. Provide 4 inch thick concrete housekeeping pad with 6 x 6 wire mesh and same cure strength as adjacent floor for all floor-mounted electrical equipment unless otherwise indicated on the Drawings. Provide dowel connections to floor if pad is not part of continuous floor pour.
 - 1. Provide inserts for anchor bolts as required for each floor-mounted piece of electrical equipment.
 - 2. Provide 3/4 inch chamfered edge at all exposed edges.
- B. Minimum pad dimensions shall be 6 inches greater than dimensions, including all protrusions, of equipment to be installed.
 - 1. Free-standing equipment: Center equipment on housekeeping pad.
 - 2. Equipment anchored to wall: Center equipment side-to-side on housekeeping pad and reduce pad front-to-back dimension by 3 inches.

END OF SECTION 260000

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SECTION 260501 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1- General Requirements and related documents.
- B. All sections of this Specification.

1.2 DESCRIPTION

- A. Contractor shall remove several items of materials and equipment under this section of the specifications. Equipment and materials to be removed shall be as indicated and noted on the Drawings and as required to facilitate the new installations.
- B. Provide labor, materials, equipment, tools and services as required to complete the demolition work indicated.
- C. Refer to Division 1 for "Schedule of Work".

1.3 DISRUPTION OF EXISTING FUNCTIONS

- A. Under no conditions shall any work be done in the present building that would interfere with its natural or intended use unless special permission is granted by the Owner.
- B. Disruptions: Maintain existing lighting, power, telephone, and other systems, and maintain existing functions in service, except for scheduled disruptions as allowed in Division 01, "General Conditions".
- C. Provide all temporary connections as necessary to facilitate the phasing of construction.

1.4 SALVAGE, DEMOLITION, AND RELOCATION

- A. It shall be the responsibility of the Contractor to remove and store those items of existing equipment as indicated on the Drawings to be removed. All items of equipment or fixtures removed shall be protected from damage insofar as is practical.
- B. These items shall be stored on site for a minimum of two (2) weeks unless indicated otherwise by the Owner's representative to allow for inspection by the Owner. Deliver, all items tagged to be retained by the Owner to a designated storage location on site or to the Owner's designated Service Center or Warehouse. All items not retained by the Owner shall be removed from the site by the Contractor at no additional cost to the Owner.
- C. The attendant conduit, hangers, foundations, etc., of those items of existing equipment to be removed, shall also be removed in their entirety. No hangers, etc., shall be abandoned in place.
- D. Relocations:
 - 1. Repair and restore to good functional condition materials and items scheduled for relocation and/or reuse and which are damaged during dismantling or reassembly operations.
 - 2. New materials and items of like design and quality may be substituted for materials and items indicated to be relocated, in lieu of relocation, upon approval of shop drawings, product data and samples.
 - 3. Remove carefully, in reverse to original assembly or placement, items which are to be relocated.
 - 4. Protect items until relocation is complete.
 - 5. Clean and repair and provide new materials, fittings, and appurtenances required to complete the relocation and to restore to good operative order.
 - 6. Perform the relocation work in accordance with pertinent sections of the specifications, utilizing skilled workers.
 - 7. Refer to Drawings for specific requirements of temporary services and relocated equipment and fixtures.
 - 8. Coordinate with the General Contractor repairs required to bring finishes back to their original conditions after demolition and or installation of new equipment.

1.5 CLEAN UP

- A. Remove all debris, rubbish, and materials resulting from cutting, demolition, or patching operations from the work area on a daily basis.
- B. Transport materials and legally dispose of off site.

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PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide materials and equipment for patching and extending work as specified in individual sections or as indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Field Conditions: Demolition Drawings are based on non-invasive field observations and existing record documents. Report discrepancies in location, dimensions or quantity to Owner and Architect prior to disturbing existing installation.
- B. Abandoned Wiring: Verify that abandoned wiring and equipment serve only facilities scheduled for demolition.
- C. Existing Conditions: Commencing demolition means Contractor accepts existing conditions.

3.2 PREPARATION

- A. Demolition: Disconnect electrical systems in walls, floors, ceilings and equipment scheduled for removal.
- B. Project Coordination: Coordinate utility service outages with utility companies and schedule work with Facility management and Owner.
- C. Temporary Wiring: Provide temporary wiring and connections as necessary to maintain existing systems in service during construction.
- D. Schedule installation of temporary wiring and connections to eliminate hazard to installing personnel.
 - 1. When work must be performed on energized circuits or equipment, use qualified personnel experienced in such operations.
 - 2. Submit "hot work" policy information to Architect for review prior to performing work on any energized circuits.
- E. Electrical Service: Maintain existing system in operation until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission, in writing, from Owner prior to partially or completely disabling system. Minimize outage duration. Make temporary connections as necessary to maintain service to areas unaffected by the scope of Work.
- F. Telephone Service: Maintain existing system in operation until new system is complete and has been accepted. Disable system only to make switchovers and connections. Obtain permission, in writing, from Owner, and notify the utility company, prior to partially or completely disabling system. Minimize outage duration. Make temporary connections as necessary to maintain service to areas unaffected by the scope of Work.
- G. Special Systems: Maintain existing systems in operation until new systems are complete and have been accepted. Disable systems only to make switchovers and connections. Obtain permission, in writing, from Owner prior to partially or completely disabling systems. Minimize outage duration. Make temporary connections as necessary to maintain service to areas unaffected by the scope of Work.
 - 1. The following systems will be affected by the scope of Work:
 - a. Fire Alarm System
 - b. Public Address System
 - c. Security System
 - d. Data System

3.3 DEMOLITION AND EXTENSION OF EXISTING WORK

- A. General: Demolish and extend existing work as indicated or described in the Drawings and Specifications.
 - 1. Lighting fixtures and electrical distribution equipment shall be salvaged for possible re-installation as directed by the Owner and Architect.
- B. Wiring: Remove abandoned wiring and cables to source of supply or termination.
- C. Raceways:
 - 1. Remove exposed abandoned conduits and raceways, including abandoned conduits and raceways above accessible ceilings.
 - 2. Conduits and raceways concealed in existing construction to remain shall be abandoned in place. Cut conduits and raceways such that finished surfaces can be patched smooth.

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- D. Wiring Devices: Remove abandoned wiring devices. Provide blank device plate for outlet box not being removed.
- E. Electrical Distribution Equipment: Disconnect and remove abandoned panelboards and electrical distribution equipment.
- F. Lighting Fixtures: Disconnect and remove abandoned lighting fixtures, including brackets stems, hangers and other accessories not indicated to be re-used.
- G. Existing Installations to Remain: Maintain access to existing electrical installations which remain active.
- H. Modify installation or provide access panel as required.
- I. Extension of existing circuits: Extend existing installations as required to maintain service to items to remain using materials and methods, as specified that are compatible with original installation.
- J. Adjacent Construction: Repair adjacent construction and finishes damaged during demolition and extension work.
- K. Dispose of hazardous materials, such as fluorescent and H.I.D. lamps and PCB's in lamp ballasts, in accordance with all Local, State and Federal ordinances and regulations.

3.4 SALVAGED MATERIALS

- A. Salvage existing materials for re-installation as directed by Owner. Coordinate locations for storage of salvaged materials with Owner.

3.5 CLEANING AND REPAIR

- A. Existing Materials: Clean and repair existing materials and equipment which remain or are to be re-used.
- B. Existing Panel boards: Clean exposed surfaces and check tightness of all electrical connections. Replace damaged circuit breakers with units of compatible construction and provide closure plates for vacant positions.
- C. Existing Lighting Fixtures: Where existing lighting fixtures are indicated to remain, clean reflector and lens and replace lamps.
 - 1. Use mild detergent to clean all interior and exterior surfaces; rinse with clean water and wipe dry; allow to dry thoroughly prior to re-installation.
 - 2. Replace lamps and broken electrical components. Replace cracked or broken lenses and louvers with new identical materials.
 - 3. Ballasts: Replace ballasts in all fluorescent lighting fixtures to remain or to be re-used with new ballasts as specified.

END OF SECTION 260501

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SECTION 260519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all other Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Provide systems of wires and cables for electric power, signaling and control.
- B. Related work specified in other sections
 - 1. 26 00 00 - Electrical
 - 2. 26 05 20 - Cable Connections
 - 3. 26 05 23 - Control Voltage Electrical Power Cables
 - 4. 26 05 32 - Raceways
 - 5. 26 05 33 - Boxes for Electrical Systems

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 REFERENCED STANDARDS

- A. ICEA 5-61-402 Thermoplastic Insulated Wire and Cable
- B. ICEA 5-66-524 Cross Linked Thermosetting Polyethylene Insulated Wires and Cables
- C. ICEA 5-68-516 Ethylene Propylene Rubber Insulated Wire and Cable
- D. ICEA 5-19-81 Rubber Insulated Wire and Cable
- E. ANSI 1581 Standard of Electrical Wires, Cables, and Flexible Cords.
- F. UL 83 Thermoplastic Insulated Wires and Cables
- G. UL 1569 Metal Clad Cables
- H. ASTM B3 Standard Specification for Soft or annealed Copper Wire
- I. ASTM B8 Standard Specification for Concentric Lay Standard Copper Conductors

1.5 SUBMITTALS

- A. Where products are of a manufacturer other than listed as acceptable manufacturers, submit manufacturer's product literature completely describing conductors and cable assemblies and evidence of U.L. Listing.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver conductors and cable assemblies to the project in the manufacturer's standard reels or boxes marked with conductor material, insulation type, conductor size and U.L. Label.
- B. Store conductors and cable assemblies in a clean, dry location to prevent damage from moisture, dust, personnel and equipment.
- C. Handle conductors and cables in a manner to prevent damage to conductor, insulation, jackets, and identifying markings.

1.7 MANUFACTURERS

- A. The material shall be the product of a manufacturer with a minimum of ten years' experience in the manufacture of similar material.
- B. Acceptable Manufacturers:
 - 1. AFC Cable Systems.
 - 2. Cerro Wire, Inc.
 - 3. General Cable
 - 4. Southwire Company
 - 5. Okonite Company

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1.8 WARRANTY

- A. The material shall be warranted to be free from defect and in proper working order for one year following the date of final acceptance.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Copper Conductors
1. Conductors shall be copper unless specifically noted otherwise on the Drawings.
 2. Copper conductors shall be soft drawn annealed copper, minimum conductivity 98% of pure copper per ASTM ASTM-B3.
 3. Sizes No. 10 AWG and smaller shall be solid conductor, single strand.
 4. Sizes No. 8 AWG and larger shall be concentric lay Class B stranding.
 5. Shall conform to the Conductor Properties proscribed in the NEC.
- B. Insulation
1. Type THW: 600 volt moisture and heat resistant thermoplastic rated 75 Deg.C. in wet or dry locations.
 2. Type THW-2: 600 volt moisture and heat resistant thermoplastic rated 90 Deg.C. in wet or dry location.
 3. Type THWN: 600 volt moisture and heat resistant thermoplastic rated 75 Deg.C. in wet or dry.
 4. Type THWN-2: 600 volt moisture and heat resistant thermoplastic rated 90 Deg.C. in wet or dry locations.
 5. Type XHHW: 600 volt moisture resistant cross linked polyethylene rated 75 Deg.C. in wet or dry locations.
 6. Type XHHW-2: 600 volt moisture resistant cross linked polyethylene rated 90 Deg.C. in wet or dry locations.

PART 3 - EXECUTION

3.1 USES PERMITTED

- A. Unless specifically noted on the drawings, permitted by the NEC and local codes and ordinances, wiring shall be Types THW-2, THWN-2 or XHHW-2 installed in metal raceways as specified in 26 05 32, Raceways.

3.2 COLOR CODING

- A. Where available, insulation shall be color coded by factory pigmentation for each phase and each voltage system employed on the project.
- B. 120/208 and 120/240 volt systems:
1. Phase A - Black
 2. Phase B - Red
 3. Phase C - Blue
 4. Neutral - White
 5. Ground - Green
- C. 277/480 volt systems:
1. Phase A - Brown
 2. Phase B - Orange
 3. Phase C - Yellow
 4. Neutral - Gray
 5. Ground - Green
- D. Switch legs, travelers and special systems shall be continuous color scheme throughout the project as selected by the Contractor.
- E. Where factory pigmentation is not available, code conductors with 1-1/2" colored tape band at each terminal and at each pull or junction box.

3.3 GROUNDING CONDUCTORS

- A. All branch circuits and feeders shall include an insulated equipment grounding conductor. Raceway systems shall not be used as the sole equipment grounding path without specific approval.

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3.4 MULTIWIRED BRANCH CIRCUITS

- A. Multiwire branch circuits shall not be permitted.

3.5 MINIMUM SIZE

- A. Conductors shall be of the minimum size shown on the drawings, lighting and power branch circuit wiring shall be minimum No.12 AWG.
- B. Feeder circuit wiring shall be sized to limit the effect of voltage drop, based on the actual installed conductor length to limit voltage drop to 2% of nominal system voltage.
- C. Branch circuit wiring shall be sized to limit the effect of voltage drop, based on the actual installed conductor length, to limit voltage drop to 3% or less of nominal system voltage.
- D. Circuits shall be grouped in raceways and grouped together when passing through enclosures to have phases and neutral grouped together to minimize circuit reactance.

3.6 INSTALLATION

- A. Examine the system in which the conductors are to be installed for defects in equipment and installation which may cause damage to the conductors, insulation, or jackets.
- B. Pull a swab or mandrel through conduit systems immediately before pulling conductors to insure a full bore, clean raceway system.
- C. Do not exceed the conductor manufacturer's maximum pulling force or minimum bending radius.
- D. Use pulling lubricant compound where necessary and recommended by the manufacturer.
- E. Conductors or cables which have insulation or jackets damaged in the pulling process shall be removed and replaced with new material.

3.7 FIELD QUALITY CONTROL

- A. Test all wiring insulation with a megohm meter prior to energization:
 - 1. Phase to ground
 - 2. Phase to phase
 - 3. Phase to neutral
 - 4. Neutral to ground
- B. Perform test in accordance with manufacturer's recommendation and to meet manufacturer's published minimum insulation values.
- C. Correct all defects revealed by such tests including replacing material with new as required.

END OF SECTION 260519

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SECTION 260520 - CABLE CONNECTIONS

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1- General Requirements and related documents.
- B. All sections of this Specification.

1.2 DESCRIPTION

- A. Work Included: Provide wire connections and devices to be readily identifiable, mechanically and electrically secure wiring system.
- B. Related work specified in other sections:
 - 1. 26 05 19 Low Voltage Electrical Power Conductors and Cables

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 SUBMITTALS

- A. Samples: Provide samples upon specific request.
- B. Product Data: If materials are by manufacturers other than those specified, submit product data giving complete description for sizes employed, material types, and electrical ratings.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Connections shall be made in atmospheres that are free from dirt, moisture, and elements which may be damaging.

1.6 MANUFACTURERS

- A. The materials shall be the product of a manufacturer with a minimum ten years' experience in the manufacture of similar materials.
- B. Acceptable manufacturers are listed with the products.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Spring Connectors: Ideal "Wingnut" 3M-Scotch, Buchanan, and Thomas and Betts.
- B. Terminal Connectors: O-Z/Gedney, Burndy, and Thomas and Betts.
- C. Splice Connectors: O-Z/Gedney or Burndy with insulating cover.
- D. "T" and Parallel Connectors: O-Z/Gedney or Burndy with insulating cover.
- E. Vinyl Plastic Tape: 3M-Scotch #33 or #88, Plymouth and Okonite.
- F. Rubber Tape: Okonite, 3M-Scotch and Plymouth.
- G. Colored Tape: 3M-Scotch, Plymouth.
- H. Wire Ties: Thomas and Betts "Ty-Rap", Ideal and Panduit.
- I. Tie Mounts, Plates, Anchors: Thomas and Betts, Ideal, and Panduit.
- J. Wire Tags: Self-laminating, cloth, wrap-on type by Thomas and Betts, Ideal, and Brady.
- K. Terminal Strips: Nylon; 600 volt; modular plug-on construction; tubular compression slip-in terminals properly sized; complete with mounting track, end clips, and anchors by Allen-Bradley, Square D, and Buchanan.
- L. Cable and Cord Fittings: Crouse-Hinds with wire mesh grip or Appleton.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine wires to be joined, tapped, spliced, terminated, and their connecting devices for defects which may affect the mechanical and electrical integrity of the connection.
- B. Do not proceed until defects are corrected.

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3.2 PREPARATION

- A. Remove proper amount of insulation necessary for connection, clean conductors.

3.3 INSTALLATION

- A. No. 10 Wire and Smaller: Connect with spring connectors, terminate at terminal strips.
- B. No. 8 Wire and Larger: Connect and terminate with above specified tape half-lapped to produce a dielectric value equal to wire insulation.
- C. Train, hold, clamp, and tag wiring in cabinets, pull boxes, panels, and junction boxes with above specified devices.
- D. Splices in feeders and mains may only be made where designated on the drawings and where prior approval is obtained from the Architect.
- E. Install terminal strips in enclosures without means for termination of wiring.
- F. Install cable and cord grips on all cables and cords, entering enclosures. Use wire mesh grips where necessary for strain relief.

3.4 FIELD QUALITY CONTROL

- A. Test: Connections shall be resistance tested with megohm meter as specified for wire.

3.5 ADJUSTMENTS

- A. Assure that wire connections made by others in equipment furnished by others are mechanically and electrically sound prior to energization.

END OF SECTION 260520

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SECTION 260523 - CONTROL -VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all other Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Work Included: Provide power wiring, raceways, and connections for items of equipment and control systems.
- B. All wiring for every system shall be installed in metal conduit. Refer to Section 26 05 32 Raceways for conduit types and materials for specific locations and applications.
- C. Related work specified in other sections:
 - 1. 23 09 00 Instrumentation and Controls for HVAC
 - 2. 26 00 00 Electrical
 - 3. 26 05 19 Low Voltage Electrical Power Conductors and Cables
 - 4. 26 05 32 Raceways
 - 5. 28 31 00 Fire Alarm System

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 WARRANTY

- A. The material shall be warranted to be free from defect and in proper working order for one year following the date of final acceptance.

1.5 COORDINATION

- A. For equipment furnished under other Divisions, obtain equipment supply and wiring requirements from the Contractor supplying the equipment.
- B. For equipment furnished under Division 23, obtain complete temperature control system drawings, and power supply and interlock wiring requirements from the Contractor furnishing the systems.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to related work specified in other sections for material requirements.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Work Included: The Electrical Contractor shall provide:
 - 1. Branch circuit and motor feeder circuit conductors, raceway, connections, and overcurrent protection for each motor or item of equipment furnished by the Owner or other Contractors.
 - 2. Motor Control Centers, where indicated on the drawings.
 - 3. Installation of motor controllers furnished by the Owner or other Contractors, along with branch circuit and motor feeder circuit conductors, raceway, and connections in accordance with the manufacturer's approved wiring diagrams.
 - 4. Disconnect switches and combination disconnect switches and motor controllers, where indicated on the drawings or required by codes, except as provided as an integral part of manufactured equipment.
 - 5. Power supply conductors, raceway, connections, and overcurrent protection for input power to HVAC Temperature Controls, HVAC Automation, and HVAC Energy Management Systems in accordance with approved rough-in and connection diagrams furnished by the system suppliers.

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6. The above represents an outline of the work for the purpose of describing one division of the work which is acceptable to insure that all work is contained within the General Contract. Nothing herein shall be construed to confine the General Contractor from assigning the work to any member or group of contractors deemed best suited to executing the work to effect the contract. Refer to specific bidding instructions of the General Contractor for the actual division of the work. The General Contractor is fully responsible for the installation of complete, operating systems in accordance with the functional intent of the specifications.
- B. Work Not Included: The Mechanical Contractor shall provide:
1. Motors and equipment, erected in place and ready for final connection of power supply wiring, along with manufacturer's approved wiring diagrams.
 2. Motor controllers, in suitable enclosures and of the type and size in accordance with the manufacturer's recommendations and NEMA requirements, along with properly sized overload elements and approved wiring diagrams.
 3. Disconnecting switches or devices which are normally provided as a part of manufactured equipment.
 4. Rough-in and connection diagrams for input power supply and connections for the HVAC Temperature Control, HVAC Automation, and HVAC Energy Management Systems.
 5. Conductors, raceways, devices, and connections for low voltage control, line voltage control, and signaling systems for the HVAC Temperature Control, HVAC Automation, and HVAC Energy Management Systems in accordance with the provisions of Division 26, and approved systems shop drawings to provide complete operating systems in accordance with the functional requirements of the specifications.
 6. The above represents an outline of the work for the purpose of describing one division of the work which is acceptable to insure that all work is contained within the General Contract. Nothing herein shall be construed to confine the General Contractor from assigning the work to any member or group of contractors deemed best suited to executing the work to effect the contract. Refer the specific bidding instructions of the General Contractor for the actual division of work. The General Contractor is fully responsible for the installation of complete, operating systems in accordance with the functional intent of the specifications.
- C. Completely connect all electrical consuming items of mechanical equipment, kitchen equipment, shop equipment, etc., provided by the Owner or other trades. Outlets of various types have been indicated at equipment locations, but no indications or exact location or scope of work is indicated on the accompanying drawings.
- D. Refer to details and information furnished by the Owner and various equipment suppliers for equipment wiring requirements and to the Plumbing and Heating, Ventilating and Air Conditioning Specifications for the scope of the connections to equipment provided under those sections, and determine from the various trades by actual measurements at the site, and by direction from the Owner and the Architect the exact locations of all items. Roughing-in drawings, wiring diagrams, etc., required for the proper installation of the electrical work will be furnished by applicable trades furnishing equipment. Request the drawings and information required in writing to the equipment supplier in ample time to permit preparation of the drawings and to permit proper installation of all wiring. Obtain from those furnishing equipment the size and type of service required for each motor or piece of electrical equipment and verify that the service to be installed is compatible.
- 3.2 INSTALLATION
- A. All conduits shall terminate in conduit boxes on motors where possible. When motors are direct-connected, the conduit may continue rigid into the box, but when motors drive through belts and have sliding bases, a piece of flexible liquid tight conduit not less than 12 inches long shall be connected between the rigid conduit and the motor terminal. Where motors are not provided with conduit boxes, terminate the conduit in a conduit at the motor.
 - B. Where disconnecting switches are not provided integral with the control equipment for motors, provide and install a disconnect switch in the circuit to each motor where indicated and required by code. Switches shall be installed as close as possible to the motor or controls they serve and they shall be within sight of the motor or control circuit.
 - C. Be responsible for installing all conductors and protective devices serving equipment motors furnished by others in strict conformance with all applicable codes, regardless of any discrepancy in plans and/or mechanical equipment sizes variations, unless covered by directives issued by the Architect.

END OF SECTION 260523

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all other Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Provide a grounding electrode for the facility and a ground electrode conductor system to connect to the electric service main equipment.
- B. Provide supplementary grounding electrodes as specified herein.
 - 1. Provide connections from the grounding electrode system to:
 - 2. The electric power system grounded circuit conductor (neutral).
 - 3. The electric power system non-current carrying enclosures and equipment ground conductors (equipment ground).
- C. Provide connections from the grounding electrode system to auxiliary ground conductors for data and voice communication systems (isolated ground).

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 REFERENCED STANDARDS

- A. National Electrical Code, NFPA 70.
- B. EIA/TIA Standard 607
- C. IEEE - Standard 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- D. IEEE Standard 81 - Guide for Measuring Earth Resistivity.

1.5 SUBMITTALS

- A. Where products are of a manufacturer other than listed as acceptable manufacturers, submit manufacturer's product literature completely describing conductors and cable assemblies and evidence of U.L. Listing.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver conductors and cable assemblies to the project in the manufacturer's standard reels or boxes marked with conductor material, insulation type, conductor size and U.L. Label.
- B. Store conductors and cable assemblies in a clean, dry location to prevent damage from moisture, dust, personnel and equipment.
- C. Handle conductors and cables in a manner to prevent damage to conductor, insulation, jackets, and identifying markings.

1.7 MANUFACTURERS

- A. The materials shall be the products of a manufacturer with a minimum of ten years experience in the manufacture of similar material.
- B. Acceptable manufacturers shall be as listed with the material descriptions.

1.8 WARRANTY

- A. The material shall be warranted to be free from defect and in proper working order for a period of one year following the date of final acceptance.

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PART 2 - PRODUCTS

2.1 GROUND RODS

- A. Standard ground rods shall be 3/4 inch diameter, 10 foot length, copper clad steel, equal to Thompson Company.

2.2 CONDUCTORS

- A. Conductors buried in contact with the earth shall be bare copper, solid for sizes up to No. 6 AWG, concentric lay strand for sizes No. 8 AWG and larger.
- B. Conductors for installation below raised access floor systems shall be bare copper, solid for sizes up to No. 6 AWG, concentric lay strand for sizes No. 8 AWG and larger.
- C. All other grounding conductors shall be copper conductor, Type THWN 600 volt 90 Deg.C. thermoplastic insulation, green color where available.

2.3 CONNECTIONS

- A. All connections made below grade, in inaccessible locations, and all connections and splices in the grounding electrode conductor system shall be made by exothermic weld process equal to Cadweld. Provide polyethylene inspection well covers and lids equal to Erico #T416B.
- B. All other connections shall be hydraulically crimped irreversible connectors equal to Thomas and Betts 54000 Series.
- C. Connections to raised access floor system pedestals shall be Thomas and Betts 38268 malleable iron mechanical clamp.
- D. Connections to cable trays shall be Thomas and Betts 10105 malleable iron mechanical clamp.
- E. Connections to domestic cold water piping shall be Thomas and Betts GUV Series copper alloy U-bolt and mechanical clamp.
- F. Connections to building structural steel shall be exothermic weld equal to Cadweld.
- G. Connections which require flexibility for movement, expansion, or vibration shall be made with flexible flat conductor, multiple strands of 30 gauge copper conductors or equivalent circular mil area to the primary ground conductor. Protect ends with copper bolt hole end pieces.

2.4 CONDUITS

- A. Provide malleable iron conduit grounding bushings where:
 - 1. Metallic raceways terminate at metal housings without mechanical and electrical connection to housing.
 - 2. At each end of metallic conductors for grounding conductors where conduits are electrically non-continuous.
 - 3. At the ends of service entrance conduit.

PART 3 - EXECUTION

3.1 GROUNDING ELECTRODE

- A. Provide one, or more, driven solid ground rods to serve as the grounding electrode for the facility. Additional rods shall be driven at not less than ten foot separation and connected together until the specified resistance testing criteria can be met.
- B. Grounding electrode shall be tested and certified to provide five ohms or less Earth resistivity.

3.2 SUPPLEMENTARY GROUND ELECTRODES

- A. The following items, where they exist on the project, shall be bonded together with the main grounding electrode described above:
 - 1. Domestic cold water service entrance.
 - 2. Building structural steel frame.
 - 3. Minimum twenty feet of bare copper conductor, minimum No. 4 AWG, encased in a concrete footing along the exterior perimeter edge of the building.
 - 4. Lightning Protection System.
- B. Ground Electrode Bus:
 - 1. Provide a single copper bus bar located adjacent to the service main disconnecting means as the common connection point for the main ground electrode and each supplementary ground electrode.
 - 2. Mount ground bus on suitable wall insulator stand-offs.

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3. All grounding electrode conductors shall be permanently connected to this bus with exothermic weld connections.
 4. All grounding electrode conductors shall be the same size and shall be not less than the size required by NEC or the size shown on the Drawings.
 5. Connect the grounding electrode system to the main ground connection in the U.L. Listed Service Disconnecting means in the main switch or switchboard.
- 3.3 GROUNDED CIRCUIT CONDUCTOR
- A. Bond the grounding electrode system to the grounded circuit conductor (neutral conductor) at one location only, on the supply side of the service disconnecting means, with a neutral disconnecting link as required by the NEC.
- 3.4 EQUIPMENT GROUNDING CONDUCTORS
- A. Bond the non-current carrying parts of the electric power system to the grounding electrode conductor at the service disconnecting means. From this point forward, all non-current carrying parts of the electric power system shall be electrically connected and continuous by means of:
1. Electrically continuous equipment enclosures, metallic boxes and metallic raceways connected with U.L. Listed connectors and couplings.
 2. Equipment grounding conductors supplementary to metallic raceway systems where shown on the Drawings.
 3. Equipment grounding conductors in non-metallic raceway systems and in flexible metal conduit systems.
 4. Where permitted under other sections of the Specification, the insulated grounding conductor provided in Type MC cable will be considered an acceptable equipment grounding conductor.
 5. Uninsulated grounding strips and spiral wrap provided in Type AC cable is not an acceptable grounding conductor.
- 3.5 SEPARATELY DERIVED SYSTEMS
- A. Separately derived systems include:
1. Secondaries of dry type power transformer.
 2. Outputs of uninterruptible power systems.
 3. Outputs of motor generator sets or frequency convertors.
- B. These systems shall be grounded in accordance with the NEC, similar to the service disconnecting means discussed above, and as shown on the Drawings.
- C. The grounding electrode conductor from a separately derived system shall be connected to the main ground electrode bus described above, or to one of the secondary ground electrode busses, if present.
- D. A second grounding electrode conductor shall connect to building structural steel frame at the nearest available location, if available.
- 3.6 TESTING
- A. Grounding Electrode:
1. The earth resistance of the main ground electrode shall be not more than 5 ohms.
 2. Perform a measurement of ground resistance by one of the means described in IEEE Standard 81, Guide for Measuring Earth Resistivity.
 3. Provide written certification of the ground resistance measurements upon request.
- B. Grounding Continuity:
1. Provide continuity tests and checks of equipment grounding and isolated grounding conductor systems to insure electrical continuity.
 2. Provide written certification of continuity checks upon requests.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1- General Requirements and related documents.
- B. All sections of this Specification.

1.2 DESCRIPTION

- A. Work Included: Provide miscellaneous materials for the supporting of electrical material and equipment.
- B. Related work specified in other sections:
 - 1. 26 00 00 Electrical
 - 2. 26 05 32 Raceways
 - 3. 26 27 16 Electrical Cabinets and Enclosures
 - 4. 26 05 33 Boxes for Electrical Systems

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 SUBMITTALS

- A. Product Data: If materials are by manufacturers other than specified, submit product data giving complete description.

1.5 MANUFACTURERS

- A. Listed with Materials.
- B. Acceptable Manufacturers
 - 1. Kindorf
 - 2. Unistrut
 - 3. Caddy

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Continuous Slotted Channel: #12 gauge steel, electrogalvanized, with zinc chromate, bases and dimensions as required for application.
- B. Hanger Rods: Continuous thread, electrogalvanized, with zinc chromate, sizes as required for loads imposed.
- C. Hex Head Cap Screws and Nuts: No. H-113 and No. H-114, respectively.
- D. One-Hole Pipe Straps: Series HS-100, galvanized steel
- E. Single Bolt Channel Pipe Straps: Steel, with machine screws and nut, Series C-105 and Series C-106.
- F. Lay-In Pipe Hanger: Series C-149.
- G. Conduit and Pipe Hanger: Series 6H.
- H. Beam Clamps: Series 500, RC, EC, and PC for applications.
- I. Concrete Inserts, Spot: Series D-256 or No. D-255.
- J. Concrete Inserts, Channel: Series D-980 or Series D-986.
- K. Riser Clamps: Series C-210.
- L. Cable Supports: O-Z/Gedney Type S.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Carefully lay out and provide concrete inserts.
- B. Securely fasten and support conduits and raceways to the building structure.

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- C. Suspend horizontal runs of conduit and raceways from the floor and roof construction by rod hangers spaced 10 feet on less on centers for sizes 2-1/2 inches and greater and 9 feet or less on centers for sizes 2 inch and smaller.
- D. Fasten single runs of conduit to the structure with one-hole pipe straps and beam clamps or hang on rod hangers.
- E. Support multiple runs of conduit and raceways from continuous channel inserts or from trapeze hangers constructed of rod hangers and channels.
- F. Fasten single conduits to rod hangers with adjustable lay-in pipe hangers or for 2 inches and smaller conduits with Series 6H pipe hangers.
- G. Fasten conduits to channels with pipe channel straps.
- H. Support conduits and raceways within 3 feet of each end of each bend, of each termination, and at other intervals to maintain horizontal and vertical alignment without sag and deformation.
- I. Do not use cable, strap, and wire hangers as fasteners.
- J. Provide riser clamps for conduits at floor lines. Provide wire and cable supports in pull boxes for risers in accordance with NEC Section 300-19 and Table 300-19 (a).
- K. Install supports to permit equally distributed expansion and contraction of conduits and raceways with expansion joints. Use guides or saddles and U-bolts and anchors designed for equal effectiveness for both longitudinal and transverse thrusts.
- L. Do not support conduits and raceways for equipment connections.
- M. Provide special supports with vibration dampers to minimize transmission of vibrations and noises.
- N. Provide trapeze hangers for conduits and raceways where routing interferes with ducts
- O. Provide hangers, racks, cable cleats and supports for wires and cables in cable chambers and other locations to make a neat and substantial installation.
- P. Provide angle iron and channel supports to the floor and structure for panelboards, cabinets, pull and junction boxes. Support independently from entering conduits and raceways. Provide supports as specified for conduits and raceways for outlet boxes and pull boxes 100 cubic inches and smaller.
- Q. Provide supports sized for the ultimate loads to be imposed.

3.2 CLEANING

- A. Clean surfaces to be painted.

END OF SECTION 260529

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SECTION 260532 - RACEWAYS

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all other Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Work Included: Provide a mechanically and electrically complete conduit system.
- B. Related work specified in other sections:
 - 1. 26 00 00 Electrical
 - 2. 26 05 19 Low Voltage Electrical Power Conductors and Cables
 - 3. 26 05 29 Hangers and Supports for Electrical Systems
 - 4. 26 05 23 Control Voltage Electrical Power Cables

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 SUBMITTALS

- A. Samples: Provide samples upon specific request.
- B. Product Data: If materials are by manufacturers other than those specified, submit product data giving complete description for sizes employed, material types, and installation methods.
- C. Certificates:
 - 1. Labels of Underwriters' Laboratories, Inc. affixed to each item of material.
 - 2. If materials are by manufacturers other than those specified submit certification that material meets applicable Underwriters' Laboratories, Inc. Standards.
 - 3. Labels of ETL Verified PVC-001 affixed to each PVC Coated Galvanized Rigid Conduit.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect conduits and finishes from damage.

1.6 MANUFACTURER

- A. The materials shall be the products of a manufacturer with a minimum of ten years experience in the manufacture of similar equipment.
- B. Acceptable Manufacturers
 - 1. Metallic Conduits: Allied, and Wheatland.
 - 2. Nonmetallic Conduits: Cantex, and SEDCO.
 - 3. PVC Coated Metallic Conduits: Plastibond, Permacote, and Korkap.
 - 4. Others: As listed with products.

1.7 WARRANTY

- A. The materials shall be warranted to be in proper working condition for a period of one year following the date of final acceptance.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rigid Metal Electrical Conduit: Hot-dipped galvanized steel with zinc coated threads and an outer coating of zinc bichromate, complete with one coupling and one end thread protector. Intermediate metal conduit (IMC) is not allowed.
- B. Electrical Metallic Tubing: Welded, electro-galvanized thin wall steel tubing.
 - 1. Conduit for power wiring shall be natural electro galvanized.
 - 2. Conduit for other systems shall be color coded in accordance with Section 26 05 23 - Control Voltage Electrical Power Cables.

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- C. Flexible Metal Electrical Conduit: Hot-dipped galvanized steel strip core with integral copper ground wire on sizes 1-1/4" and smaller.
- D. Liquidtight Flexible Metal Electrical Conduit: Hot-dipped galvanized steel strip core with extruded polyvinyl jacket.
- E. Rigid Nonmetallic Electrical Conduit: Schedule 40 heavy wall polyvinylchloride, high impact resistant.
- F. Elbows and Bends:
 - 1. All Types: Size 1-1/4 inch and larger shall be factory manufactured.
- G. Bushings:
 - 1. 1-1/4" and Smaller: Same material as the conduit with which they are installed.
 - 2. 1-1/2" and Larger: Hot-dipped galvanized with thermosetting phenolic insulation, 150 Deg.C.
- H. Locknuts:
 - 1. 1-1/2" and Smaller: Zinc plated heavy stuck steel, O-Z/Gedney.
 - 2. 2" and Larger: Cadmium plated malleable iron, O-Z/Gedney.
- I. Hubs: Cadmium plated malleable iron, tapered threads, neoprene "O" ring, insulated throat, O-Z/Gedney.
- J. E.M.T. Compression Connectors: Gland compression type, zinc plated steel body, cadmium plated, malleable iron nut, insulated throat, O-Z/Gedney.
- K. E.M.T. Compression Couplings: Gland compression type, zinc plated steel body, cadmium plated malleable iron nut, O-Z/Gedney.
- L. Liquidtight Conduit Connectors: Cadmium plated malleable iron body and nut, cadmium plated steel ferrule, insulated throat, integrally cast external ground lug, O-Z/Gedney.
- M. Seals for Watertight Wall and Floor Penetrations: Malleable iron body, oversize sleeve, sealing ring, pressure clamp and rings and sealing grommet, hex head cap screws, O-Z/Gedney.
- N. Seals for Penetrations through Existing Walls: Thunderline Corporation Link-Seal watertight sleeves, complete with wall and casing seals.
- O. Fire Seals: Galvanized iron pipe sleeves sealed with approved foam type fireproofing.
- P. Expansion Fittings: Hot-dipped galvanized malleable iron with bonding jumpers selected for linear or linear with deflection, as required.
- Q. Escutcheons: Chrome plated sectional floor and ceiling plates, Crane No. 10.
- R. Accessories: Reducers, bushings, washers, etc., shall be cadmium plated malleable iron on the forms and dimensions best suited for the application.
- S. Identifying Tape for Underground Conduits: Polyethylene tape, 6 inches wide, with continuous printing along length, Brady Identoline:
 - 1. For Electric Power Conduits: Yellow with black letters.
 - 2. For Other Services: Green with black letters.
- T. Sleeves: 22 gauge galvanized steel sleeves where conduits pass through walls and floors. Standard galvanized steel pipe where conduits pass through beams, outside walls, or structural members.

PART 3 - EXECUTION**3.1 INSPECTION**

- A. Examine surfaces to which conduits are to be secured for:
 - 1. Defects which will adversely affect the execution and quality of work.
 - 2. Deviations from allowable tolerances for the building material.
- B. Do not start work until defects and deviations are corrected.

3.2 INSTALLATION

- A. Size conduits as indicated on the drawings and as required by the NEC for the number and sizes of wires to be drawn into conduit. Do not use conduit sized less than 3/4" unless specified otherwise.
- B. Conceal conduits from view in all areas except mechanical and electrical equipment rooms and crawl spaces. Should it appear necessary to expose any conduit:
 - 1. Bring to the attention of the Architect, immediately, and
 - 2. Rearrange the work to facilitate an approved installation.
- C. Install all conduits at elevations and locations to avoid interference with grading of other work, the structure, finished ceilings, walls. Avoid causing cutting of masonry units.
- D. To prevent displacement, securely support and hold in place all conduits installed in advance of other work and to be concealed in the building structure.

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- E. Carefully lay out conduits run within the structure, such as floors, beams, walls, to avoid densities excessive for the construction. Relocate those conduits when excessive densities occur.
 - F. Ream, remove burrs, and swab inside conduits before conductors are pulled in.
 - G. Cap or plug conduits with standard manufactured accessories as soon as the conduits have been permanently installed in place.
 - H. Bends and offsets in 1" and smaller conduits may be done with approved bending devices. Do not install conduits which have had their walls crushed and deformed and their surface finish damaged due to bending.
 - I. Where space conditions prohibit the use of standard ells, elbows, and conduits, use cast ferrous alloy fittings of such forms and dimensions as best required for the application.
 - J. Make all conduit joints mechanically tight, electrically continuous, and watertight. Pitch conduits in a manner to avoid creating moisture traps.
 - K. Install insulated throat threaded hubs on conduits entering enclosures without threaded hubs where exposed to damp or wet locations.
 - L. Connect and couple E.M.T. with compression type fittings. Do not use indentor and set screw fittings.
 - M. Install and neatly rack exposed conduits parallel with and perpendicular to the building walls. Do not install exposed diagonal conduit runs.
 - N. Route and suspend conduits crossing expansion joints to permit expansion, contraction, and deflection utilizing approved fittings to prevent damage to the building, conduits, and supporting devices in accordance with the National Electrical Code.
 - O. Do not run conduits exposed on the roof unless approval is obtained prior to installation.
 - P. Do not place conduits in close proximity to equipment, systems, and service lines, such as hot water supply and return lines, which could be detrimental to the conduit and its contents. Maintain a minimum 3" separation, except in crossing, which shall be a minimum 1".
 - Q. Connect motors, equipment containing motors, equipment mounted on an isolated foundation, and other equipment and devices which are subject to vibration and which require adjustment with flexible metallic conduit from the device to the conduit serving it. Size the flexible conduit length more than 12 diameters, but less than 18 diameters. Rigidly support the points of attachment on each side of the connection.
 - R. Install escutcheons on all exposed conduits passing through interior floors, walls, or ceilings. Install fire sealing materials on all conduits passing through fire rated partitions. Install wall and floor fire seals on all conduits passing through exterior walls and floors.
 - S. Conduit sleeves shall be sized to permit insertion of conduit with adequate clearance for movement due to expansion and contraction. Where conduits pass through outside walls, watertight fittings, as specified herein, shall be used.
 - T. Provide pullstring in each empty conduit. Label pullstring when conduit termination is not obvious.
- 3.3 USES PERMITTED
- A. Rigid Metal Conduit:
 - 1. Exterior conditions above grade.
 - 2. Interior wet or damp locations.
 - B. Schedule 40 PVC:
 - 1. Below grade exterior to the building.
 - C. Electrical Metallic Tubing:
 - 1. All uses above grade interior to the building, except as limited elsewhere in this section.
 - D. Flexible Metal Conduit:
 - 1. Final connection to vibrating or adjustable equipment.
 - 2. Connection to vibrating equipment shall contain one 90 degree bend.
 - E. Liquid tight Flexible Metal Conduit:
 - 1. All uses permitted for flexible metal conduit.
 - a. In damp or wet locations.
 - b. Exterior to the building.

END OF SECTION 260532

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SECTION 260533 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCE DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all of the Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Work Included: Provide outlet boxes for the installation of wiring devices, lighting fixtures, and power and control connections.
- B. Related work specified in other section:
 - 1. Electrical: Section 26 00 00
 - 2. Wiring Devices: Section 26 27 26
 - 3. Lighting: Section 26 51 00
 - 4. Control Voltage Electrical Power Cables: Section 26 05 23

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 SUBMITTALS

- A. Samples: Provide samples upon specific request.
- B. Product Data: If materials are by manufacturers other than those specified, submit product data giving complete description for sizes employed, material types, and electrical ratings.

1.5 MANUFACTURERS

- A. Listed with Materials.
 - 1. Appleton Electric Company
 - 2. Raco
 - 3. Steel City
 - 4. Crouse Hinds
 - 5. Hubbell
 - 6. Raceway Components
 - 7. Walker

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Flush Mounted Outlet Boxes: Standard, stamped galvanized steel with factory conduit knockouts, one piece and welded construction:
 - 1. Series 4S and 4S0 square boxes with covers.
 - 2. Series M1, M2, M3 - 250 and Series M1, M2, M3 - 350 masonry boxes with covers.
 - 3. Series 2G and GC-5075 switch boxes with covers.
 - 4. Series OCR concrete rings with Series OCP and OCP-3/8 back plates.
 - 5. Series 40 and 40D octagonal boxes with raised covers.
 - 6. Series SX expandable bar hangers.
- B. Surface Mounted Outlet Boxes: Cast metal with threaded hubs. Type FS and FD of form suited to the application.
- C. Fire Rated, Flush, Poke-Thru Outlets: Raceway Components, Inc. #RC-700A.
- D. Fire Rated, Flush, Poke-Thru Outlets with Conduit Adapter: Raceway Components, Inc. #RC-700-6-A.
- E. Floor Outlet Boxes: Hubbell cast flush floor boxes, fully adjustable with flush service fitting, and carpet flange (if required).

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PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine building structure to which outlet boxes are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

3.2 PREPARATION

- A. Carefully measure and lay out exact locations in conference with the Construction Manager.
- B. Owner may change outlet box locations a distance of 5 feet before rough-in without additional cost.

3.3 INSTALLATION

- A. In dry walls for single and two gang outlet provide 4S and 4D boxes; for 3 or more outlets use masonry boxes.
- B. In poured concrete floors, provide cast flush floor boxes complete with service fittings and carpet flanges (if required).
- C. In existing concrete floors, provide fire-rated poke-thru outlets complete with wiring devices and other accessories (if required).
- D. In block and masonry walls provide masonry boxes of depths required for wall thickness.
- E. In poured concrete and plastered walls provide 4S and 4D boxes for single gauge outlets and 2G and 3G-5075 boxes for multiple ganged outlets.
- F. In concrete ceiling provide OCR rings.
- G. In other ceilings provide 40 and 40D boxes. Omit covers if standard canopy and device plates entirely cover the ceiling opening.
- H. In exposed work, exterior of the building, in wet locations, and flush in non-waterproofed walls below grade provide FS and FD boxes.
- I. Submit for approval special boxes for special devices and applications. Size according to device and application in accordance with NEC.
- J. Install outlet boxes finished to within 1/8 inch of finished surfaces.
- K. Install center of box at heights above finished floor:
 - 1. Wall Switches: 45 Inches
 - 2. Convenience Outlets: 18 Inches
 - 3. Telephone/Data Outlets: 18 Inches
 - 4. Wall Telephone Outlets: 45 Inches
 - 5. Boxes Indicated Above Counters: 4 Inches above backsplash and trim, unless otherwise indicated.
- L. Install wall switch outlet boxes on the strike side of doors as finally hung.
- M. Group outlet on circuits with homeruns as indicated on the Drawings.
- N. Do not provide through-the-wall and back-to-back boxes unless specifically noted on the drawings.
- O. Provide standard manufactured plugs in unused openings of boxes.
- P. Provide boxes at the terminal of conduit runs to outlets and devices.
- Q. Provide plaster rings and covers where required by the building structure.
- R. In brick finished walls, locate to work brick in a brick course where possible, and to permit conduits and raceways to enter from the rear without cutting brick, where possible.
- S. Provide 3/8 inch studs and lighting fixture outlet boxes where shop drawings of fixtures require and elsewhere as may be required for fixtures.
- T. Rigidly attach to structure and ceiling supporting members in suspended ceilings to avoid cutting mechanical ceiling members.
- U. Center outlet in paneling and in other Architectural features.
- V. Locate light fixture outlets in uniform relation with ceiling tiles.
- W. Label all junction boxes with circuit information as to its use for special system equipment. Use an indelible marker to mark information on cover.

3.4 CLEANING

- A. Clean surfaces to be painted.

END OF SECTION 260533

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCE DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all of the Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Provide identification of electrical equipment.
- B. Provide identification of over current devices.
- C. Provide identification of branch circuits, outlets, and wiring devices.
- D. Provide identification of required clear working spaces for electrical equipment.
- E. Provide identification of rooms and spaces for access by qualified personnel.
- F. Related work specified in other section:
 - 1. Section 26 05 33: Boxes for Electrical Systems.
 - 2. Section 26 22 13: Low Voltage Distribution Transformers.
 - 3. Section 26 24 13: Circuit Breaker Distribution Switchboards.
 - 4. Section 26 24 16: Panelboards.

1.3 QUALITY ASSURANCE

- A. Signs and placards shall meet the requirements by OSHA.

1.4 SUBMITTALS

- A. Submit literature describing all signage and marking materials to the Architect for approval prior to installation.

PART 2 - PRODUCTS

2.1 PLACKARDS

- A. Plackards shall be engraved phenolic name plates with engraved lettering engraved. Lettering shall be minimum 24 point type in basic block font.
- B. Plackards shall be securely and permanently adhered to the equipment enclosures without fasteners or penetrations into the enclosures.
- C. Plackards shall be color coded for various systems as follows:
 - 1. Utility Power Systems: White plackard, black lettering.
 - 2. Generator Power Systems: Red plackard, white lettering.
 - 3. UPS or UPS-A Systems: Gray plackard, white lettering.
 - 4. UPS-B Systems: Brown plackard, white lettering.
 - 5. Other Systems: As directed by Owner.

2.2 LABELS

- A. Labels shall be typewritten, adhesive backed printed labels. Lettering shall be minimum 18 point type in basic black font.

2.3 MARKING MATERIALS

- A. Materials for marking of required working clearance shall be adhesive backed yellow tape, equal to 3M Company 471 Series. Clean and prepare floor surface in accordance with manufacturer's instructions.

2.4 SIGNAGE

- A. Signage for electrical equipment rooms shall be preprinted manufactured sign units providing warning of the Danger of Electrical Equipment Hazards and limiting access to Qualified Personnel only.
- B. Signage shall be securely and permanently adhered to the door surface without fasteners or penetrations into the door surface.
- C. All signage shall be approved by the Architect prior to installation.

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PART 3 - EXECUTION

3.1 SERVICE ENTRANCE EQUIPMENT

- A. Provide a placard for each service entrance equipment identifying
 1. The name of the equipment.
 2. The data of installation.
 3. The utility company available fault current.
 4. The supply system voltage.
 5. The name of the engineering company of record for the project.
 6. The number of service disconnecting means associated with this service.
 7. The name and locations of any other service entrance equipment on the property.
- B. Provide each service disconnecting means, switch or circuit breaker with a placard identifying the device as "Service Disconnecting Means X of X Devices."
 1. Utility source disconnecting means.
 2. PV Source disconnecting means.
 3. Wind power source disconnecting means.
- C. Provide Feeder Protective Devices with a placard identifying the name of the device or circuit number and the name of the equipment or load served.

3.2 DISTRIBUTION SWITCHBOARDS AND PANELBOARDS

- A. Provide each switchboard and panelboard with a placard identifying.
 1. The name of the equipment.
 2. The supply system voltage.
 3. The name of the equipment supplying the switchboard or panelboard.
 4. The circuit number of the overcurrent device supplying the switchboard or panelboard.
- B. Provide each feeder protective device with a placard identifying the name of the device or circuit number and the name of the equipment or load served.

3.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. Provide each panelboard with a placard identifying:
 1. The name of the equipment.
 2. The supply system voltage.
 3. The name of the equipment supplying the switchboard or panelboard.
 4. The circuit number of the overcurrent device supplying the panelboard.
- B. Provide each panelboard with a typewritten circuit directing card describing the name of the load served and the room number (3) where the devices are located. Reference the room number(s) actually installed at the project, not the room numbers for Architectural construction documents.

3.4 LOW VOLTAGE DISTRIBUTION TRANSFORMERS

- A. Provide each transformer with a placard identifying:
 1. The name of the equipment.
 2. The name of the supply source equipment and protective device circuit number.
 3. The supply system voltage.
 4. The load systems voltage.
 5. The name of the equipment supplied from the load side of the transformer.

3.5 OTHER EQUIPMENT

- A. Provide other electrical and mechanical equipment with placards identifying.
 1. The name of the equipment.
 2. The name of the supply source equipment.
 3. The circuit number of the overcurrent device supplying the equipment.

3.6 OUTLET BOXES, JUNCTION BOXES AND WIRING DEVICES

- A. Provide labels affixed to the inside cover for each outlet box, junction box, and wiring device identifying the panel name and branch circuit numbers for the overcurrent devices supply the circuits.

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3.7 REQUIRED WORKING CLEARANCES

- A. Provide marking on the floor around each item of equipment defining the required working clearances in accordance with the National Electrical Code.

3.8 ELECTRICAL EQUIPMENT ROOMS

- A. Provide each entry door into a room or space containing electrical power distribution equipment providing Warning of the Electrical Hazard and restricting entrance to Qualified Personnel only.

END OF SECTION 260553

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all other Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Provide lighting and appliance branch circuit panelboards, circuit breakers and accessories.
- B. Related work specified in other sections:
 - 1. 26 00 00 - Electrical

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 REFERENCED STANDARDS

- A. NEMA PB 1 - Panelboards
- B. NEMA PB1.1 - Instructions for Safe Installation, Operation and maintenance of Panelboards Rated 600 Volts or Less.
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- E. UL 50 - Enclosures for Electrical Equipment
- F. UL 67 - Panelboards
- G. UL 98 - Enclosed and Dead-front Switches
- H. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- I. Federal Specification W-P-115C - Type Class 1
- J. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.

1.5 SUBMITTALS

- A. Submit Shop Drawings including:
 - 1. Voltage Ratings.
 - 2. Main lug or breaker rating and location voltage ratings.
 - 3. Main Bus Rating.
 - 4. Neutral Bus Rating and location.
 - 5. Ground Bus Rating and location.
 - 6. Thru-feed or sub-feed lug ratings and location.
 - 7. Overall Panelboard Dimensions.
 - 8. Interior Mounting Dimensions.
 - 9. 1/4" scale layout of proposed equipment location including required working clearances, interference with other equipment and available recessing depth where applicable.
 - 10. Location and arrangement of branch breakers.
 - 11. Number of poles, trip ratings, and interrupting ratings of branch breakers.
 - 12. Top and bottom conduit entries and knockouts.
 - 13. Enclosure NEMA Type.
 - 14. Panel deadfront, trim, door, hinge and locking provisions.
 - 15. Manufacturer's literature describing circuit breakers and trip units for each type and frame employed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Equipment shall be included and off loaded in accordance with the manufacturer's published instructions.
- B. Upon arrival, inspect equipment for damage incurred in shipping.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

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- D. Conform to NEMA PB2 service conditions during and after installation of panelboards.

1.7 MANUFACTURER

- A. The equipment shall be the product of a manufacturer with a minimum of ten years' experience with the manufacturer of similar equipment.
- B. Acceptable Manufacturers:
1. Square D Company.
 2. General Electric.
 3. Eaton, Cutler-Hammer.

1.8 WARRANTY

- A. The equipment shall be warranted to be in proper working order for a period of one year following the date of final acceptance.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Interior:
1. Shall be equal to Square D type NF panelboard for 480 volt and Square D NQOB for 208 volt. Continuous main current ratings, as indicated on drawings.
 2. Minimum Short Circuit Rating:
 - a. 65,000 rms symmetrical amperes at 480Y/277 or as indicated on the Drawings.
 - b. 25,000 rms symmetrical amperes at 208Y/120 or as indicated on the Drawings.
 - c. All panelboard components shall be fully rated for the required short circuit interrupting rating. Series rating of devices is not permitted.
 3. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current rating shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing shall be plated aluminum. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
 4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
 5. A solidly bonded aluminum equipment ground bar shall be provided. An additional aluminum isolated/insulated ground bar shall also be provided as indicated on the Drawings.
 6. UL Listed panelboards with 200% rated solid neutral shall be plated aluminum for non-linear load applications. Panelboards shall be marked for non-linear load applications.
 7. Interior trim shall be dead-front construction to shield user from energized parts. Dead-front trim shall have filler plated covering unused mounting space.
 8. Nameplate shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, CSA/UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
 9. Interiors shall be field convertible for top or bottom incoming feed. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.
 10. Interior phase bus shall be pre-drilled to accommodate field installable options (i.e., Sub-Feed Lugs, Sub-Feed Breakers, and Thru-Feed Lugs).
 11. Interiors shall accept 125 ampere breakers in group mounted branch construction.
- B. Main Circuit Breaker
1. Circuit protective devices shall be UL Listed for 100% continuous current when applied in distribution panelboards. Ampere ratings shall be as shown on the drawings.
 2. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40 Deg.C. ambient environment. Thermal elements shall be ambient compensating above 40 Deg.C.

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3. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located in the front of the breaker that allows the user to simultaneously select the desired trip level all poles.
 4. Circuit breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breaker shall be CSA and UL Listed for reverse connection without restrictive line or load markings.
 5. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.
 6. Lugs shall be UL Listed to accept solid or standard copper and aluminum conductors. Lugs shall be suitable for 75 Deg.C. rated wire.
 7. The circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.
- C. Branch Circuit Breakers
1. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the drawings.
 2. Molded case branch circuit breakers shall have bolt-on type bus connectors.
 3. Circuit breakers shall have an overcurrent toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles
 4. The exposed faceplates of all branch circuit breakers shall be flush with one another.
 5. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 75 Deg.C. rated wire.
 6. Breakers shall UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.
 7. Breaker shall be UL Listed with the follow ratings: (15-125A) Heating, Air Conditioning, and Refrigeration (HACR), (15-30A) High Intensity Discharge (HID), (15-20A) Switch Duty (SWD), (15-50A) Equipment Protection Device (EPD) (480Y/277Vac maximum).
- D. Enclosures
1. Type 1 Boxes
 - a. Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel not acceptable.
 - b. Boxes shall have removable endwall with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
 - c. Box width shall not exceed 20" wide.
 2. Type 1 Fronts
 - a. Front shall meet strength and rigidity requirements per UL 50 Standards. Shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. Mounting shall be flush or surface as indicated on the Drawings.
 - c. Front shall have flat latch type lock with catch and spring loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.
 - d. Fronts shall be hinged door-in-door construction with front trim connected to enclosure with continues piano hinge and latch to access all wiring and termination without removing the door from the enclosure. A separate door, hinge and latch shall be provided to access the deadfront compartment to provide access to main and branch breaker operating handles with no exposure to energized parts.
 3. Type 3R, 5 and 12
 - a. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59 inches or more in height. All lock assemblies shall be keyed alike. One 91) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.

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- c. Maximum enclosure dimensions shall not exceed 21" wide and 9.5" deep.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.
- B. Provide panelboard supports to the building structure independent of raceways.

3.2 FIELD QUALITY CONTROL

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.3 IDENTIFICATION

- A. Provide engraved panelboard nameplate permanently affixed to the panel door, giving panelboard name designation, system voltage, and name of the panelboard supply source.
- B. Provide a neatly typewritten circuit directory card in card holder inside panel door describing the name and location of devices served by each branch breaker using numbers finally established at the project.

3.4 FUTURE PROVISIONS

- A. From each flush mounted panelboard section, provide a minimum of two 1" conduits stubbed into the accessible ceiling and/or crawl space, as may be available, for future branch circuit wiring.
- B. Provide a pull cord in all future conduits with identifying tags on both ends.

3.5 COORDINATION OF LOADS SERVED

- A. Confirm that all branch circuit breakers are of the proper type and configuration for the loads finally connected:
 - 1. HCAR Rated.
 - 2. HID Rated.
 - 3. GFCI Rated.
 - 4. AFCI Rated.
 - 5. Three pole common trip breakers for multi-wire branch circuits.
- B. Reconnect loads, rearrange branch circuit breakers or provide new breakers as required to insure branch circuit breakers are proper type and properly rated for the loads finally connected.

3.6 CLEANING

- A. Throughout the construction period, maintain panelboards and interiors free of dust, debris, wire trimmings, etc. Provide heavy duty plastic barriers as required.
- B. Before final acceptance, thoroughly clean panelboards and interiors and vacuum clean to a dust free condition.

3.7 TRAINING

- A. Provide eight hours of training for the Owner's personnel in the operation and maintenance of the equipment.

END OF SECTION 262416

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SECTION 262716 - ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 REFERENCE DOCUMENTS

- A. Conditions of the Contract and Division 01 - General Requirements are hereby made a part of this section.
- B. All sections of this specification.

1.2 DESCRIPTION

- A. Work Included: Provide cabinets for the installation of wiring and equipment.
- B. Related work specified in other section:
 - 1. 26 00 00 - Electrical
 - 2. 26 24 16 - Panelboards
 - 3. 26 28 16 - Enclosed Switches and Circuit Breakers
 - 4. 26 05 23 - Control Voltage Electrical Power Cables

1.3 QUALITY ASSURANCE

- A. Source Quality Control: Tests to meet applicable Underwriters' Laboratories, Inc. Standards.
- B. Reference Standards:
 - 1. Underwriters' Laboratories, Inc. applicable Standards.
 - 2. National Electrical Code.
- C. Design Criteria: National Electrical Manufacturer's Association construction types based on environment.
 - 1. Indoor: NEMA Type 1
 - 2. Outdoor: NEMA Type 3R

1.4 SUBMITTALS

- A. Shop Drawings shall include dimensions, knockout sizes and locations, material types and gauges, finishes, and installation methods.
- B. Certificates shall include labels of Underwriters' Laboratories, Inc., and National Electrical Manufacturer's Association affixed to each item.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Square D
- B. General Electric
- C. Eaton, Cutler-Hammer

2.2 MATERIALS

- A. For Panelboards:
 - 1. Same manufacturer as panelboard, boxes of code gauge steel, welded with edges turned to receive trim, and galvanized.
 - 2. Trim and doors No. 12 gauge steel minimum, hinged door, flush tumbler lock and catch keyed alike throughout the work, factory enamel finish, suitable for field color coat.
 - a. Flush: Overlap minimum 3/4 inches top, bottom, and sides.
 - b. Surface: Same size as cabinet.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine structure to which cabinets are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

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3.2 PREPARATION

- A. Carefully measure and lay out exact locations.
- B. Provide supports.

3.3 INSTALLATION

- A. Provide cabinets where indicated and where necessary.
- B. Provide flush type in finished areas centered in paneling and other Architectural features.
- C. Provide surface type in equipment rooms, above accessible finished ceilings, and in crawl spaces.
- D. Install lighting and power cabinets with tops 6 feet 6 inches above finished floor.
- E. Install cabinet trim and doors straight and plumb.

3.4 CABINET IDENTIFICATION

- A. Cabinets for all panelboards, switchboards, disconnect switches, transformers, motor starters, and electrical equipment furnished shall be provided with engraved phenolic lamacoid plastic name plates with 1/2 inch block engraving.
- B. Name plates shall give equipment designation as scheduled on the drawings, circuit number designation, and voltage and phase of service.

3.5 ADJUSTMENT AND CLEANING

- A. Adjust trims and doors for vertical and horizontal alignment.
- B. Clean surfaces to be painted.

END OF SECTION 262716

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all other Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Work Included: Provide disconnect switches and enclosed circuit breakers for branch circuit, motor circuits, and items of equipment.
- B. Related work specified in other sections:
 - 1. Division 23
 - 2. 26 00 00 Electrical
 - 3. 26 28 13 Fuses

1.3 QUALITY ASSURANCE

- A. The equipment supplied and installed shall meet the requirements of the National Electrical Code and all applicable local codes and ordinances.
- B. All equipment supplied shall be Underwriter's Laboratories Inc. listed and so labeled.

1.4 REFERENCED STANDARDS

- A. UL 50 Cabinets and Boxes
- B. UL 98 Enclosed and Deadfront Switches
- C. UL 489 Molded Case Circuit Breakers
- D. UL 977 Fused Power Circuit Devices
- E. NEMA AB1 Molded Case Circuit Breakers and Molded Case Switches
- F. NEMA KS1 Enclosed Switches

1.5 SUBMITTALS

- A. Submit shop drawings including:
 - 1. Enclosure outline drawings and dimensions.
 - 2. Nameplate schedule.
 - 3. Assembly ratings including:
 - a. Main lug ratings and location.
 - b. Voltage ratings.
 - c. Short circuit ratings.
 - 4. Conduit entry and exit locations, dimensions, and knock-outs.
 - 5. Cable terminal sizes.
 - 6. Fuse types and ratings.
 - 7. Manufacturer's literature describing circuit breakers and trip units.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and off loaded in accordance with the manufacturer's published instructions.
- B. Upon arrival, inspect equipment for damage insured in shipping.
- C. Store and protect equipment from moisture and dust by storing in a clean, dry, heated space. Provide additional heavy plastic cover to protect the equipment and components. Provide auxiliary heating in the sections in accordance with the manufacturer's recommendations.

1.7 MANUFACTURER

- A. The equipment shall be the product of a manufacturer with a minimum of ten years' experience with the manufacture of similar equipment.
- B. Acceptable Manufacturers:
 - 1. Square D Company.
 - 2. General Electric.

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3. Eaton, Cutler-Hammer.

1.8 WARRANTY

- A. The equipment shall be warranted to be in proper working order for a period of one year following the date of final acceptance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Enclosed Switches
 1. Provide enclosed switches where indicated on the drawings or required by NEC.
 2. Switches shall be NEMA Type HD, heavy duty, rated 600 volts, with quick-make, quick break switch units and external operator, rated 100,000 A.I.C.
 3. Switches shall be fused or unfused as shown on the drawings and as required by NEC, capacity and number of poles as indicated on the drawings.
 4. Enclosures shall be provided with interlocks to prevent opening the enclosure without first opening the switch and to prevent operating the switch with the enclosure open.
 5. Enclosures shall be provided with a means for pad locking in the open position.
 6. Enclosures shall be provided with an equipment grounding lug.
 7. Enclosures for use on four wire shall be provided with an insulated neutral bus.
 8. Line side and load side terminals shall be provided with insulating cover to prevent accidental contact.
 9. Indoor locations shall be provided with NEMA Type 1 Enclosures.
 10. Outdoor locations shall be provided with NEMA Type 3R Enclosures and water tight threaded hubs for conduit entry.
- B. Enclosed Circuit Breakers
 1. Provide enclosed circuit breakers or molded case switches where indicated on the drawings or required by the NEC.
 2. Circuit breaker for rating 250 amperes or less shall be thermal magnetic molded case circuit breakers.
 3. Circuit breakers 300 amperes through 1200 amperes shall be electronic trip, microprocessor based, true RMS sensing, with adjustable, defeatable instantaneous pickup.
 4. Molded case switches shall be non-automatic with no over current trip function.
 5. Units shall be 600 volt or 250 volt as required and unless noted otherwise shall be 42,000 A.I.C.
 6. Enclosures shall be provided with a means for pad locking in the open position.
 7. Enclosures shall be provided with and equipment ground bus.
 8. Enclosures for use on four wire systems shall be provided with an insulated neutral bus.
 9. Line side and load side terminals shall be provided with insulating covers to prevent accidental contact.
 10. Indoor locations shall be NEMA Type 1 Enclosures.
 11. Outdoor locations shall be NEMA Type 3R enclosures and watertight hubs for threaded conduit entry.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect building structure to which disconnects are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

3.2 PREPARATION

- A. Carefully measure and lay out exact locations maintaining working clearances required by the National Electrical Code.

3.3 INSTALLATION

- A. Provide disconnects where indicated and where required by the National Electrical Code and all equipment where integral disconnects are not provided by the manufacturers.
- B. Provide disconnects mounted to building structure ahead of flexible conduit final connection to each fan powered terminal box.

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- C. Install within sight of equipment served.
- D. Provide final connection to equipment served.
- E. Provide engraved lamicoid name plate secured to cabinet with designation of equipment served, operating voltage, and circuit designation.

END OF SECTION 262816