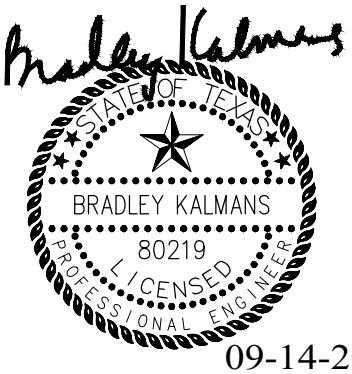


09-14-2022

Project Manual
For
CSP 23.03

HVAC UPGRADES PART THREE

BEAUMONT INDEPENDENT SCHOOL DISTRICT

Issue Date: September 14, 2022

Salas O'Brien, LLC Project No.: 2022-02715

Salas O'Brien, LLC

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Beaumont Independent School District
Salas O'Brien Project No. 2022-02715



09-14-2022

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BEAUMONT ISD – HVAC UPDATES PART 3
SALAS O'BRIEN JOB #: 2022-02715

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E3.1 ELECTRICAL DETAILS AND SCHEDULES - AUSTIN EARLY COLLEGE HS
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M3.1 MECHANICAL LEGENDS AND DETAILS - MARSHALL MS
M4.1 MECHANICAL SCHEDULES - MARSHALL MS
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SECTION 00 01 16

REQUEST FOR COMPETITIVE SEALED PROPOSALS

Competitive Sealed Proposals for the work identified below in accordance with Proposal Documents thereof and such addenda thereto as may be issued prior to date of proposal opening will be received by the Board of Trustees, Beaumont Independent School District, until proposal closing date and time, as identified below. Proposals from Contractors will then be opened in public and read aloud.

OWNER: Beaumont Independent School District

PROJECT: CSP 23.03 HVAC Upgrades Part Three

PROPOSAL DATE AND TIME: **Tuesday, November 1, 2022 @ 2:00 PM,** Receipt of Competitive Sealed Proposals

LOCATION AND PROPOSAL OPENING:
Beaumont Independent School District
Beaumont ISD Administration
3395 Harrison Avenue
Beaumont, TX 77706

MAIL OR DELIVER TO: Beaumont Independent School District
Purchasing Department
3395 Harrison Avenue
Beaumont, Texas 77706

ENGINEER:
Salas O'Brien, LLC
10930 W. Sam Houston Parkway N, Suite 900
Houston, Texas 77064
(281) 664-1900

PRE-PROPOSAL CONFERENCE **Wednesday, September 28, 2022 @ 10:00 AM**
Taylor Career and Technical Education Center
2330 North Street
Beaumont, TX 77702

General Contractors only may obtain plans and specifications at place identified below.

Proposal Documents will be available electronically beginning Wednesday, September 14, 2022, and may be obtained from the following:

Beaumont ISD Purchasing Website
https://www.bmtisd.com/Page/7030

In addition, proposal documents can be received from the following locations:

Salas O'Brien, LLC
10930 W. Sam Houston Parkway N, Suite 900
Houston, Texas 77064
(281) 664-1900
Attention: Sharon Slauta (sharon.slauta@salasobrien.com)

Office Hours are: 7:00 AM to 5:00 PM Monday through Thursday
8:00 AM to 12:00 Noon Friday

Virtual Builders jmiller@virtualbx.com	I SQ FT Plan Room www.isqft.com
Reed Construction Data (RCD) www.reedconstructiondata.com	McGraw-Hill Construction Dodge (on-line services) www.dodgeplans.construction.com

All proposals must be in the hands of the Owner no later than the time specified above. Please seal all proposals in duplicate in an envelope with the following information on the face of the envelope.

REQUIRED TO BE SUBMITTED BEFORE 2:00 PM
Competitive Sealed Base Proposal for CSP 23.03 HVAC Upgrades Part Three
Do Not Open Until November 1, 2022 @ 2:00 PM

The Owner reserves the right to reject any and all proposals and to waive any informality in proposals.

No proposal shall be withdrawn within 30 days after the proposal opening without the specific consent of the Owner.

PROPOSAL BOND: A Bidder's Bond from a bonding company acceptable to the Owner, or a cashier's check, or a certified check, in an amount equal to or greater than 10% of the greatest amount proposed must accompany each proposer's proposal.

PAYMENT BOND AND PERFORMANCE BOND: A Payment Bond and Performance Bond, each in an amount equal to or greater than 100% of the Contract Sum conditioned upon the faithful performance of the Contract will be required. Please note that all bonding companies presented must be acceptable to the Owner.

QUALIFICATION STATEMENTS: Proposers are required to comply with certain procedures as enumerated in the Instructions to Proposers and those outlined below.

Competitive Sealed Proposals will be accepted from qualified Proposers only, for the entire scope of work described in the Proposal Documents. As a prerequisite to qualifying for the award of contract for this Work, each Proposer must complete all items of the Contractor Information and Experience Statement (AIA Document A305). The document may be obtained from the Houston Chapter of the American Institute of Architects, 902 Commerce St., Houston, TX 77002, (713) 520-0155.

In addition to information required in Document A305, Proposers shall also address the selection criteria issues listed within the Instruction to proposers' document. Completed Document A305, proposed project team with resumes for all project staff, and other requested information must be submitted prior to the receipt of Proposals. The A305 and all corresponding documentation shall be combined into a single PDF document and either emailed or transmitted electronically via a file share service including explicit instructions of how to gain access to documents. Contractor shall confirm receipt of A305 and all corresponding documentation with the Owner prior to the stated due date and time. References provided shall include name and current email address.

The above-described information shall be submitted to the Engineer by Wednesday, October 12, 2022 @ 3:00 PM. Attention: Sharon Slauta (sharon.slauta@salasobrien.com)

The prevailing rates of wages are the minimums that must be paid in conformance with all applicable laws of the State of Texas.

All General Contractors submitting a proposal are encouraged to attend the proposal opening.

Subcontractors and Suppliers intending to submit proposals to General Construction Proposers are required to prepare their proposal/bids based on a complete set of documents. If after reviewing the complete set of documents, Subcontractors and Supplier Proposers desire to purchase individual drawings and specification sections for their convenience, they may do so by ordering the specific drawings and specifications directly from the reproduction company. Each proposer purchasing a partial set of documents is responsible for determining exactly which documents

he requires and is responsible for all costs associated with printing and delivery. Subcontractors and Suppliers exercising this option must agree to do so on the basis that 1) all documents shall be returned to the Engineer, without refund, after receipt of proposals and 2) documents shall not be used on other construction projects. Successful Subcontractors and Supplier Proposers may retain their Documents until completion of the construction.

All General Contractors submitting a proposal are encouraged to visit the site.

END OF SECTION

SECTION 00 21 14

PROPOSAL FORM

CSP 23.03 HVAC UPGRADES PART THREE
BEAUMONT INDEPENDENT SCHOOL DISTRICT

Submitted by: _____

Date: _____ Phone No.: _____

To: Beaumont Independent School District
Purchasing Department
3395 Harrison Avenue
Beaumont, Texas 77706

Having examined Proposal and Contract Documents prepared by Salas O'Brien, LLC, dated September 9, 2022, and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials and perform all work for the completion of the above-named project for the sum indicated below.

In submitting his Proposal, the undersigned agrees to the following:

1 Hold base proposal open for acceptance 60 days.
2 Hold alternate proposals open for acceptance 60 days.
3 Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal that Owner considers most advantageous.
4 Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
5 Complete work in accordance with the Contract Documents within the stipulated contract time.

I. BASE PROPOSAL

Undersigned agrees to complete the work for the lump sum amount of:

_____
(Amount written in words governs)

Dollars $_____
(Amount in figures)

The Base Proposal is to include a $300,000.00 Owner's Contingency Allowance as shown in Specification Section 01 21 00.

THIS FORM MUST BE SUBM1TTED IN DUPLICATE BY 2:00 PM, TUESDAY, NOVEMBER 1, 2022.

II. ALTERNATES

<u>Alternate No. 1A:</u> This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Water Source Heat Pumps as manufactured by <u>Daikin</u> and as shown on the drawings and listed in the specifications. There are no Water Source Heat Pumps provided under the Base Proposal.

Undersigned agrees to complete the work for the lump sum amount of:

_____
(Amount written in words governs)

Dollars $_____
(Amount in figures)

Current Lead Time (including shipping) – Water Source Heat Pumps (Weeks) _____

<u>Alternate No. 1B:</u> This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Water Source Heat Pumps as manufactured by <u>ComfortAire (GeoLogix)</u> and as shown on the drawings and listed in the specifications. There are no Water Source Heat Pumps provided under the Base Proposal.

Undersigned agrees to complete the work for the lump sum amount of:

_____
(Amount written in words governs)

Dollars $_____
(Amount in figures)

Current Lead Time (including shipping) – Water Source Heat Pumps (Weeks) _____

<u>Alternate No. 1C:</u> This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Water Source Heat Pumps as manufactured by <u>Water Furnace</u> and as shown on the drawings and listed in the specifications. There are no Water Source Heat Pumps provided under the Base Proposal.

Undersigned agrees to complete the work for the lump sum amount of:

_____
(Amount written in words governs)

Dollars $_____
(Amount in figures)

Current Lead Time (including shipping) – Water Source Heat Pumps (Weeks) _____

<u>Alternate No. 2A</u>: This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Variable Refrigerant Flow Systems and Packaged 100% Outside Air Units as manufactured by <u>Carrier</u> and as shown on the drawings and listed in the specifications. There are no Variable Refrigerant Flow Systems or Packaged 100% Outside Air Units provided under the Base Proposal.

Undersigned agrees to complete the work for the lump sum amount of:

_____

(Amount written in words governs)

Dollars $_____
(Amount in figures)

Current Lead Time (including shipping) – Variable Refrigerant Flow Systems (Weeks) _____

Current Lead Time (including shipping) – Packaged 100% Outside Air Units (Weeks) _____

Alternate No. 2B: This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Variable Refrigerant Flow Systems and Packaged 100% Outside Air Units as manufactured by Daikin and as shown on the drawings and listed in the specifications. There are no Variable Refrigerant Flow Systems or Packaged 100% Outside Air Units provided under the Base Proposal.

Undersigned agrees to complete the work for the lump sum amount of:

_____
(Amount written in words governs)

Dollars $_____
(Amount in figures)

Current Lead Time (including shipping) – Variable Refrigerant Flow Systems (Weeks) _____

Current Lead Time (including shipping) – Packaged 100% Outside Air Units (Weeks) _____

Alternate No. 2C: This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Variable Refrigerant Flow Systems and Packaged 100% Outside Air Units as manufactured by Trane and as shown on the drawings and listed in the specifications. There are no Variable Refrigerant Flow Systems or Packaged 100% Outside Air Units provided under the Base Proposal.

Undersigned agrees to complete the work for the lump sum amount of:

_____
(Amount written in words governs)

Dollars $_____
(Amount in figures)

Current Lead Time (including shipping) – Variable Refrigerant Flow Systems (Weeks) _____

Current Lead Time (including shipping) – Packaged 100% Outside Air Units (Weeks) _____

III. ADDENDA: The undersigned acknowledges receipt of Addenda Numbers

Rec'd	Add. No.	Date
_____	01	
_____	02	
_____	03	
_____	04	

IV. CHANGES IN THE WORK

The undersigned understands that changes in the work shall be performed in accordance with the Supplementary Conditions.

V. LIQUIDATED DAMAGES

The undersigned understands that liquidated damages as defined in the Supplementary Conditions will be included in the form of Agreement Between Owner and Contractor and that the contractor will be bound thereto.

It is understood that the right is reserved by the Owner to reject any or all proposals or waive any informalities in Receipt of Proposals.

The undersigned certifies that the amounts contained in this Competitive Sealed Proposal have been carefully checked and are submitted as correct and final.

Type of Proposer's Organization:

_____
(Corporation, Co-Partnership, Individual, etc.)

Proposer: _____
(Print or Type)

_____
(Signature of Proposer)

Title of Office: _____
(Print or Type)

Legal Address: _____
(Print or Type)

_____

Zip Code: _____ Tel.: (___)_____-_____
(Print or Type)

ATTEST:

_____
(Secretary, if Proposer is a Corporation)

SEAL:
(If Corporation)

COMPETITIVE SEALED PROPOSAL MUST BE MADE IN DUPLICATE

NOTE: In order to receive consideration, the following documents must be submitted with the Proposal:
01 Section 00 21 14 – Proposal Form
02 Section 00 43 13 – Proposal Security Form

NOTE: In order to receive full consideration, the following documents must be submitted not later than twenty-four (24) hours after receipt of Base Proposals.
01 Section 00 45 17 – Proposed Subcontractor Form
02 Section 00 45 18 – Proposed Personnel and Safety Record

END OF SECTION

DOCUMENT 00 43 13

PROPOSAL SECURITY FORM

KNOW ALL MEN BY THESE PRESENTS, that we _____, as

Principal, and _____, as Surety, are held and firmly bound unto the Beaumont Independent School District, Jefferson County, hereinafter called the Owner, in the penal sum of

_____ Dollars ($_____)

lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying

Proposal, dated November 1, 2022, being for **CSP 23.03 HVAC Upgrades Part Three**, for the Beaumont Independent School District, the kind and extent of work involved being set forth in detail in the proposed Contract Documents cited herein.

NOW, THEREFORE, if the Principal shall not withdraw the accompanying proposal within thirty (30) days after the date set for opening thereof, and shall within ten (10) days after the prescribed forms are presented to him for signature, enter into a written contract with the Owner in accordance with the Proposal as accepted; and give Bond and good and sufficient surety for the faithful performance and proper fulfillment of such contract including payment of all persons supplying labor or materials therefor, or in the event of the withdrawal of said proposal within the period specified, or the failure to enter into such contract and give such bond within the time specified, if the Principal shall pay to the Owner the difference between the aggregate amount for which the Owner may enter into a contract for the same work with another Proposer; if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their several seals this _____ day of _____, *2022*, the name and Corporate Seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representatives, pursuant to authority of its governing body.

_____ _____

Business Address Individual Principal

_____ _____

Business Address Individual Principal

ATTEST:

_____ BY:_____

Secretary President

_____ _____

Business Address Corporate Surety

ATTEST:_____ BY:_____

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH PROPOSAL.

END OF SECTION

SECTION 00 45 17

PROPOSED SUBCONTRACTOR FORM

NOTE: THIS FORM MUST BE SUBMITTED WITHIN 24 HOURS OF RECEIPT OF PROPOSAL.

GENERAL CONTRACTOR: _____

01 GENERAL

A. One of the evaluation criteria used to select the successful General Contractor is the sub-contractors proposed to be used for the Work. In order to receive consideration for the award of the Contract, each Proposer must submit a list of sub-contractors proposed be used for the Work.

B. Recognizing the Proposer may not have firm contractual agreements with sub-contractors immediately following submission of Proposals, an allowance is made to submit two (2) sub-contractors for each trade listed below.

02 PROPOSED SUB-CONTRACTORS

List sub-contractors in the order with which there is the best likelihood of using for the Work stipulated.

Trade	Sub-Contractor 1	Sub-Contractor 2
Mechanical	_____	_____
Electrical	_____	_____
Piping	_____	_____
Insulation	_____	_____

NOTE: THIS FORM MUST BE SUBMITTED WITHIN 24 HOURS OF RECEIPT OF PROPOSAL.

END OF SECTION

SECTION 00 45 18

CONTRACTOR'S PROPOSED PROJECT PERSONNEL & SAFETY RECORD

PART 1 - GENERAL

A. An item of the evaluation criteria used to select the successful general contractor to perform this work is the qualifications of the Contractor's proposed project personnel to be assigned to this project.

B. Please submit the names of the personnel in the spaces provided below and submit as an attachment a resume and other supportive information of those persons listed.

01 Principal in Charge:

_____

02 Project Manager:

_____

03 Assistant Project Manager (as applicable):

_____

04 Construction Superintendent:

_____

05 Assistant Superintendent (as applicable):

_____

C. Contractors Safety Record: Submit the following Safety related information:

01 Current Workmen's Compensation Modifier

02 Number of lost time incidents during the past five years and the associated number of lost days. Include the number of Occupational Safety and Health Administration citations received during the past five years.

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITHIN 24 HOURS OF BASE PROPOSAL.

END OF SECTION

DOCUMENT 00 61 13

PERFORMANCE BOND FORM

KNOW ALL MEN BY THESE PRESENT

STATE OF TEXAS

COUNTY OF JEFFERSON

THAT WE, _____, a Corporation of the State of Texas, with home office and principal place of business in _____, Texas, hereinafter called "Principal" and _____ a Corporation of the State of _____, hereinafter called "Surety" are held and firmly bond unto the Beaumont Independent School District, hereinafter called "Owner", in the amount of _____ ($_____) Dollars for payment whereof the said principal and surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

The condition of this obligation is such that whereas the Principal has entered into a certain contract with the Beaumont Independent School District, the Owner, dated the _____ day of _____, 2022, for the complete construction on the property of the Owner, located in Jefferson County, Texas, of the Work described as:

CSP 23.03 HVAC UPGRADES PART THREE
for
BEAUMONT INDEPENDENT SCHOOL DISTRICT

which said Contract and Documents referred to therein is herein now referred to and made a part hereof as fully and completely as if copies in detail herein.

NOW, THEREFORE, the condition of this obligation is such that if said Principal shall well and truly and faithfully perform all the undertakings, covenants, terms, conditions, and agreements of said Contract, including, but not limited to, the faithful performance of the Work required in accordance with the plans and specifications, during the original term thereof and extension thereof which may be granted by the Owner with or without notice to the Surety, and if said Principal shall satisfy all claims and demands incurred under such Contract and shall fully indemnify and save harmless the Owner from all costs, damages and reasonable expenses which it may suffer by reason of failure so to do and shall fully reimburse and repay the Owner all outlay and expenses, including attorney's fees, which the Owner may incur in making good any default, and shall reimburse and repay the Owner for all costs, including attorney's fees, which the Owner may incur in the prosecution or defense of any suit or proceeding arising out of the breach or default of the Principal, then this obligation shall be void; otherwise, to remain in full force and effect.

The said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder or of the specifications accompanying the same, shall in anyway affect its obligation on this bond, and it does hereby waive notice of such change, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications thereunder.

It is expressly provided that if any legal action shall be filed upon this bond, venue shall lie in Harris County, Texas.

Simultaneously with the execution of this Performance Bond, the parties hereto have executed a Payment Bond, reference to which is made for all purposes. Nothing in this Performance Bond shall in any way invalidate or nullify the obligations of the parties as set forth in said Payment Bond.

Provided, however, that this bond is executed pursuant to the provisions of Article 5160 of the revised Civil Statutes of Texas, as amended by Acts of the 61st Legislature, 1969, and liabilities on this bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copies at length herein.

Provided, however, that nothing in the bond shall be construed to limit the rights of the beneficiaries of this Bond which they might have under general, special or the common law of the State of Texas not inconsistent with the terms hereof and not inconsistent with the provisions of Article 5160, as amended.

IN TESTIMONY WHEREOF, the parties hereto have executed this instrument on this _____ day of _____, 2022

_____
(Authorized Signature of Principal)

_____
(Title)

APPROVED AS TO FORM: **ATTEST:**

_____ _____
Owner: Beaumont Independent School District (Secretary of Principal's Corporation)

_____ _____
Attorney Representing Owner (Authorized Signature of Surety)

_____
(Title)

END OF SECTION

DOCUMENT 00 61 14

PAYMENT BOND FORM

KNOW ALL MEN BY THESE PRESENT

STATE OF TEXAS

COUNTY OF JEFFERSON

THAT WE, _____, a Corporation of the

State of Texas, with home office and principal place of business in _____, Texas,

hereinafter called "Principal" and _____ a Corporation of the

State of _____, hereinafter called "Surety" are held and firmly bond unto the Beaumont Independent School District, hereinafter called "Owner", for the use and benefit of all persons, firms and corporations who may furnish material or perform labor upon the buildings or improvements hereinafter referred to, in the penal sum of

_____ ($_____) Dollars, (the Contract Price), in lawful

money of the United States of America, to be paid in _____, Texas for payment of which sum well and truly to be made we bind ourselves and our successors, jointly and severally, by these presents.

CSP 23.03 HVAC UPGRADES PART FOUR
for
BEAUMONT INDEPENDENT SCHOOL DISTRICT

which said Contract and Documents referred to therein is herein now referred to and made a part hereof as fully and completely as if copies in detail herein.

NOW, THEREFORE, the condition of this obligation is such that if the Principal shall promptly make payment to all persons, firms and corporations furnishing materials for, or performing labor in the prosecution of the Work provided for in such Contract, and any extension or modification thereof, then this obligation shall be void; otherwise to remain in full force and effect.

Provided, however, that this bond is executed pursuant to the provisions of Article 5160 of the revised Civil Statutes of Texas, as amended by Acts of the 61st Legislature, 1969, and liabilities on this bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copies at length herein.

Provided, however, that nothing in the bond shall be construed to limit the rights of the beneficiaries of this Bond which they might have under general, special or the common law of the State of Texas not inconsistent with the terms hereof and not inconsistent with the provisions of Article 5160, as amended.

Said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or of the specifications accompanying the same, shall in anyway affect its obligation on this bond, and it does hereby waive notice of such change, extension of time, alteration or addition to the terms of the Contract or to the Work or to the specifications thereunder.

No final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder whose claim may be unsatisfied, and it is expressly provided that if any legal action shall be filed upon this bond, venue shall lie in Harris County, Texas.

Simultaneously with the execution of this Payment Bond, the parties hereto have executed a Performance Bond, reference to which is made for all purposes. Nothing in this Payment Bond shall in any way invalidate or nullify the obligations of the parties as set forth in said Performance Bond.

IN TESTIMONY WHEREOF, the parties hereto have executed this instrument on this _____ day of _____, 2022

_____
(Authorized Signature of Principal)

_____
(Title)

APPROVED AS TO FORM:
ATTEST:

_____ _____
Owner: Beaumont Independent School District (Secretary of Principal's Corporation)

_____ _____
Attorney Representing Owner (Authorized Signature of Surety)

_____
(Title)

END OF SECTION

SECTION 00 61 23

CONTRACT DOCUMENTS

I. CONSTRUCTION CONTRACT AGREEMENT

A. The contract for the construction of the project shall be executed by the successful bidder on the 2017 Edition of AIA Document A101 "Standard Form of Agreement between Owner and Contractor." Said contract, fully executed, shall be delivered to the Owner within ten (10) days of receipt of "Notice of Acceptance."

II. CONDITIONS OF THE CONTRACT

A. The General Conditions of the Contract for Construction, AIA Document A201-2017 Edition, is hereby specifically made a part of the Contract Documents, whether attached hereto or not; and as supplemented and amended herein, constitutes the General Conditions.

B. Supplementary Conditions:

01 The Supplementary Conditions contain modifications to the General Conditions of the Contract for Construction, AIA Document A201. Where any part of that document is modified by Supplementary Conditions, the unaltered provisions of the General Conditions shall remain in effect. Refer to Section CB for the Supplementary Conditions.

III. AVAILABILITY

A. Printed copies of these documents may be examined in the Engineer's office. AIA Documents may be obtained from the Houston Chapter of the American Institute of Architects, 3000 Richmond, Suite 500, Houston, Texas 77098; (713) 520-0155. Copies may also be obtained from local architects' supplies stores.

B. Failure to obtain and examine these documents in no way relieves the Contractor, Subcontractors, Sub-subcontractors, and material suppliers of responsibilities incorporated in the Agreement.

IV. CONTRACT DOCUMENT ORGANIZATION

A. The Contract Documents are segregated into Drawings and Specifications.

B. The Drawings, although organized by discipline, are to be treated as an aggregate set describing the work required. Drawings within each discipline relate to all other Drawings outside the discipline and proposals / sub-bids and be based on the aggregate set of Drawings and all work described.

C. The Project Manual / Specifications are organized according to CSI format.

D. The Specifications, although organized by discipline / CSI section, are to be treated as an aggregate set describing the work required. Specifications within each discipline / CSI section relates to all other Specifications outside the discipline / CSI section and proposals / sub-bids and are based on the aggregate set of Specifications and all work described.

END OF SECTION

SECTION 00 61 25

INSURANCE CERTIFICATES AND BONDS

1.0 GENERAL

A. This Section shall govern the entire Contract.

B. No Work will be commenced until all requirements of this Section have been approved by the Owner in writing. The Owner will be furnished a certificate of insurance acceptable, prior to the commencement of any Work.

C. The insurance shall contain a provision that at least thirty days prior written notice shall be given to the Owner in the event of cancellation, material change, or non-renewal.

D. Insurance shall be underwritten by a company rated not less than B+ XII in Best's latest published guide.

E. There shall be a hold harmless agreement in which the Contractor assumes liability on the contract and holds Beaumont ISD harmless: (Reference AIA Document A201, Article 3.18 indemnifications.)
3.18 Indemnification
3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Engineer, Engineer's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

F. The Contractor shall purchase and maintain in force the following kinds of insurance and bonds for operations under construction contracts and as specified in each section.

G. Before an exposure to loss may occur, the Contractor shall file with the Owner a copy of each policy that includes insurance coverages required by this section. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner.

H. The Owner and Contractor waive all rights against (1) each other and any of their Subcontractors, Sub-subcontractors, agents and employees, each of the other, and (2) the Engineer, Engineer's consultants, separate contractors described in Article 6 of General Conditions, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement

or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

I. A loss insured under Contractor's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests my appear. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

J. If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made, replacement of damaged property shall be covered by appropriate Change Order.

K. Depending on the type of insurance, proof of insurance shall be evidenced on an original Certificate of Insurance – Construction, ACORD Form 25-S, with an original signature of the authorized representative. Policy exclusions and/or restrictions should be clearly explained on the certificate or in an attached letter from the issuing Agency. Blank areas on the certificate should have "not covered" written across the printed areas when coverage is not provided.

L. The Owner as fiduciary shall have power to adjust and settle a loss with insurers.

M. Contractor shall require all of its subcontractors and suppliers of every tier to maintain minimum insurance coverage, both limits and endorsements, as herein required of Contractor.

2.0 CASUALTY INSURANCE

A. Worker's Compensation insurance to statutory limits, and employer's liability insurance to limits of $500,000 shall be kept in full force and effect for the duration of the project by all Contractors and Subcontractors providing services on this construction site. All policies and coverages shall be in full conformance with the latest regulations of the Texas Worker's Compensation Commission and the Texas Labor Code. All persons providing services on this project shall provide a Certificate of Coverage directly to the Owner and Engineer. Furthermore, the Owner reserves the right to continue monitoring the coverages of all workers for the entire duration of this Project.

B. Commercial General Liability Insurance (Occurrence basis only).

Bodily Injury and Property Damage	Each Occurrence	$1,000,000
	General Aggregate	$2,000,000
	(The general aggregate shall apply per location)	
Products/Completed Operations	Aggregate	$2,000,000
Personal and Advertising Injury	Occurrence	$1,000,000
Fire Damage, Legal Liability	Any one fire	$100,000
Medical Expenses	Any one person	$5,000

The Owner shall be named as an additional insured by endorsement on the Contractor's policy as to the subject job.

C. AUTOMOBILE LIABILITY INSURANCE

Business (Commercial) Automobile Liability Insurance All owned, non-owned and hired coverages:
Bodily Injury and Property Damage Combined $1,000,000

No deletions/exclusions from standard coverage form allowed without written consent of Owner.

D. UMBRELLA LIABILITY INSURANCE (EXCESS)

Umbrella Liability Insurance - $2,000,000

01 The Owner shall be named as an additional insured on the Contractor's policy as to the subject job.

02 This policy shall provide coverage over the Workmen's Compensation, Commercial General Liability and Business Automobile Liability. (Covered all owned, non-owned and hired automobiles).

3.0 PROPERTY INSURANCE (BUILDER'S RISK)

A The policy shall be written in the name of the Owner, Contractor, and subcontractors as their interest may appear.

B The policy shall be a “stand-alone” policy covering this work only, and shall not be a part of contractor’s “Reporting Form” policy.

C The policy shall be written on an all risk basis for physical loss or damage and include theft, vandalism, malicious mischief.

D The amount of coverage shall be for the full insurable value of work.

E The deductible shall not be over $5,000.00 without the approval of the Owner. (Deductible losses shall be paid by the Contractor.)

F The policy shall include an endorsement allowing Owner occupancy, and the insurance shall not be cancelled or altered on account of partial occupancy prior to completion.

G A subrogation clause shall waive subrogation as to the Contractor, subcontractor, sub-subcontractors, the Owner and his employees and representatives.

H The original builders risk policy shall be furnished to the Owner prior to start of the job.

4.0 BONDS

A. Statutory Performance Bond and Labor and Material Payment Bond, each in a personal sum equal to 100% of contract sum. File copies of the bond with the County Clerk and furnish the Owner a file receipt.

B. A Proposal Bond or Proposal Security in the amount of 10% of the greatest amount proposed must be submitted with formal proposals on contract or as otherwise specified in documents.

C. Performance and payment bonds shall remain in force throughout the warranty period of the contract.

D. The Work shall not commence until the bonds and insuring companies have been accepted as satisfactory by the Owner.

E. The original bonds will be delivered to the Owner with an attached authorization power of attorney.

END OF SECTION

SECTION 00 61 27

GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

The American Institute of Architects' Document A201, "General Conditions of the Contract for Construction", 2017 Edition, form a part of the Contract Documents as if reproduced here.

Copies of this AIA document are on file in the Engineer's office and may be reviewed upon request. Copies may be purchased from the nearest American Institute of Architects chapter.

END OF SECTION

SECTION 00 73 00

SUPPLEMENTARY CONDITIONS
TO THE
GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

The following supplements modify the "General Conditions of the Contract for Construction", AIA Document A201 - 2017. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect. The "General Conditions" are a part of these documents whether or not they are bound herein.

ARTICLE 1 - CONTRACT DOCUMENTS

1.1 BASIC DEFINITIONS

1.1.1 Revise the first sentence of subparagraph 1.1.1 as set forth below:

The Contract Documents consist of the Agreement, the Conditions of the Contract (General, Supplementary and other Conditions), Performance Bond, Labor and Material Payment Bond, the Drawings, the Specifications, all Addenda issued prior to execution of the Agreement and all Modifications thereto.

1.1.3 THE WORK

Add the following sentence to the end of paragraph 1.1.3:

The Work also includes all supplies, skill, supervision, transportation services and other facilities and things necessary, proper or incidental to the carrying out and completion of the terms of the contract and all other items of cost or value needed to produce, construct and fully complete the public work identified by the Contract Documents.

1.1.9 DESCRIPTION OF PARTIES
The following definitions apply to parties named in Contract Documents:

1.	Owner:	Beaumont Independent School District Purchasing Department 3395 Harrison Avenue Beaumont, Texas 77706
2.	Engineer:	Salas O'Brien, LLC 10930 W. Sam Houston Parkway N, Suite 900 Houston, Texas 77064 281-664-1900

1.1.10 ADDENDA

Addenda are written or graphic instruments issued prior to the execution of the Contract, which modify or interpret the bidding documents, including Drawings and Specifications, by additions, deletions, clarifications or corrections. Addenda will become part of the Contract Documents when the Construction Agreement is executed.

1.1.11 APPROVED, APPROVED EQUAL, APPROVED EQUIVALENT, OR EQUAL

The terms Approved and Approved Equal relate to the substitution of materials, equipment or procedure approved in writing by the Engineer prior to receipt of competitive sealed proposals. Refer to Article 3.19 Substitutions for procedure which must be followed after award of contract. The substitution procedure process to be followed prior to receipt of competitive sealed proposals is described in the instruction to proposers.

1.1.12 ABBREVIATIONS

N.I.C; or By Others; or By Owner; or Existing	Not in contract. Indicating work not to be done by this Contractor under this Agreement.
ADA	Americans with Disabilities Act of 1990
ADAAG	Americans with Disabilities Act Accessibility Guidelines for Buildings & Facilities
AIA	American Institute of Engineers
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ASA	American Standards Association
ASTM	American Society for Testing Materials
AWSC	American Welding Society Code
FS	Federal Specification
NBS	National Bureau of Standards
NEC	National Electrical Code
SPR	Simplified Practice Recommendation
UL	Underwriters Laboratories, Inc.
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute

1.1.13 PROPOSAL DOCUMENTS

Proposal Documents consist of all documents bound into or referenced in the Project Manual, the Drawings, and Addenda related thereto. The Project Manual contains the Proposal and Bidding Requirements, Sample Forms, Conditions of the Contract, the Specifications, and a list of Drawings, and Schedules, some of which are bound into the Project Manual (Other Drawings and Schedules are bound separately). The terms “Bid” and “Competitive Sealed Proposal” shall have the same meaning.

1.1.14 PROJECT CONSULTANTS

Project Consultants are defined as all parties listed in paragraph 1.1.9 above, except the Owner.

1.1.15 MISCELLANEOUS OTHER WORDS

Provide: Whenever the word "provide" is used in these documents, it shall mean the same as "furnish and install".

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS:

Add the following to paragraph 1.2:

1.2.4 PRECEDENCE OF THE CONTRACT DOCUMENTS: The most recent issued Document takes precedence over previous issued forms of the same Document. The order of precedence is as follows with the highest authority listed first.

.1 The Agreement
.2 The Addenda
.3 The Supplementary Conditions
.4 The General Conditions of the Contract for Construction
.5 Drawings and Specifications shall have equal authority. Should these documents disagree in themselves, the Engineer will select the appropriate method for performing the work at no additional increase in the Contract Cost.

1.2.5 RELATION OF SPECIFICATIONS AND DRAWINGS: The Drawings and Specifications are correlative and have equal authority and priority. Should they disagree in themselves, or with each other, base the proposals on the most expensive combination of quality and quantity of work indicated. The appropriate method of performing the Work, in the event of the above mentioned disagreements, will be made by the Engineer. After award of the contract, and if necessary, an appropriate reduction in the contract will be accomplished by allowance expenditure authorization or change order.

1.2.6 OPTIONAL MATERIALS, BRANDS AND PROCESSES: When more than one is specified for a particular item of Work, the choice shall be the Contractor's. The final selection of color and pattern will be made from the range available within the option selected by the Contractor, unless the item is specified to match a specific color or sample furnished. Where particular items are specified only products of those named manufacturers are acceptable. Certain specified construction and equipment details may not be regularly included as part of the named manufacturer's standard catalog equipment but shall be provided by the manufacturer as required for the proper functioning of the equipment. Reasonable minor variations in equipment are expected and will be acceptable; however, indicated and specified performance and material requirements are minimum, and will be required in addition to standard accessories. The Engineer reserves the right to determine the equality of equipment and materials that deviate from any of the indicated and specified requirements.

1.2.6 OPTIONAL MATERIALS AND PROCESSES: When more than one material, product, item and / or process is specifically listed for a particular item of Work, the choice shall be the Contractor's. The final selection of color and pattern will be made from the range available within the option selected by the Contractor, unless the item is specified to match a specific color, existing finish or sample furnished.

1.2.7 OTHER ACCEPTABLE MANUFACTURERS: Where a particular manufacturer’s material(s), product(s) and / or item(s) is used as the basis of design, such item in conjunction with the specified attributes and performance requirements shall set the minimum standard to be furnished. Where other “acceptable manufacturers” are listed, the Contractor shall have the option of providing material(s), product(s) and / or item(s) from a listed manufacturer provided the listed manufacturer’s material(s), product(s) and / or item(s) proposed to be furnished meet or exceed all specified attributes and performance criteria. Reasonable minor variations may be expected and shall be acceptable. It is the Contractor’s responsibility to verify that a bid / proposal received from a listed “acceptable manufacturer” meets or exceeds all specified requirements PRIOR to the contractor’s submission of a bid or proposal to the Owner. No allowance shall be made for the Contractor’s use of a listed “acceptable manufacturer” who’s material(s), product(s) and / or item(s) does not meet or exceed all specified requirements. The Engineer reserves the right to determine the equality of material(s), product(s) and / or item(s) that deviate from any of the indicated and / or specified requirements.

Supplement Article 1 with the following paragraphs and sub-paragraphs:

1.7 MISCELLANEOUS OTHER DEFINITIONS

1.7.1 ADDENDA, ADDENDUM

Documents issued by the Engineer prior to execution of the Owner Contractor Agreement that modify or clarify the Proposal/Bidding Documents. The addenda become a part of the Contract Documents

1.7.2 ALTERNATIVE COMPETITIVE SEALED PROPOSALS

A separate amount stated on the Proposal/Bid Form which, if accepted by the Owner, will be added to or deducted from the Base Competitive Sealed Proposal. If accepted, the work that corresponds to the Alternative Proposal will become part of the Agreement between Owner and Contractor. Alternative Proposals shall remain valid for a minimum period of 30 days after receipt of proposals, regardless if an Owner - Contractor Agreement has been executed, unless indicated otherwise herein.

1.7.3 BASE COMPETITIVE SEALED PROPOSAL

The Contractor's competitive sealed proposal for the Work, not including any Alternative Proposals.

1.7.4 CONTRACT TIME

The period of time including Anticipated Weather Days that is established in the Contract Documents for Substantial Completion of the Work. This period of time is subject to authorized adjustments for Unanticipated Weather Days and other Calendar Day extensions of time as enumerated in the Contract Documents.

1.7.5 DATE OF AGREEMENT

The date the Owner formally awards a Contract for Construction of the Work. This date will be inserted on the first page of the Agreement Between Owner and Contractor and shall be referenced in Performance Bond and Payment Bond forms. See also Date of Commencement of the Work (1.7.6).

1.7.6 DATE OF COMMENCEMENT OF THE WORK

The date that either (1) the fully executed Agreement Between Owner and Contractor, or (2) a written Notice to Proceed is delivered to the Contractor. This date constitutes day zero ("0") of the stated Contract Time.

1.7.7 DATE OF FINAL COMPLETION

The date that all required construction is completed, including punch list work, for all phases or campuses, as applicable. This date shall be established in the Owner – Contractor Agreement based on either 1) the Contract Time stipulated by the Contractor on the Proposal Form; or 2) a guaranteed completion date as defined in an Alternate Proposal if accepted by the Owner. See AIA Document A201, paragraph 9.10.

1.7.8 DATE(S) OF SUBSTANTIAL COMPLETION

Projects which are not phased or do not involve multiple campuses shall have a single date of Substantial Completion. Projects which consist of sequential phases or multiple campuses shall have a date of Substantial Completion for each phase or campus, as applicable. See AIA Document A201 and Section 00 73 00, paragraphs 8.3 and 9.8.

1.7.9 DAY

The following days are referenced in the documents:

.1 Calendar Days: The days of the Gregorian Calendar. The Contract Time is established in Calendar Days and extensions of time granted for Regular Work Days lost, if any, will be converted to Calendar Days.

.2 Holidays: The days officially recognized by the construction industry in this area as a holiday; normally limited to the observance days of New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and the day after, and Christmas Day.

.3 Regular Work Days: All calendar days except holidays, Saturdays, and Sundays. Requests for extensions of time shall be requested on the basis of Regular Work Days, and those days, if approved; will be converted to Calendar Days by multiplying Regular Work Days by a factor of one and three-tenths (1.3).

.4 Anticipated Weather Days: An allowance of Regular Work Days, established as probable days lost due to weather delays; said allowance to be included in the Contractor's proposed Completion Time on his Proposal Form.

.5 Weather Days: Regular Work Days when rain, flooding, snow, unusually high winds, excessively wet grounds, or similar circumstances prevent progress on major portions of the Work. The Contractor will be entitled to an extension of the Contract Time for the net additional time, if any, which results from deducting the amount of Anticipated Weather Days from the total amount of approved Weather Days.

.6 Net Weather Days: The difference in working days between Anticipated Weather Days and Weather Days.

1.7.10 NOTICE TO PROCEED

A notice that may be given by the Owner, or Engineer, to the Contractor that directs the Contractor to start the Work. It may also establish the Date of Commencement of the Work.

1.7.11 PUNCH LIST

A comprehensive list prepared by the Contractor prior to Substantial Completion to establish all items to be completed or corrected. This list may be supplemented by the Owner and / or Owner's Consultants. See AIA Document A201, paragraph 9.8.

1.7.12 UNIT PRICES

A cost for a unit of work as described in the Contract Documents. If accepted, the Owner may add or deduct Unit Price work at the amounts stated on the Proposal Form and such amounts shall not be a subject to additional mark up by the Contractor or his subcontractors. Unit prices accepted by the Owner shall be valid through the completion of the Contract. The owner may elect to reject unit prices prior to executing the Contract. If the unit prices are accepted, they will be incorporated into the Agreement. The Owner may elect to reject the unit prices bid without precluding the right to request Changes in the work as described in Article 7 of the General and Supplementary Conditions.

1.7.13 STRUCTURE OF SPECIFICATIONS

.1 In the preparation of the Specifications, an effort has been made to segregate the various sections of the specifications under headings, by trade. This is done only for convenience and shall not relieve the Contractor of the responsibility of furnishing every item indicated or specified whether properly segregated or not.

.2 No responsibility, either direct or implied, will be assumed by the Owner or the Engineer for omissions or duplications by the Contractor in the completion of the contract due to any alleged error in the arrangement of these specifications, nor shall any such segregation of work and materials serve to make the Engineer an arbiter in defining limits to the agreements between the Contractor and his subcontractor or suppliers.

.3 The misplacement, addition or omission of any letter, word or punctuation mark shall in no way damage the true spirit, intent, or meaning of these specifications.

.4 Abbreviations of the names of technical organizations and societies whose specifications, standards, or criteria are included by reference or noted by initials. References are the latest editions published prior to the date of the specifications unless otherwise noted.

1.7.14 INTERPRETATIONS OF DETAILS, METHODS, SPECIFICATIONS, ETC.

.1 The following paragraphs are intended to govern throughout these specifications as though repeated under each separate section. These paragraphs are herein only in order to simplify the specifications and avoid repetition.

.2 The Contractor shall be responsible for the proper working, workmanship, installation, operation, appearance and durability of items incorporated into the project. (The excuse that it was installed "as detailed or specified" and it does not function properly is not valid. If the Contractor is in disagreement with any items, details, methods, or specifications, he shall notify the Engineer in writing prior to their incorporation in the work. Such matters will be clarified in writing by the Engineer).

.3 All manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with printed instructions of the manufacturer.

.4 The Contractor shall execute each part of the Work in strict accordance with the Contract Documents. The Contractor and all sub-contractors shall have the qualifications and skill required to complete the work in each of the trades and specialties involved. Where there is any doubt as to the requirements or quality of the work, the Contractor shall secure instruction or clarifications from the Engineer before executing the work in question.

ARTICLE 2 - OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.2.1 Delete the last sentence.

Delete paragraph 2.2.5 in its entirety and substitute the following:

2.2.5 The Contractor will be furnished free of charge, twenty (20) copies of the Drawings and Specifications for the execution of the work. Provisions for additional sets shall be made; however, the Contractor shall pay actual reproduction costs of any additional copies required or requested.

2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

Delete paragraph 2.4 in its entirety and substitute the following:

2.4 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails, after receipt of written notice from the Owner, to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for Consultants' additional services and expenses made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Engineer. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

Supplement Article 2 with the following paragraphs / subparagraphs

2.5 OWNER'S RIGHT TO OCCUPY THE PROJECT

2.5.1 The Owner shall have the right to occupy or use without prejudice to the right of either party, any completed or largely completed portions of the project, notwithstanding the time for completing the entire Work or such portions that may not have expired. Such occupancy and use shall not constitute acceptance of any work not in accordance with the Contract Documents.

2.5.2 If such prior use delays the completion of the project, the Contractor shall be entitled to extension of time, which claim shall be in writing with supporting data attached.

2.5.3 Refer to Article 11 - Insurance and Bonds regarding property insurance requirements in the event of such occupancy.

ARTICLE 3 -CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY THE CONTRACTOR

Delete paragraphs 3.2.1, 3.2.2, 3.2.3 and 3.2.4 in their entirety and substitute the following:

3.2.1 Contractor shall carefully study and compare the Agreement, Conditions of the Contract, Drawings, Specifications, Addenda, and Modifications and shall at once report to the Engineer any error, inconsistency, or omission he may discover. Contractor shall be liable for any damage to Owner for failure to report any error, inconsistency or omission he may discover or should have discovered, but he shall not be liable to Owner or Engineer for any damage resulting from such error, inconsistency or omission which he should not have discovered or which he did discover and at once so reported. Contractor shall do no work without approved Drawings and Specifications.

3.2.2 The Contractor shall not be entitled to additional compensation for the "rework portion" of any additional work caused by his failure to carefully study and compare the contract documents prior to execution of the Work.

3.2.3 The Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Engineer for assistance in interpretation. The Contractor shall not ask the Engineer for observation of Work prior to the Contractor's field superintendent's personal inspection of the Work and his determination that the Work complies with the Contract Documents. The Contractor shall arrange meetings prior to commencement of the Work of all major subcontractors to allow the subcontractor to demonstrate his understanding of the Contract Documents to the Engineer and to allow the subcontractor to ask for any interpretation he may require.

3.2.4 If, in the opinion of the Engineer, the Contractor does not make a reasonable effort to comply with the above requirements of the Contract Documents and this causes the Engineer or his Consultants to expend an unreasonable amount of time in the discharge of the duties imposed on him by the Contract Documents, then the Contractor shall bear the cost of compensation for the Engineer's and / or Consultants' additional services made necessary by such failure. The Engineer will give the Contractor prior notice of intent to bill for additional services related to Articles 3.2.5 , 3.2.6, and 3.12 before additional services are performed.

3.2.5 If the Contractor has knowledge that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the Work or to honor his Warranty, he shall promptly notify the Engineer in writing, providing substantiation for his position. Any necessary changes, including substitution of materials, shall be accomplished by appropriate Modification.

3.2.6 Prior to pouring any concrete floor slabs, the Contractor shall submit plan and section drawings, at scale of ¼" = 1'0", of each mechanical room to the Engineer. These drawings shall be fully dimensioned showing all equipment piping, ductwork, electrical panels and devices, and structure, noting particularly the clearances proposed for each item. The Contractor shall make all corrections noted by the Engineer and resubmit the drawings until noted "Reviewed – No Exceptions" by the Engineer to ensure coordination among the trades. Once approved, the Contractor may begin Work on the floor slabs. The ¼" scale coordination drawings shall be required prior to the Engineer or Engineer reviewing any submittals relating to components affected by the coordination plans.

Contractor's application for payment requests shall not be approved once the project has entered the slab phase unless the coordination plans have been submitted and reviewed without exception. Delays on the project due to the failure of the Contractor to submit the coordination drawings shall not be grounds for substantiated delays or requests for extensions of time.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following paragraphs:

3.3.4 The Contractor is especially cautioned to coordinate the routing of mechanical and electrical items prior to commencing these operations.

3.3.5 Beaumont Independent School District is a tobacco-free environment. No use of tobacco products will be allowed on the property at any time. The Contractor shall post signs, in both English and Spanish, at all entrances, notifying all employees, subcontractors, and suppliers of this provision. The Contractor shall take all necessary steps and precautions to ensure adherence to this policy.

3.5 WARRANTY

Add the following paragraphs:

3.5.2 In the event of failure of materials, products, or workmanship, either during construction or the warranty period (which shall be one year from the Date of Substantial Completion, except where a longer period is specified), the Contractor shall take appropriate measures to assure correction or replacement of the defective

items, whether notified by the Owner or Engineer. Items of work first performed after Substantial Completion shall have their warranties extended by the period of time between Substantial Completion and the actual performance of the Work.

3.5.3 Refer to warranty forms included under Section 01 77 00 – Close-Out Procedures , which will be required prior to final payment.

3.5.4 In the event an item under warranty fails, the Contractor shall extend the original warranty period by a length of time equal to the elapsed time which occurs from the notification in writing by the Owner or a warranty claim until acknowledgement by the Owner that the claim has been resolved.

3.5.5 Appropriately 11 months after Substantial Completion, the Contractor shall accompany the Owner and Engineer on a complete re-inspection of the Project and be responsible for correcting any / all additional deficiencies observed or reported.

3.6 TAXES

Add the following paragraph:

3.6.2 The Owner is exempt from the Texas Sales Tax on any purchase of tangible personal property and will issue Certificates of Exemption from the Texas Sales Tax on materials furnished by Contractors on School Construction projects. The Contractor shall give a written statement to the Owner (with a copy to the Engineer) as to the prorating of costs of skilled crafts, labor and materials for the project prior to awarding of a Construction Contract. The Contractor and subcontractors shall obtain Certificates of Resale from their suppliers in order to avoid payment of the State Sales Tax on materials incorporated in School projects. Failure of the Contractor to obtain Certificates of Resale from their suppliers shall make the Contractor responsible for absorbing the tax.

3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS

Supplement Paragraph 3.7.1 with the following sub-paragraphs:

3.7.1.1 The Owner shall pay directly to the governing authority, the cost of all permanent utility impact fees, capital recovery fees, utility assessments and similar non-construction related fees, unless specifically indicated herein. Verify discrepancies, if any, prior to submitting competitive sealed proposals.

3.7.1.2 The Owner shall pay all fees to the Texas Department of Licensing and Regulation (TDLR) for document review and project inspections relative to the Elimination of Architectural Barriers Act. The Engineer will submit the documents to the TDLR for review and approval.

3.7.1.3 The Owner shall be responsible for submitting Contract Documents to the governing authority for the purpose of obtaining required building permits from the City of Beaumont or Jefferson County, as applicable. Permit document submission will be made at such time that, under normal City / County scheduling.

3.7.1.4 The Contractor shall be responsible for obtaining all temporary utility charges, tap charges, water meter charges and any other similar fees assessed by jurisdictional authorities having control over this project related to the actual installation of building utilities and services.

3.7.1.5 The Contractor shall be responsible for obtaining and paying for all City and County Building Permits, plan checking fees and on-site inspection fees. The Contractor shall verify all such costs with the governing authority and include all such costs in the Base Proposal Amount.

3.7.1.6 The Contractor shall not be granted any extra compensation for not being able to start construction while awaiting the issuance of a building permit.

3.7.1.7 If the Contractor performs Work which he knew or should have known to be contrary to applicable laws, statues, ordinances, building codes, local rules or regulations, without such written notice to the Owner, the Contractor shall assume full responsibility for such Work and shall bear their attributable costs and penalties.

3.7.3 Delete in its entirety

3.8 ALLOWANCES

Paragraph 3.8.1 – Delete in its entirety and substitute the following:

3.8.1 The General Contractor shall include in his proposal the Allowances stated in the Specifications. Each stated Allowance describes the extent of Work to be included in the Allowance as either 1) material only, delivered and unloaded at the job site; or 2) materials, equipment and installation. The Contractor's overhead, profit, and other expenses contemplated for the allowance material, equipment and installation shall be included in the Base Proposal and is not part of the Allowance.

The Contractor shall purchase the Allowance materials, equipment and / or installation as directed by the Owner, or Owner's Consultant on the basis of the lowest responsible bid of at least three competitive bids. If the actual cost of the Allowance is more or less than the specified Allowance amount, the Contract Sum will be adjusted accordingly by Change Order.

3.8 SUPERINTENDENT

Delete paragraphs 3.9.1, 3.9.2 and 3.9.3 in their entirety and substitute the following:

3.9.1 The Contractor, within five days after the award of the Contract and prior to beginning any field operations, shall furnish to the Owner and the Engineer in writing the name and professional qualifications of the person(s) proposed by the Contractor as the Superintendent(s) and Project Manager. The Contractor shall not assign any person(s) as Superintendent(s) and Project Manager to whom the Owner or the Engineer has made reasonable objection. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Engineer objects to any nominated Superintendent(s) and Project Manager.

3.9.2 The Contractor shall employ competent Superintendent(s), and necessary assistants who shall be in attendance at the Project site throughout the duration of the Work, up to and including Final Completion. Superintendent(s), Project Manager and assistants shall be in attendance at the Project site during the all regularly scheduled Project Meetings.

3.9.3 Prior to Final Completion, the Contractor shall not substitute a Superintendent(s) and Project Manager other than for death, disability, leaving the employ of the Contractor, or other substantial reason which cannot be avoided. Substitution of Superintendent(s) or Project Manager shall not be made without the consent of the Owner. The process and criteria described above shall be in force in the event a substitution of Superintendent or Project Manager is necessary. The Contractor shall reimburse the Owner, Engineer and his consultants (on a reasonable hourly basis) for additional costs incurred due to said substitution. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Engineer objects to any nominated Superintendent(s) or Project Manager.

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

Add the following subparagraph:

3.10.4 The Contractor shall submit to the Engineer with each monthly Application for Payment, a copy of the progress schedule showing all modifications required to have the schedule reflect appropriate revisions and actions necessary to assure that the project completion schedule is met. This provision shall be prerequisite for approval of Applications for Payment.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following subparagraph:

3.11.2 The Contractor shall post all addenda on construction documents prior to commencing work on the site.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

Add the following subparagraph:

3.12.6.1 If, in the opinion of the Engineer, the shop drawings indicated a lack of study and review by the Contractor is incomplete, or indicate an inadequate understanding of the work covered by the shop drawings, prior to submittal to the Engineer, the shop drawings will be returned, unchecked, to the Contractor for correction of any / all of these deficiencies for subsequent resubmittal. Additional service charges as outlined in 3.2.4 may be charged by the Engineer in this event.

3.12.7 Delete in its entirety and substitute the following:

The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed by the Engineer without request for re-submittal.

Add the following subparagraphs to 3.12:

3.12.11 The Contractor shall submit complete drawings, data and samples to the Engineer at least 30 days prior to the date the Contractor needs the reviewed submittals returned. The Contractor shall be prepared to submit color samples on any key items (such as quarry tile, vinyl wall covering, etc.) within thirty (30) days after the execution of the Agreement. The Engineer will finalize color selections ONLY after samples of all key items are received. Color selections of key items shall NOT be done piece meal.

3.12.12 The Contractor shall submit the number of copies of product data and samples which the Contractor and his subcontractors need for their use PLUS two additional sets for the Engineer, two additional sets for the Owner (one for initial review) and one additional set for each of the Owner's consultants involved with the particular section of Work. Where shop drawings are involved, submit one high quality reproducible transparency and one opaque print of the shop drawing for the Engineer, one opaque print of the shop drawing for the Owner, and one additional opaque print for each of the Owner's consultants involved with the particular section of Work. The reproducible transparency will be marked by the Engineer and/or his consultants, and returned to the Contractor for printing and distribution as required. After final review and correction of the submittal, the Contractor shall send two corrected sets of opaque prints to the Engineer, one to the Owner, and one to each of the Owner's consultants involved with the particular section of Work.

3.12.13 The Contractor shall provide composite drawings within 3 months of execution of the Agreement showing how all piping, ductwork, lights, conduit and equipment, etc. will fit into the ceiling space allotted, including clearances required by the manufacturer, by Code, or in keeping with good construction practice. Space for all trade elements must be considered on the same drawing. Drawings shall be 1/4" per foot minimum scale and shall include invert elevations, elevation views and sections required to meet the intended purpose. Trades required to participate include, but are not necessarily limited to structural, mechanical, plumbing, fire sprinkler, electrical and special systems.

3.13 USE OF SITE

Add the following subparagraphs:

3.13.2 The Contractor's access to the site, parking, field office location, material and equipment storage, and confinement of said areas shall be coordinated with, and approved by the Owner prior to the Contractor's mobilization on the site. Once agreed upon, the Contractor shall not adjust or increase any of the above areas without consent by the Owner.

3.13.3 The Contractor's use of the site shall not interfere with the normal operation of the Owner. The Contractor shall not interface in any manner with students. The Contractor shall not interface in any manner with staff members unless specifically approved by the campus principal.

3.13.4 The Contractor shall use all means necessary to eliminate students' reasonable access to the Contractor's construction operations areas. Safety of the students is paramount.

3.15 CLEANING UP

Add the following subparagraph:

3.15.3 Prior to, and as a prerequisite for the Engineer's inspection for Substantial Completion, the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; replace air filters in mechanical equipment; clean roofs, gutters, and downspouts; remove obstructions and flush debris from drainage systems; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

3.18 INDEMNIFICATION:

Revise the first sentence of paragraph 3.18.1 to read as follows:

3.18.1 The Contractor shall defend, indemnify and hold harmless the Owner, its trustees and employees, the Engineer, Engineer's consultants, and their agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting there from, but only to the extent caused in whole or in part by negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused by a party indemnified hereunder.

Supplement Article 3 with the following paragraph / subparagraphs:

3.19 REPRODUCIBLE RECORD DRAWINGS AND ELECTRONIC DOCUMENTS

3.19.1 At the completion of the project, the contractor shall submit one (1) complete set of drawings with all changes made during bidding and construction, including concealed mechanical, electrical, and plumbing items. Drafting shall be compatible and the Contractor shall submit these as Dayrex film positive reproducibles. The record drawings shall delete the seal of the Architect and/or Engineer and any reference to those firms providing professional services to the Owner. Additionally the Contractor shall provide modified electronic documents on Auto Cad version 14 on CD ROM Disk.

3.20 PREVAILING WAGE RATES

3.20.1 No employee used in this construction may be paid less than the minimum wage rate provided in Article 5959d, Vernon's Civil Statues, The Texas Minimum Wage Act of 1970. Refer to Wage Rates Schedule, included herein. The Contractor shall provide proof to the Owner that all employees, including employees of subcontractors, are paid in accordance with State of Texas statutes. The General Contractor shall complete the Owner's wage rate survey forms for all work performed by this company and subcontractors. Each separate scope of work shall be addressed with all column headings answered. These must be returned in a manner acceptable to the Owner before the first payment is made to each subcontractor. See Article 16 – LABOR STANDARDS below for the Owner's Wage Rate Survey for Educational Construction.

3.21 ANTITRUST VIOLATIONS

3.21.1 To permit the Owner to recover damages suffered; in antitrust violations, the Owner/Contractor Agreement shall include the following, "Contractor hereby assigns to Owner any and all claims for overcharges associated with the Agreement which are under the antitrust laws of the United States, 15 U.S.C.A., Sec. 1 et.seq. (1973)". The Contractor shall include this provision in his agreements with each subcontractor and supplier. Each subcontractor shall include such provisions in agreements with sub-subcontractors and suppliers.

ARTICLE 4 - ADMINISTRATION OF THE CONTRACT

4.2 ENGINEER'S ADMINISTRATION OF THE CONTRACT

4.2.1 Delete paragraph 4.2.1 in its entirety.

4.2.7 Delete the words “and approve” in the first line of the paragraph.

ARTICLE 5 - SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTORS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

Delete paragraphs 5.2.1, 5.2.2, 5.2.3, and 5.2.4 in their entirety and substitute the following:

5.2.1 The Owner’s Proposal evaluation criteria includes the requirement for the Proposer / Contractor to submit with the Proposal proposed sub-contractors for selected portions of the Work which the Proposal is based on. Refer to Specification section 00 45 17 for required sub-contractors to be submitted with the Proposal.

5.2.2 As soon as practicable after Award of the Contract but no later than 10 days prior to the submittal date for the Contractor's first Application for Payment, Contractor shall furnish to the Owner and Engineer in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principle portions of the Work. Where Subcontractors or Sub-subcontractors have been listed in the Specifications or in an Addendum as a Listed Subcontractor the proposed entity shall be one of those firms listed, unless agreement has been reached to accept a proposed Substitute Subcontractor as listed on the Proposal Form. Regarding proposed persons or entities to perform portions of the Work where no Listed Subcontractors have been listed or approved by Addendum, the Engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Engineer, after due investigation, has objection to any such proposed person or entity. Failure of the Owner or Engineer to reply promptly shall constitute notice of no objection. Failure of the Contractor to submit the subject names in a timely manner will delay processing of the Contractor's Application for Payment.

5.2.3 The Contractor shall not contract with a proposed person or entity to which the Owner or Engineer has made a timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made an objection under the provisions of paragraph 5.2.1.

5.2.4 If the Owner or Engineer has objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Engineer has no objection. The Contract Sum shall be increased or decreased by the difference in cost occasioned by such change and an appropriate Change Order shall be issued. However, no increase in the Contract Sum shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required in paragraph 5.2.1.

Add the following paragraphs to Article 5.2

5.2.5 Prior to such substitution the Contractor shall notify the Engineer of his intent and reasons for such proposed substitutions. The Contractor shall not change a Subcontractor, person or entity previously selected if the Owner or Engineer makes objection to such change.

5.2.6 The Contractor shall submit the list of proposed Subcontractors on AIA Document G805. The Contractor may obtain blank copies from the Engineer.

5.2.7 The Contractor and sub-contractors are required to visit the site and completely familiarize himself with the existing conditions prior to the submission of Proposal(s). No additional increase in the Contract amount will be provided when existing or known conditions require a certain amount of work to comply with the intent of the Contract Documents.

5.3 SUBCONTRACTUAL RELATIONS

Add the following subparagraph:

5.3.2 The Drawings and Specifications have been organized to facilitate work required by various trades; however, each Subcontractor shall formulate their bid and provide their respective work based on a complete set of Contract Documents. No allowance for time or cost shall be made by the Owner for a subcontractor who bases their scope of work on a partial set of Contract Documents.

ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1 Delete the last sentence "If the Contractor claims… make such Claim as provided in Paragraph 4.3"

6.2 MUTUAL RESPONSIBILITY

6.2.3 Delete paragraph 6.2.3 in its entirety.

ARTICLE 7 - CHANGES IN THE WORK

7.4 MINOR CHANGES IN THE WORK

7.4.1 Delete the words "or extension of the contract time".

Supplement to Article 7 with the following paragraphs / sub-paragraphs:

7.5 CHANGES FUNDED BY ALLOWANCES

7.5.1 Allowances balances may be used to fund changes in the work. The Contractor will not be allowed an overhead and profit mark-up when changes in the work are funded by one of the Allowances.

7.6 ALLOWABLE MARKUPS FOR CHANGES IN THE WORK

7.6.1 In Subparagraphs 7.2.2, 7.3.3, 7.3.6 the allowance for the combined overhead and profit included in the total cost to the Owner shall be based on the following schedule:

.1 For the Contractor for work performed by the Contractor's own forces, a maximum markup of 10 percent of that cost.
.2 For the Contractor for work performed by the Contractor's Subcontractor(s), 5 percent of the amount due the Subcontractor (s).
.3 For each Subcontractor of Sub-subcontractor involved, for work performed by that Subcontractor's or Sub-subcontractor's own forces, 10 percent of the cost.
.4 For each Subcontractor for work performed by the Subcontractor's Sub-subcontractor's, 5 percent of the amount due the Sub-subcontractor(s).
.5 Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.6.
.6 In order to facilitate checking of quotations for extras or credits, all competitive proposals of contractors, Subcontractors, and Sub-subcontractors, (except those so minor that their propriety can

be seen by inspection) shall be accompanied by a complete and detailed work sheet showing itemization of costs including labor, materials and other costs.

ARTICLE 8 - TIME

8.1 DEFINITIONS

8.1.2 Delete this subparagraph and substitute the following:

8.1.2 Unless agreed otherwise, the date inserted on the Agreement form and the Date of Commencement of the Work shall be as follows:

.1 The date inserted on the first page of the Agreement form will be the date the Owner formally awards the Contract. As soon as feasible after receipt of Competitive Sealed Proposals, the Engineer will present Agreement forms to the Contractor for his review and signature; the Contractor will be allowed a maximum of five (5) days from the date the prepared Agreements are presented to him to 1) obtain the required bond forms and insurance certificates and 2) return the executed Agreement and supporting documents to the Engineer for transmittal to the Owner for his final review and execution.

.2 The Date of Commencement of the Work is the date that either (1) the fully executed Agreement or (2) a written Notice to Proceed is delivered to the Contractor and constitutes day "0" (zero) of the stated Completion Time.

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.4 Add the following Paragraph

The following is a requirement of the Contract and will be included in the Agreement Between Owner and Contractor under Time of Completion.

Under the provisions of the Base Proposal, the work to be performed under this Contract shall be commenced within 10 calendar days and substantially completed in accordance with Substantial Completion date set forth in the Summary of Work. The parties hereto agree that time is of the essence of this contract and that the pecuniary damages which would be suffered by the Owner, if the Contractor does not complete all work called for in the contract documents by the specified date, are in their very nature difficult of ascertainment.

It is therefore expressly agreed as a part of the consideration inducing the Owner to execute this contract that the Owner may deduct from the final payment made to the Contractor a sum equal to $1,000.00 per day for each and every calendar day beyond the agreed date which the Contractor shall require for Substantial Completion of the work included in this contract. It is expressly understood that the said sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the work is not completed within the agreed time, or within the legally extended time, if any, otherwise provided for herein. Said sum shall be considered as liquidated damages only and in no sense shall be considered a penalty, said damage being caused by additional compensation to personnel, for loss of interest on money, additional service fees from Owner's Consultants and other miscellaneous increased costs, all of which are difficult to exactly ascertainment."

ARTICLE 9 - PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add paragraph 9.2.2 and subparagraphs as follows:

9.2.2 In order to facilitate the review of Applications for Payment, the Schedule of Values shall be submitted on AIA Documents G702 and G703 or other similar forms approved by the Engineer, and shall include the following:

9.2.2.1 General Contractor's costs for Contractor's fee, bonds and insurance, mobilization, record documents, O&M manuals, etc., shall be listed as individual line items.

9.2.2.2 Contractor's costs for various construction items shall be detailed. For example, concrete work shall be subdivided into footings, grade beams, floor slabs, paving, etc. These subdivisions shall appear as individual line items.

9.2.2.3 On major subcontracts, such as mechanical, electrical and plumbing, the schedule shall indicate line items and amounts in detail (for example; underground, major equipment, fixtures, installation of fixtures, start up, etc.).

9.2.2.4 Costs for subcontract Work shall be listed without any additional General Contractor's costs for overhead, profit or supervision.

9.2.2.5 Where payment for stored materials may be requested prior to installation, material and labor shall be listed as separate line items.

9.2.2.6 Refer to Specification section 01 29 73 – Schedule of Values for additional description and requirements.

9.3 APPLICATIONS FOR PAYMENT

9.3.1 Delete 9.3.1 in its entirety and substitute the following:

9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Engineer an itemized Application for Payment for operations completed in accordance with the schedule of values. Prior to this submittal, the Contractor shall contact the Engineer's Field Department for on-site review of the proposed application. Upon approval by the Engineer's Field Department, the Application for Payment shall be notarized and submitted to the Engineer.

Add the following subparagraphs to 9.3.1:

9.3.1.3 Included shall be data required to support the Contractor's right to payment as may be required by the Owner or Engineer, such as copies of requisitions from subcontractors and material suppliers, and reflecting retainage, if provided for elsewhere in the contract documents.

9.3.1.4 Until Final Completion and Contract Close-Out, the Owner shall pay ninety five percent (95%) of the amount due the Contractor on account of progress payments, except retainage will be twenty percent (20%) for the amount due the Contractor for contractor’s fee on account of progress payments.

9.3.2 Delete this subparagraph in its entirety and substitute the following:

9.3.2 Payments will be made on account of materials or equipment 1) incorporated in the Work; 2) suitably stored at the site; and / or 3) suitably stored at some off-site location provided the following conditions are met for off-site storage:

.1 The location must be agreed to, in writing, by the Owner and Surety.
.2 The location must be a bonded warehouse.
.3 Surety must agree, in writing, to each request for payment.
.4 The Contractor must bear the cost of the Owner's and Engineer's expenses related to visiting the off-site storage area.
.5 Transportation of the off-site stored materials to the site shall be made by common carrier; thereby eliminating any contractual relationship with the Owner.

Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest, including applicable insurance, naming

the Owner as insured. Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment.

The Contractor acknowledges that the review of materials stored off site is an additional service of the Engineer and shall be charged for that service. The cost for that service will be established by the Engineer and is not subject to appeal.

Add the following subparagraphs to 9.3:

9.3.4 The Contractor shall submit requests for payment in quadruplicate originals using for the “top sheets”, originals of APPLICATION AND CERTIFICATE FOR PAYMENT AIA DOCUMENT G702; continuation sheets showing in detail the amounts requested, etc., may be submitted on CONTINUATION SHEET AIA DOCUMENT G703 or a similar document using the same format if approved by the Engineer. All blank spaces in AIA DOCUMENT G702 must be completed and the signatures of the Contractor and Notary Public shall be original on each form. By submitting his application for payment, the Contractor certifies that the individual signing the application is authorized to do so. Additionally, if the Contractor prepares his application for payment utilizing “Excel” spreadsheet software, he shall submit a duplicate 3-1/2” high-density floppy disk with each application for payment to facilitate the Engineer’s review of the application.

9.4 CERTIFICATES FOR PAYMENT

Add the following subparagraphs to 9.4:

9.4.3 The Engineer will affix his signature to the same form described in Paragraph 9.3.4 to signify his certification of payment provided the application is otherwise satisfactory.

9.6 PROGRESS PAYMENTS

9.6.1 Delete this subparagraph and substitute the following:

9.6.1 After the Engineer has issued a Certificate for Payment, the Owner shall make progress payments in accordance with the following subparagraph, which shall be inserted as Article 5.1 Progress Payments in the Owner-Contractor Agreement, AIA Document A101, 2017 Edition.

Based upon the applications for payment and supporting documents submitted to the Engineer by the Contractor and certification of the amount payable by the Engineer, the Owner shall make progress payments on account of the contract sum to the Contractor as provided in the contract documents for the period ending the last day of the month as follows:

.1 Not later than twenty-five (25) days following the end of the period covered by the Application for Payment, ninety-five percent (95%) of the portion of the Contract Sum properly allocable to subcontracts, labor, materials, and equipment incorporated in the work and ninety-five percent (95%) of the portion of the contract sum properly allocable to materials and equipment suitably stored at the site or at some other location agreed upon in writing (subject to the conditions listed in Article 9.3.2), less the aggregate of previous payments made by the Owner.

.2 Upon Substantial Completion of the entire work, a sum sufficient to increase the total payments to ninety-five percent (95%) of the contract sum, less such amounts as the Engineer shall determine for all incomplete work and unsettled claims as provided for in the Contract Documents.

.3 Final release of the full 5% retainage shall be upon final acceptance by the Engineer and Owner of all close-out documentation and procedures. Partial release of retainage will not be considered.

9.7 FAILURE OF PAYMENT:

9.7.1 Delete the phrase "or awarded by binding dispute resolution" in the first sentence of the paragraph.

9.8 SUBSTANTIAL COMPLETION

9.8.1 Add the following subparagraphs:

9.8.1.1 Projects that involve phased sequential construction or projects that involve separate work on multiple campuses shall have Certificates of Substantial Completion issued for each phase or campus, as applicable. All conditions for Substantial Completion, including liquidated damages, shall apply for each date of Substantial Completion for each phase or campus, as applicable.

9.8.1.2 Individual Substantial Completion Dates for each phase or campus shall be determined and agreed upon by the Owner, Engineer and Contractor. Where an Alternative Proposal dictating a required, guaranteed completion date (dates) is included in the Proposal Form and accepted by the Owner, the date(s) stated therein shall establish the Substantial Completion Dates to be incorporated into the Agreement.

9.8.1.3 In order for the project, a major portion thereof, a project phase or project campus to be considered Substantially Complete, the following conditions must be met:

.1 All inspections by governmental authorities having jurisdiction over the project must have been finalized; any remedial work required by them must have been completed; and Certificates of Occupancy and similar governmental approval forms must have been issued and copies delivered to the Owner and Engineer.

.2 All work, interior and exterior, shall have been completed and cleaned except minor items which, if completed after occupancy, will not, in the Owner's opinion, cause any interference to the Owner's use of the building or any portion thereof. A significantly large number of items to be completed or corrected will preclude the Engineer from issuing a Certificate of Substantial Completion. The Owner and Engineer will be the sole judge of what constitutes a significantly large number of items. It is anticipated that the detailed list of items of work to be completed or corrected at the Date of Substantial Completion will be no longer than three (3) typed pages.

.3 All work, including cleanup, touch-up painting, testing of equipment, etc., must be 100% complete. The only exception will be for items of work previously installed in a correct manner, in proper working order that may have failed due to manufacturing defects and require re-ordering.

9.8.2 Add the following subparagraphs:

9.8.2.1 The Contractor’s superintendent shall participate in the preparation of the Contractor’s punch list that is submitted to the Engineer and Owner for supplementation. Upon receipt, the Engineer shall perform a spot review to determine the adequacy and completeness of the Contractor’s punch list. Should the Engineer determine that the Contractor’s punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for further inspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.

9.8.2.2 Upon receipt of an acceptable Contractor’s punch list, the Contractor’s Superintendent shall accompany the Engineer, his Consultants and the Owner (at his discretion) during their inspections and the preparation of their supplements to the Contractor’s punch list. The Superintendent shall record or otherwise take note of all supplementary items. The Engineer will endeavor to furnish to the Contractor typed, hand written or recorded supplements to the punch list in a prompt manner; however, any delay in the Contractor’s receiving said supplements from the Engineer will not be cause for a claim for additional cost or extension of time as the Contractor’s Superintendent shall have been in attendance during the inspections of the Engineer and his Consultants and will have been expected to take his own notes.

9.8.5 Delete in its entirety and substitute with the following:

9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner, at his sole discretion, may make payment of retainage applying to such Work or

designated portion thereof. Such payment, if made, shall be adjusted in the Owner's favor for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

9.8.5 Add the following subparagraph:

9.8.5.1 After the date of Substantial Completion of the project as evidenced by the Certificate of Substantial Completion, 2017 Edition, the Contractor will be allowed a period of thirty (30) days, unless extended by mutual agreement or provision of the Contract, within which to complete all work and correct all deficiencies contained in the punch list attached to the Certificate of Substantial Completion. Failure by the Contractor to complete such corrections within the stipulated time will be reported to the Contractor's surety. In the report of deficiency the Contractor and surety will be informed that, should correction remain incomplete for fifteen (15) additional days, the Owner will initiate action to complete corrective work out of the remaining contract funds in accordance with Article 14.2. Additional costs of the Owner, Engineer, and other consultants incurred because of the Contractor's failure to complete the correction of deficiencies within thirty (30) days after the date of Substantial Completion, unless extended by mutual agreement or provision of the contract, will be deducted from the funds remaining to be paid to the Contractor. Should corrective work following Substantial Completion require more than one re-inspection after notification by the Contractor that corrections are complete, the cost of subsequent inspections shall also be deducted from funds remaining unpaid to the Contractor.

9.9 PARTIAL OCCUPANCY OR USE

Delete the third sentence of paragraph 9.9.1

9.10 FINAL COMPLETION AND FINAL PAYMENT

9.10.2 At subparagraph 9.10.2, modify as follows:

.1 At item / provision designated (4), delete the phrase "if any".
.2 At item / provision designated (5), delete the phrase "If required by the Owner".

9.10.2 Add the following to subparagraphs:

9.10.2.1 Prior to final payment and in addition to other final closeout items specified, the Contractor shall submit in duplicate to the Engineer the following completed forms:

01 Contractor's Affidavit of Payment of Debts and Claims, AIA Document G706.(modified)
02 Contractor's Affidavit of Release of Liens, AIA Document G706A.(modified)
03 Contractors, Subcontractors and suppliers separate Lien Releases on the prescribed forms with signature and notary seal on the same sheet of paper.
04 Consent of Surety to Final Payment, AIA Document G707.
05 General Contractor's guarantee – notarized.
06 Subcontractor's guarantees – notarized.
07 Special extended warranties and guarantees – notarized.
08 Notarized affidavit from each subcontractor or supplier who furnished material incorporated into the Work stating that no asbestos building materials were used.
09 Maintenance and instruction manuals. Three (3) sets of each bound in a three inch (3") 'D-slant' ring binder.
10 Record Drawings. Auto Cad Electronic Disks & CD.
11 Final list of subcontractors (AIA Document G805).
12 Refer to Specification section 01 77 00 for additional close-out requirements
13 Note: The forms required in items 01 through 08 above shall each be furnished with original signatures and all blanks filled in.

Documents identified as affidavit must be notarized. All manuals will contain an index listing the information submitted. The index sections will be divided and identified by tabbing each section as listed in the index.

9.10.4 Delete in its entirety and substitute the following:

9.10.4 Final payment, constituting the entire unpaid balance of the Contract Sum, as adjusted by Change Order, shall be paid by the Owner to the Contractor thirty-one (31) days after Owner's receipt of the Final Certificate of Payment issued by the Engineer; provided all Work has been completed, the Contract fully performed, and all Close-Out procedures and documentation is complete. Partial release of retainage, if any, prior to Final Payment shall be at the sole discretion of the Owner

Add the following subparagraph:

9.10.4.1 Acceptance of Final Payment by the Contractor, a Subcontractor or Material Supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following subparagraph:

10.2.7.1 The Contractor shall be responsible for taking all precautions necessary to protect the work in place from any freezing weather conditions which could cause any potential damage to portions or all work in place. The Contractor shall be responsible for performing all repairs and/or replacement of any work that results from freezing weather conditions.

10.3 HAZARDOUS MATERIALS

Delete subparagraph 10.3.2 in its entirety and substitute the following:

10.3.2 If requested in writing by the Contractor, the Owner shall obtain the services of a licensed laboratory to verify a presence or absence of the material or substance reported by the Contractor and, in the even such material or substance is found to be present, to verify that is has been rendered harmless. If requested in writing by the Contractor or Engineer, the Owner shall furnish in writing to the Contractor and Engineer, the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Engineer will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Engineer has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Engineer have no reasonable objection.

Delete subparagraphs 10.3.3 and 10.3.6 in their entirety.

Add the following paragraphs / subparagraphs:

10.5 ASBESTOS, LEAD OR PCBs CONTAINING MATERIALS

10.5.1 The Contractor and each subcontractor, sub-subcontractor and suppliers prior to final payment, shall submit an original notarized statement on their letterhead certifying "to the best of their information, knowledge, and belief asbestos, asbestos containing materials, and PCBs have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems." For the purpose of definition as used in this statement, the term "potable water systems" includes, but is not limited to, those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibs, as applicable to the project.

10.5.2 To the best knowledge of the Owner, the Engineer and his consultants, no products or materials containing asbestos or polychlorinated biphenyl (PCB) or other toxic substances have been specified for this project. No products or materials containing asbestos or PCB are to be incorporated in this project. In the event the

Contractor or his Sub-contractors become aware that any products or materials specified, ordered, scheduled for or already incorporated in the work on this project, contain asbestos, or PCB, the situation shall be reported immediately to the Owner and Engineer in writing. An acceptable, equal substitute for the product or material in question shall be proposed by the Contractor and the product or material in question, if already onsite or incorporated in the work, shall be removed from the site immediately and returned to the supplier or manufacturer.

ARTICLE 11 - INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

Delete paragraph 11.1.1 in its entirety and substitute the following:

11.1.1 Refer to Section 00 61 25 - Insurance & Bonds Requirements

11.1.2 Delete reference to “Subparagraph 11.1.1” and insert “Section 00 61 25 - Insurance Certificates and Bonds”.

11.1.3 Delete references to “Subparagraphs 11.1 and 11.1.2” and insert “Section 00 61 25 - Insurance Certificates and Bonds”.

11.3 PROPERTY INSURANCE

Delete paragraph 11.3.1 and subparagraphs 11.3.1.1, 11.3.1.2, 11.3.1.3, 11.3.1.4, and 11.3.1.5 in their entirety.

Delete paragraphs 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.6, 11.3.7, 11.3.8, 11.3.9, and 11.3.10 in their entirety.

ARTICLE 12 – UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following to 12.2.2.1:

The “prompt” correction of defective work by the Contractor after receipt of Warranty Claim notification from the Owner as described above shall be defined as follows:

01 The Contractor shall make written response to the Owner within twenty-four (24) hours of receipt of the Warranty Claim acknowledging receipt of the claim and providing the proposed schedule to conduct corrective work. Corrective work shall not interfere with the Owner’s normal operation and use of the Work, unless expressly approved by the Owner.

02 For corrective work which is not a life safety issue or which will not, by the nature of the defect, cause subsequent damage to the building or other Work, corrective work shall be completed within fourteen (14) days.

03 For corrective work which by its nature may cause subsequent damage to the building or other Work, corrective work required to prevent subsequent damage shall be completed within twenty-four (24) hours, and if such work is a temporary repair, permanent repair of the corrective work shall be completed within seven (7) days. The Contractor shall appropriately complete all corrective work relative to subsequent damage caused by a Warranty Claim.

04 For corrective work which affects services to, and ordinary use of the Building, corrective work shall be completed within twenty-four (24) hours, and if such work is a temporary repair, permanent repair of the corrective work shall be completed within seven (7) days.

05 The time frames stated above for completion of permanent corrective work shall be equitably adjusted as required for legitimate delays caused by weather delays, material acquisition and other factors beyond the Contractor’s direct control.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

Add the following subparagraph:

13.6 INTEREST

Delete paragraph 13.6 and subparagraph 13.6.1 in their entirety.

Add the following paragraphs:

13.8 The Owner shall have the right to examine, copy and/or audit the books and other records in possession of the Contractor relating to this Contract at any time deemed necessary by the Owner.

ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

14.2 TERMINATION BY THE OWNER FOR CAUSE

Add the following Paragraph:

14.2.5 Contractor hereby assigns the Owner 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. Section 1 ET.SEQ. (1973).

Add the following Paragraph:

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete subparagraph 14.4.3 in its entirety and substitute the following:

14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment from the Owner on the same basis provided in Subparagraph 14.1.3.

Add the following Article:

ARTICLE 15 - CLAIMS AND DISPUTES

Delete paragraph 15.1.1 in its entirety and substitute the following:

15.1.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner, Engineer and Contractor arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate claims shall rest with the party making the claim.

15.2 INITIAL DECISION

Delete paragraph 15.2.6 in its entirety and replace with the following:

15.2.6 If a claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Engineer, the Engineer will notify the parties in writing that the Engineer’s decision will be made within seven days, such decision shall be final and binding on the parties but subject to litigation or other legal proceeding.

Delete subparagraph 15.2.6.1 in its entirety.

15.3 MEDIATION

Delete the following Paragraphs: 15.3.1, 15.3.2, and 15.3.3 in their entirety and all other references to Mediation.

15.4 ARBITRATION

Delete the following Paragraphs: 15.4.1, 15.4.1.1, 15.4.2, 15.4.3, 15.4.4, 15.4.4.1, 15.4.4.2, and 15.4.4.3 in their entirety and all other references to arbitration.

ARTICLE 16 - LABOR STANDARDS

16.1 PREVAILING WAGE RATES

16.1.1 Contractor and each Subcontractor shall pay to all laborers, workmen, and mechanics employed in execution of this Contract not less than rates set forth below for each craft or type of workman or mechanic needed to execute Contract.

16.1.2 Determination of prevailing wages shall not be construed to prohibit payment of more than rates names.

16.1.3 Attention of Contractor and all Subcontractors is called to the following laws of Texas relating to labor; (V.T.C.S. Article 5159a, as amended Section 5 of Acts 1973, 63rd Legislature, P. 995, Chapter 399, V.T.C.S. of Texas Article 5165.1 and 5165.3 as amended by Section 5 of Acts 1973, 63rd Legislature, P.995, Chapter 399).

16.2.1 PREVAILING WAGE RATE DETERMINATION INFORMATION

The following information is from Chapter 2258 Texas Government Code Title 10:

2258.021. Duty of Governmental Entity to Pay Prevailing Wage Rates

(a) The state or any political subdivision of the state shall pay a worker employed by it or on behalf of it:
  (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
  (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.

(b) Subsection (a) does not apply to maintenance work.

(c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public body of the state or a political subdivision of the state.

2258.023 Prevailing Wage Rates to be Paid by Contractor and Subcontractor; Penalty

(a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.

(b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, $60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.

(c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.

(d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.

(e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

2258.051 Duty of Public Body to Hear Complaints and Withhold Payment

(1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and

(2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without determination by the public body that there is good cause to believe that the contractor has violated this chapter.

END OF SECTION

Prevailing Wage Rate Determination Information

The following information isfrom Chapter 2258 Texas Government Code:

Sec. 2258.021. Right to be Paid Prevailing Wage Rates.

(a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:
    (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
    (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.
(b) Subsection (a) does not apply to maintenance work.
(c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

Sec. 2258.023. Prevailing Wage Rates to be paid by Contractor and Subcontractor; Penalty.

(a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.
(b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, $60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.
(c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.
(d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.
(e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

Sec. 2258.051. Duty of Public Body to Hear Complaints and Withhold Payment.

A public body awarding a contract, and an agent or officer of the public body, shall:

(1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
(2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without a determination by the public body that there is good cause to believe that the contractor has violated this chapter.

Prevailing Wage Rates – School Construction Trades

Effective: June 12, 2022

Texas Gulf Coast Area

CLASSIFICATION	2022 HOURLY RATE
ASBESTOS WORKER	$21.13
BRICKLAYER; MASON	$25.32
CARPENTER; CASEWORKER	$23.38
CARPET LAYER; FLOOR INSTALLER	$25.12
CONCRETE FINISHER	$23.40
DATA COMM/TELE COMM	$23.50
DRYWALL INSTALLER; CEILING INSTALLER	$26.65
ELECTRICIAN	$25.93
ELEVATOR MECHANIC	$28.80
FIREPROOFING INSTALLER	$22.25
GLAZIER	$22.30
HEAVY EQUIPMENT OPERATOR	$22.40
INSULATOR	$20.50
IRONWORKER	$25.50
LABORER, HELPER	$16.71
LATHERER; PLASTERER	$23.25
LIGHT EQUIPMENT OPERATOR	$20.50
METAL BUILDING ASSEMBLER	$21.10
MILLWRIGHT	$33.63
PAINTER; WALL COVERING INSTALLER	$19.60
PIPEFITTER	$26.97
PLUMBER	$26.71
ROOFER	$20.50
SHEET METAL WORKER	$19.90
SPRINKLER FITTER	$26.13
STEEL ERECTOR	$23.95
TERRAZZO WORKER	$23.50
TILE SETTER	$19.58
WATERPROOFER; CAULKER	$19.88

This document was developed in strict accordance with Chapter 2258 of the Texas Government Code.

Prevailing Wage Rates

Worker Classification Definition Sheet

CLASSIFICATION	DEFINITION
ASBESTOS WORKER	Worker who removes and disposes of asbestos materials.
BRICKLAYER; MASON	Craftsman who works with masonry products, stone, brick, block, or anymaterial substituting those materials and accessories.
CARPENTER; CASEWORKER	Worker who build wood structures or structures of any material which has replaces wood. Includes rough and finish carpentry, hardware andtrim.
CARPET LAYER; FLOOR INSTALLER	Worker who installs carpets and/or floor coverings, vinyltile.
CONCRETE FINISHER	Worker who floats, trowels, and finishes concrete.
DATA COMM/TELE COMM	Worker who installs data/telephone and television cable and associate equipment and accessories.
DRYWALL; CEILING INSTALLER	Worker who installs metal framed walls and ceiling, drywall coverings, ceiling grids, and ceilings.
ELECTRICIAN	Skilled craftsman who installs or repairs electrical wiring and devices. Includes fire alarm systems and HVAC electrical controls.
ELEVATOR MECHANIC	Craftsman skilled in the installation and maintenance of elevators.
FIREPROOFING INSTALLER	Worker who sprays or applies fire proofing materials.
GLAZIER	Worker who installs glass, glazing, and glass framing.
HEAVY EQUIPMENT OPERATOR	Includes but not limited to: all CAT tractors, all derrick-powered, all poweroperated cranes, back-hoes, back-fillers, power operated shovels, winch trucks, and all trenching machines.
INSULATOR	Worker who applies, sprays, or installs insulation.
IRONWORKER	Skilled craftsman who erects structural steel framing, and installs structuralconcrete Rebar.
LABORER, HELPER	Worker qualified for only unskilled or semi-skilled work. Lifting, carrying materialsor tools, hauling, digging, clean up.
LATHERER; PLASTERER	Worker who installs metal framing and lath. Worker who applies plaster to lathing and installs associated accessories.
LIGHT EQUIPMENT OPERATOR	Includes but not limited to , air compressors, truck crane drivers, flex planes, building elevators, form graders, concrete mixers less than 14cf), conveyers.
METAL BUILDING ASSEMBLER	Worker who assembles pre-made metal buildings.
MILLWRIGHT	Mechanic specializing in the installation of heavy machinery, conveyance, wrenches, dock levelers, hydraulic lifts, and alignpumps.
PAINTER; WALL COVERING INSTALLER	Worker who prepares wall surfaces and applies paint and/or coverings, tape, and bedding.
PIPEFITTER	Trained worker who installs piping systems, chilled water piping and hot water(boiler) piping, pneumatic tubing controls, chillers, boilers, and associated mechanical equipment.
PLUMBER	Skilled craftsman who installs domestic hot and cold water piping, waste piping, storm system piping, water closets, sinks, urinals, and relatedwork.
ROOFER	Worker who installs roofing materials, Bitumen (asphalt and coal tar) felts, flashings, all types of roofing membranes, and associated products.
SHEET METAL WORKER	Worker who installs sheet metal products, Roof metal, flashings and curbs, ductwork, mechanical equipment, and associated metals.
SPRINKLER FITTER	Worker who installs fire sprinklers systems and fire protectantequipment.

CLASSIFICATION	DEFINITION
STEEL ERECTOR	Worker who erects and dismantles structural steel frames of buildings and other structures.
TERRAZZO WORKER	Craftsman who places and finishes Terrazzo.
TILE SETTER	Worker who prepares wall and/or floor surfaces and applies ceramic tiles to these surfaces.
WATERPROOFER; CAULKER	Worker who applies water proofing material to buildings. Products include sealant, caulk, sheet membranes, and liquid membranes, sprayed, rolled or brushed.

SECTION 01 10 00

SUMMARY OF WORK

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Project Location:

Early College High School
3410 Austin Street
Beaumont, TX 77706

Marshall Middle School
6455 Gladys Avenue
Beaumont, TX 77706

Taylor Career & Technical Education Center
2330 North Street
Beaumont, TX 77702

Vincent Middle School
350 Eldridge Street
Beaumont, TX 77707

Homer Elementary School
8950 Homer Drive
Beaumont, TX 77708

West Brook High School
8750 Phelan Boulevard
Beaumont, TX 77706

B. The Project scope varies and includes the replacement of existing HVAC equipment and systems.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials for the project scope of work are described on the Drawings and included in other sections of the Specifications.

PART 3 - EXECUTION

3.1 SCHEDULE

A. Completion Time: The Owner has a critical need for the entire project to be completed within the period with on-site Work on the project can commence on Notice to Proceed and the substantial completion date is **August 11, 2023.**

B. Proposers shall structure their pricing and proposal as required to meet the designated schedule.

C. Submission of a proposal for consideration shall be construed as proposer's agreement to meet the stipulated schedule without qualification or exclusion.

END OF SECTION

SECTION 01 21 00

ALLOWANCES

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

The following Allowances shall be included in the Base Proposal. These sums shall be reconciled per Article 3.8 of the General Conditions.

1.2 CONDITIONS

A. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. These allowances shall cover the net cost of the materials and equipment delivered and unloaded at the site, and all applicable taxes.

The Contractor's handling costs on site, labor, installation, overhead, profit and other expenses contemplated for the original allowance shall be included in the Contractor's Base Proposal sum, and not in the allowance.

The Contractor shall cause the work covered by these allowances to be performed for such amounts and by such persons as the Engineer may direct, but he will not be required to employ persons against whom he makes reasonable objection.

If the cost, when determined, is more than or less than the allowance, the Contract sum shall be adjusted accordingly by Change Order, which will include additional handling costs on the site, labor, installation costs, overhead, profit and other expenses resulting to the Contractor from any increase over the original allowance.

a) All labor, equipment and installation required for the installation and / or performance of the designated work shall be included in the allowance amount, unless noted otherwise in the Allowance description.

B. Unexpended balance of allowance sums shall revert to the Owner in the final settlement Change Order of the Contract.

PART 2 - ALLOWANCES

2.1 ITEMS

A. Owner Contingency:
Contractor shall include in the Base Proposal the following sums as a contingency to cover the cost of hidden, concealed or otherwise unforeseen conditions which develop during completion of the work. Contractor shall proceed with the work in question only after receiving written directions executed by the Owner and the Engineer. Owner will not be obligated to pay the cost of any work performed without prior written authorization. The Contractor's overhead and profit relative to this contingency sum and work performed in accordance herewith, shall be included in the total Base Proposal price, but not included in the contingency sum. Unexpended balance of contingency sums shall revert to the Owner in the final settlement of the Contract.

Allow the sum of $300,000.00 for Owner’s Contingency $300,000.00

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements Included:
   1. Identification and description of alternate work.

B. Related Requirements:
   1. Proposal Form
   2. Contract Form
   3. Specifications Sections identified in each alternate.

1.2 PROCEDURES

A. Proposers are required to submit alternate amounts to add work or to deduct work from the Base Proposal as described below. Failure to submit alternate amounts in spaces provided on Proposal Form will be basis for disqualification of proposal.

B. The successful proposer may not modify, withdraw, or cancel any Alternate Proposal or any part thereof for 30 days after date of receipt of proposals, unless specifically noted otherwise.

C. Contractor will be responsible for all changes in the Work affected by acceptance of Alternates. Claims for additional costs or time extensions resulting from changes to the Work as a result of the Owner's election of any or all alternates will not be allowed.

D. Refer to the Drawings and Specifications for items of work affected by Alternates.

E. Election of Alternates will be exercised at the option of Owner.

F. Coordinate related work and modify or adjust surrounding work as required to complete the Work included under each alternate.
   1. Include as part of each Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for, a complete installation whether or not indicated as part of Alternate.
   2. Cost listed for each Alternate includes cost of related coordination, modification, or adjustment.

G. Notification: Immediately following award of the Contract, prepare and distribute to each entity or person to be involved in the performance of the Work, a notification of the status of each proposed Alternate. Indicate whether Alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to Alternates, if any.

1.3 SELECTION AND AWARD OF ALTERNATES

A. Indicate change to the Base Proposal amount as a result of prices for the Alternates described below and listed on the Proposal Form, or any supplement to it, by adding to or deducting from the Base Proposal amount or by indicating " No Change."

B. Indicating "No Proposal" as an Alternate is unacceptable and is reason for rejection of the entire proposal.

1.4 SCHEDULE OF ALTERNATES

A. ALTERNATE NO. 1A:

This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Water Source Heat Pumps as manufactured by **Daikin** and as shown on the drawings and listed in the specifications. There are no Water Source Heat Pumps provided under the Base Proposal.

B. ALTERNATE NO. 1B:

This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Water Source Heat Pumps as manufactured by **ComfortAire (GeoLogix)** and as shown on the drawings and listed in the specifications. There are no Water Source Heat Pumps provided under the Base Proposal.

C. ALTERNATE NO. 1C:

This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Water Source Heat Pumps as manufactured by **Water Furnace** and as shown on the drawings and listed in the specifications. There are no Water Source Heat Pumps provided under the Base Proposal.

D. ALTERNATE NO. 2A:

This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Variable Refrigerant Flow Systems and Packaged 100% Outside Air Units as manufactured by **Carrier** and as shown on the drawings and listed in the specifications. There are no Variable Refrigerant Flow Systems or Packaged 100% Outside Air Units provided under the Base Proposal.

E. ALTERNATE NO. 2B:

This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Variable Refrigerant Flow Systems and Packaged 100% Outside Air Units as manufactured by **Daikin** and as shown on the drawings and listed in the specifications. There are no Variable Refrigerant Flow Systems or Packaged 100% Outside Air Units provided under the Base Proposal.

F. ALTERNATE NO. 2C:

This alternate shall establish the amount to be added to the base proposal for the contractor to furnish and install Variable Refrigerant Flow Systems and Packaged 100% Outside Air Units as manufactured by **Trane** and as shown on the drawings and listed in the specifications. There are no Variable Refrigerant Flow Systems or Packaged 100% Outside Air Units provided under the Base Proposal.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Applications and Certificates for Payment.
2. Change Order Procedures.
3. Schedule of Values

B. Related Requirements:
1. Document 00 61 27 - General Conditions of the Contract for Construction
2. Document 00 73 00 - Supplementary Conditions to the Contract for Construction
3. Section 01 32 16 - Construction Progress Schedules
4. Section 01 77 00 - Closeout Procedures

1.2 APPLICATIONS AND CERTIFICATES FOR PAYMENT

A. Progress payments will be made as the work proceeds, at intervals stated in the Contract.

B. Work covered by progress payments, including items in off-site storage, become the property of the Owner at the time of payment.

C. Form of Application and Certificate for Payment: Notarized AIA Document G702 - *Application and Certification for Payment*, supported by AIA Document G703 - *Continuation Sheet*. Originals only, two copies.

D. Conditions governing regular schedule for applications, payment and retainage are stated in the Contract.

E. With each Application for Payment, certify that such Application for Payment represents a just estimate of cost reimbursable under terms of Contract.

1.3 CONSTRUCTION CHANGE ORDER PROCEDURES

A. Submit to Engineer within 5 days of date of Owner/Contractor Agreement, the individual’s name authorized to accept changes on behalf of Contractor, and to be responsible for informing others in Contractor's employ of changes in the work.

B. Change Order forms will be furnished and issued by Engineer.

C. Contractor Documentation of Changes:
1. Maintain detailed records of work done on an accounting basis acceptable to Engineer and Owner. Provide full information required for evaluation of proposed changes.
2. Document each quotation for a change in cost or time with sufficient data to allow evaluation of quotation.
3. On request, provide additional data to support computations:
a. Quantities of products, labor and equipment.
b. Insurance and bonds.
c. Overhead and profit.
d. Justification for any change in Contract Time.
e. Credit for deletions from Contract, similarly documented.
4. Support each request for additional costs, and for work proposed on a time and material

basis, with description of products, equipment, cost of labor and subcontracts, completely documented.

5. Values for changes in work will be computed according to the Conditions of the Contract.

D. Initiation of Changes:

1. Engineer may submit a Proposal Request including a detailed description of the proposed changes along with revised or supplementary drawings and specifications.
2. Contractor may initiate a proposed change by submitting a request to Engineer describing the proposed change along with a statement of reason for change, proposed effect on Contract Sum and Contract Time, related back-up documentation, and a statement of the effect on work of separate contractors. Document requested substitutions according to Section 01 62 00 - *Product Options*. Submittal of such requests and receipt of same by Engineer does not ensure acceptance or approval of proposed change.

E. Authorization:

1. The Owner may request, through the Engineer, a written Construction Change Directive instructing Contractor to proceed with changes of all or part of the Work, for inclusion in a subsequent Change Order. Directive will include the basis for necessary adjustments, if any, to Contract Sum and Time.
2. Changes that affect Contract Sum and/or Contract Time will require a Change Order signed by the Owner and the Engineer. Contractor's signature will indicate agreement. Other orders, written or oral, by the Owner through the Engineer or by the Engineer will be treated as a Change Order only if Contractor provides proper written notice as described in the *Conditions of the Contract*.
3. Promptly execute the change in work only upon receipt of an approved Change Order or Owner's written Construction Change Directive.

F. Execution:

1. Engineer will issue Change Orders for signatures of parties as provided in *Conditions of the Contract.*
2. Promptly revise *Schedule of Values* and *Application for Payment* forms to record each authorized Change Order as a separate line item and adjust Contract Sum as shown on Change Order.
3. Promptly revise *Progress Schedules* to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by Change, and resubmit Schedule.
4. Promptly enter Changes in *Project Record Documents*.

1.4 SCHEDULE OF VALUES FORM AND CONTENT

A. Type schedule on 8-1/2 x 11-inch white paper; Contractor's standard forms and automated printout will be considered for approval by Engineer upon request. Identify schedule with:

1. Title of project and location.
2. Engineer and Engineer's project number.
3. Name and address of Contractor.
4. Contract designation.
5. Date of submission.

B. Follow the Table of Contents of this Project Manual as the format for listing component items. Identify each line item with the number and title of the respective major section of the Specifications.

C. For each major line item list sub-values of major products or operations under the item.

D. For the various portions of the work:

1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
2. If progress payments will be requested for stored materials, break down the value into:
   a. Cost of the materials, delivered and unloaded, with taxes paid.
   b. Total installed value.
3. Submit a sub-schedule for each separate stage of work in Section 01 11 00 - *Summary of Work*.

E. The sum of values listed in the schedule shall equal the total Contract Sum.

F. Indicate separate value associated with materials and labor.

G. Re-submittal: After review by Engineer, revise and resubmit schedule until approved.

PART 2 - PRODUCTS - Not used

PART 3 - EXECUTION - Not used

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Instructions to Proposers for substitutions.

B. Work Included: Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the work, as specified herein and in other provisions of the Contract Documents.

C. Related Work:
1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. Use required means to assure arithmetical accuracy of the sums described. When so required by the Engineer, provide copies of the subcontracts or other data acceptable to the Engineer, substantiating the sums described.

B. The Schedule of Values shall be broken down into costs for each specification section as labor and materials at a minimum.
1. The contractor is encouraged to make the schedule of values very detailed in order to facilitate review and approval of requested percentages complete on pay applications.
2. Where breakdown is vague, or includes multiple / combined assemblies, stages, tasks, etc., Engineer's review shall be conservative in favor of the Owner regarding approval of Pay Applications.

1.3 APPLICATION FOR PAYMENT SCHEDULE OF VALUES

A. The schedule of values, once approved shall be transferred to columns B and C of AIA G702/G703 – Application for Payment to be used for all progress payments.

B. Once AIA G702/G703 – Application for Payment has been submitted for payment, individual line item amounts in column C must remain unchanged throughout the progress of the work.

C. In the beginning stages of the construction, total amounts for entire divisions may be used if complete breakdowns are not available; and shall be line item populated as soon as practical.

D. No payments will be approved in divisions that do not have a line item breakdown.

E. Allowances shall be shown, and remain throughout construction, as a single line item on the master application for payment in amount(s) as stipulated in the Contract Documents.

F. For each Allowance, expenditures and accounting shall be included on a separate, attached spread sheet of the same format as the master application for payment.

G. The master application for payment shall reflect only the summary of each allowance; and shall not contain individual allowance activity(s).

1.4 MULTIPLE PHASES / BUILDINGS

A. For projects consisting of multiple phases, separate each phase on the Application for Payment and include separate division 2 through 32 line items for each phase.

B. For projects consisting of multiple buildings, separate each building on the Application for Payment and include separate division 2 through 32 line items for each building.

1.5 SUBMITTALS

A. Prior to the first Application for Payment, submit a proposed schedule of values to the Engineer, as outlined below.

B. Meet with the Engineer and determine additional data, if any, is required to be submitted.

C. Secure the Engineer's approval of the schedule of values prior to submitting the first Application for Payment.

PART 2 - PRODUCTS

2.1 SCHEDULE OF VALUES

A. Schedule of values for Division 2 through 32 shall be broken down for each separate section of work, and include multiple items covered where appropriate.
   01 Each item of work shall be broken down by material and labor at a minimum.
   02 Where payment for shop drawings, submittals, record drawings and similar are expected, the items must be included as a separate item on the schedule of values.

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Coordination of work of the Contract.

B. Related Sections:
   1. Section 01 10 00 - Summary of Work
   2. Section 01 31 19 - Project Meetings
   3. Section 01 77 00 - Closeout Procedures

1.2 DESCRIPTION

A. Coordinate scheduling, submittals, and work of the various sections of specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.

B. Coordinate sequence of work to accommodate early Owner occupancy as specified in Section 01 11 00 - *Summary of Work*.

1.3 MEETINGS

A. In addition to progress meetings specified in Section 01 31 19 - *Project Meetings*, conduct coordination meetings and pre-installation conferences with applicable personnel and affected subcontractors to assure proper coordination of work.

1.4 COORDINATION OF SUBMITTALS

A. Schedule and coordinate submittals specified in Section 01 33 23 - *Shop Drawings, Product Data and Samples.*

B. Coordinate work of various trades having interdependent responsibilities for equipment, such as installing, connecting to and placing in service.

C. Coordinate requests for substitutions to assure compatibility of space, of operating elements and effect on work of other sections.

1.5 COORDINATION OF SPACE

A. Mechanical and electrical work is diagrammatically shown on the Drawings. Coordinate use of project space and sequence of installation. Follow routings shown for pipes, ducts and conduits as closely as practicable, with due allowance for available physical space. Install ductwork, conduit, and plumbing lines parallel to building lines. Efficiently utilize available space to maximize accessibility for other trade's installations, and for maintenance and repairs.

B. In finished areas, except as otherwise shown, conceal pipes, ducts and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

1.6 COORDINATION OF CONTRACT CLOSEOUT

A. Coordinate completion and cleanup of the Project Site in preparation for substantial completion of portions of work designated for Owner partial occupancy.

B. After early Owner occupancy of premises, coordinate access to site by construction personnel for correction of defective work and work not in compliance with the Contract Documents, and to minimize disruption of Owner's activities.

C. Assemble and coordinate closeout submittals specified in Section 01 77 00 - *Closeout Procedures*.

PART 2 - PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Instructions to Proposers for substitutions.

B. Scope of Work:
   01 Contractor participation in preconstruction conference.
   02 Contractor administration of pre-installation conferences.
   03 Contractor administration of progress meetings

1.2 PRECONSTRUCTION CONFERENCE

A. Engineer will administer preconstruction conference for execution of Owner-Contractor Agreement, and exchange preliminary submittals.

B. Engineer will administer site mobilization conference at project site for clarification of Owner and Contractor responsibilities, in use of site and for review of administration procedures.

1.3 PRE-INSTALLATION CONFERENCES

A. Contractor shall convene pre-installation conferences with each sub-contractor prior to commencing work of the sub-contractor.
   01 Contractor shall record attendance on a sign-in sheet.
   02 Contractor shall keep minutes of the conference and distribute to all attending parties prior to the start of the work.

B. The purpose of the meeting is to fully review subcontractor's work to assure initial installation will be in accordance with the Contract Documents. The agenda shall include, but not necessarily limited to the following:
   01 Review the contract documents, including any changes thereto.
   02 Review all RFI's that may affect the work.
   03 Review the final reviewed submittals, including AE and Contractor comments.
   04 Review conditions of installation, preparation and installation procedures.
   05 Review coordination with related / interfacing work.
   06 It is the responsibility of the contractor / sub-contractor to resolve all unknown issues, unclear issues, coordination issues, and assembly interface issues in order to comply with the requirements of the Contract Documents.

C. Require attendance includes, but is not limited to the following:
   01 Contractor's superintendent
   02 Engineer's field representative
   03 Relative sub-contractor
   04 Sub-contractors providing adjacent and / or interfacing work.
   05 Other sub-contractors whose work may be affected by the relative sub-contractor.

D. Pre-installation conferences shall be scheduled a minimum of 48 hours in advance of the start of relative work unless otherwise agreed to by all parties.

E. Pre-installation conferences may be scheduled with multiple sub-contractors at the same time to facilitate awareness of related work. Coordinate with Engineer's field rep.

F. The contractor shall keep meeting minutes and distribute to all attendees within three days after the meeting; or sooner if required to facilitate project scheduling.

1.4 PROGRESS MEETINGS

A. Contractor shall schedule and administer all project meetings after mobilization conference throughout progress of the work at bi-weekly intervals, plus any special called meetings, and all preinstallation conferences.

B. Contractor shall make physical arrangements for meetings, preside at meetings, record minutes, and distribute copies of minutes within two days to attendees, and those affected by decisions made at meetings.

C. Required Attendance:
01 Contractor's Superintendent
02 Contractor's Project Manager
03 Engineer's Project Manager
04 Engineer's Field Representative
05 Engineer's Consultants as appropriate to agenda topics for each meeting.
06 Owner's Representative.

D. The primary purpose of the weekly progress meetings is to update the Owner of the project status, progress, schedule and outstanding issues. It shall not be a venue for resolving issues that can otherwise be resolved between the Contractor and Engineer / consultants; unless direct input from the Owner is required.
01 In as much as practical, meetings shall be scheduled on the same day and time each week. Changes in the normal schedule must be agreed to by all parties.

E. Required Agenda Items:
01 Review work completed since the previous meeting.
02 Review status of progress schedule and adjustments thereto, and delivery schedules.
03 Review submittal log,
04 Review change proposal log, minor changes and other adjustments to the Work
05 Review pending changes and substitutions.
06 Review AE construction observation reports and resolutions to outstanding issues
07 Review as-built documents and close-out progress,
08 Discuss other items affecting progress of work.
09 New business

1.5 PROGRESS MEETING MINUTES

A. Progress meeting minutes shall be furnished by the Contractor and shall be structured to identify all discussion topics and action items by the initiating meeting and the eventual outcome / decisions made relative to each issue.

B. Meeting minutes shall be produced in a form acceptable to the Engineer. Coordinate as required.

C. Each meeting with unresolved information or pending action items shall remain on the meeting minutes, in the above format, through one meeting beyond resolution or completion of the pending action of the item, where the item can be reviewed one more time and ALL parties agree the item can be removed from the meeting minutes.

D. The last meeting shown on the meeting minutes shall relate to the most recent meeting held and shall include ALL topics of discussion at that meeting.

E. Up-to-date meeting minutes shall be furnished to all attendees at the beginning of each meeting.

END OF SECTION

SECTION 01 31 20

PRE-CONSTRUCTION MEETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Participation in preconstruction meeting.

B. Related Requirements:
   1. Section 01 10 00 - Summary of Work
   2. Section 01 31 00 - Project Management and Coordination
   3. Section 01 31 19 - Project Meetings

1.2 PRECONSTRUCTION MEETING

A. Engineer will schedule a preconstruction meeting within 15 days after Notice of Contract Award.

B. Attendance: Owner, Engineer and Consultants, General Contractor, and representatives of major subcontractors and Suppliers.

C. Minimum Agenda
   1. Submittal of executed bonds and insurance certificates
   2. Execution of Owner-Contractor Agreement
   3. Distribution of Contract Documents
   4. Submittal of list of subcontractors, list of products, schedule of values and progress schedule
   5. Designation of responsible personnel
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal requests, change orders, allowances and Contract closeout procedures
   7. Scheduling
   8. Use of premises by Owner and Contractor
   9. Owner's requirements and occupancy
   10. Temporary facilities
   11. Survey and building layout
   12. Security and housekeeping procedures
   13. Procedures for testing
   14. Procedures for maintaining record documents
   15. Requirements for startup of equipment
   16. Accessibility Issues
   17. Inspection and acceptance of equipment put into service during construction period
   18. Notice to proceed
   19. Color samples
   20. Procedures for site meetings
   21. Site access and security
   22. Substantial and final project completion procedures

PART 2 – PRODUCTS - Not Used

PART 3 – EXECUTION - Not Used

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Instructions to Proposers for substitutions.

B. Scope of Work: This section establishes requirements of Contractor to produce and maintain a construction schedule throughout the progress of work; as well as, Owner imposed limitations on the construction schedule.

1.2 SUBMITTALS

A. Construction schedules shall be produced using a critical path method, linking associated tasks and their impact on interfacing / subsequent work.
   01 Provide (separate) schedules for each campus.
   02 Provide schedule in as much detail as practical to accurately monitor progress of the work and adherence to the schedule.
   03 Provide in both text and graphic formats.

B. Preliminary Construction Schedule: Within one (1) weeks after receipt of Notice to Proceed, submit a preliminary construction schedule for review.

C. Construction Schedule: Within two (2) weeks after receipt of Notice to Proceed, submit one reproducible and four prints of the construction schedule.

D. Throughout the progress of the Work, provide / submit updated progress schedules at each regularly scheduled site progress meetings.

1.3 RELIANCE UPON SCHEDULE

A. The construction schedule will be an integral part of the Contract, and will establish conditions for various activities and phases of construction.

B. The Owner, Engineer and Engineer’s Consultant shall rely on the schedule to perform related and interfacing activities.

C. Whenever the progress of the Work falls behind two weeks or more, the Contractor shall adjust the schedule accordingly to demonstrate how progress shall be adjusted to get back on the original schedule.

PART 2 - PRODUCTS

2.1 CONSTRUCTION SCHEDULE

A. Diagram: Graphically show the order of all activities necessary to complete the work and the sequence in which each activity is to be accomplished.

B. Activities shown on the diagram shall include, but not necessarily be limited to:
   01 Project mobilization.
   02 Submittals and approvals of shop drawings and samples.
   03 Phasing of construction.
   04 Procurement of equipment and critical materials.
   05 Fabrication and installation of materials and equipment.
   06 Final clean-up.
   07 Final inspection and testing.

C. Accurately track and incorporate delays caused by inclement weather and factors outside the Contractor's control.

D. Provide updated schedules at each regularly scheduled site progress meeting.

2.2 CONSTRUCTION SCHEDULE LIMITATIONS

A. Work performed under this Contract shall be performed in accordance with the following paragraphs so that the Owner can accept the project as substantially complete as noted below.

B. When the Owner-Contractor Agreement stipulates a guaranteed completion date, the Contractor shall use all means necessary to assure adequate progress of the Work to achieve the contracted Substantial Completion date.

C. At no time can Work disable any critical features, systems or functions of a campus without the approval of the Owner. Coordinate as required.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Instructions to Proposers for substitutions.

1.2 QUALITY ASSURANCE

A. It is the sole responsibility of the Contractor / sub-contractor / material supplier to provide materials and work that conforms to the requirements of the Contract Documents.

B. The function of the submittal process is to provide the Contractor / sub-contractor / material supplier additional review / quality control of the materials / work proposed to be furnished for the Work.

C. Prior to delivery to the Engineer or Consultant, each submittal shall be thoroughly reviewed by the party / sub-contractor generating the submittal, as well as the General Contractor.
   01 Each reviewer shall document their review by affixing a stamp and signature, or a signed review cover sheet to each submittal. General contractor sign-off for the submittal originator is not acceptable.
   02 All corrections shall be clearly noted.
   03 The Contractor shall determine whether the submittals are suitable to forward to the Engineer / Consultant, or return to the originator for revisions and re-submittal.
   04 Submittals which do not display (at least) two prior, separate reviews (submitter and general contractor) shall be rejected and returned to the general contractor.

D. The Engineer's / Consultant's review of submittals is only for review of the general conformance with the design concept of the project and general compliance with the information given in the Contract Documents.
   01 The Engineer's / Consultant's review of submittals shall NOT be construed as approval of the products, assemblies or work being submitted, unless specifically stated as such.
   02 The Engineer / Consultant shall not field verify any information requested on the submittal. That is the responsibility of the Contractor.

E. Submit only what is proposed to be furnished. Where cut-sheets, etc. also contain information on items not to be furnished, clearly indicate / identify / separate the specific items proposed to be furnished from those which are not proposed to be furnished.
   01 Where no such indication is made, it shall be understood the submittal is presenting options to be selected by the Engineer / Consultant at no additional cost to the Owner.

F. Submittals shall be rejected by the Engineer / Consultant for any of the following:
   01 Lack of required review stamps / cover sheets.
   02 Apparent / obvious lack of review by the general contractor or original provider / subcontractor.
   03 An inordinate amount of revisions already noted by the general contractor / sub-contractor.
   04 Incomplete or missing information.
   05 Inclusion of other items not proposed to be furnished.

G. The Contract Documents in electronic format may be made available to the contractor / sub-contractor for their use, provided the users execute a release form to the Engineer / Consultant.

H. All submittals shall be submitted with a cover sheet containing the following information:
   01 Contractor's submittals number
   02 Date of submission and dates of any previous submissions
   03 Project title and Engineer's project number
   04 Relative specification section number
   05 Names of Contractor, subcontractor, supplier, and / or manufacturer.
   06 Signed and dated review stamp or comment sheet from the party / sub-contractor generating the submittal
   07 Signed and dated review stamp or comment sheet from the General Contractor.

I. Each submittal shall contain an identification numbered and specific written title. The identification number shall be in the following format and sequence:
   01 Begin with the relevant specification section number (i.e. 042000).
   02 Follow with a two-digit identifier indicating the first, second, etc. submittal for that particular section (i.e. 042000-01).
   03 The written title shall specifically identify the submittal information (i.e. 042000-01 – Masonry Reinforcement). General descriptors shall not be accepted unless they clearly identify the submittal information.

J. Resubmission Requirements:
   01 Make any corrections or changes in the submittals required by the Engineer or Consultant and resubmit until reviewed without rejection or direction for re-submittal.
   02 Clearly indicate the re-submittal by a capital "R" suffix to the submittal number (i.e. original submittal: 042000-01, first re-submittal: 042000-01-R-01, 042000-01-R-02, etc.).

K. Failure to comply with the quality assurance requirements may result in immediate rejection without review of the submittal. In such circumstances, no additional time shall be granted to the Contractor for resultant delays.

PART 2 - PRODUCTS

2.1 ELECTRONIC DELIVERY

A. Electronic delivery of paper submittals in 11x17 or smaller size in PDF format is required. Delivery of larger size submittals in electronic format is encouraged, but optional to the General Contractor.
   01 Provide a single, electronic copy of submittals with all previous review comments / mark-ups via email or other electronic means to the Engineer / Consultant.
   02 Submittals shall be returned electronically to the General Contractor along with review comments sheets / mark-ups.
   03 Quantities retained and distributed shall be the responsibility of each party (i.e. Contractor, Engineer and / or Consultant).

B. Electronic submittals in PDF format shall be made in the same format (size) of the actual submittal (i.e. 8-1/2x11, 11x17, 24x36, and / or 30x42).

C. The following are exceptions to the above and shall be submitted in electronic and hard copy:
   01 Bound MEP manuals / submittals in excess of 25 pages. Submit the number to be returned plus three (3) copies to be retained by the Engineer and consultant.

2.2 HARD COPY DELIVERY

A. Owner's Record Set of Submittals

01 The contractor shall maintain a separate set of all final submittals to be delivered to the Owner at project close-out.
02 Submittals shall be organized, in order, by spec section.

2.3 MANUFACTURER'S PRODUCT DATA

A. Manufacturer's Product Data: Submit manufacturer's complete printed data on each product; including, but not necessarily limited to product cut-sheets, specifications, quality references, MSDS sheets, and general information, as necessary to demonstrate compliance with all specified requirements

B. Manufacturer's Installation Instructions:
01 When work is specified to comply with manufacturer's printed installation instructions, submit copies of such instructions, including all requirements as they specifically relates to the work required in this Contract.
02 Submission of generic details that do not depict actual conditions of this project shall be rejected.
03 Contractor shall distribute copies to all parties providing interfacing work to the completed installation / assembly.

2.4 SHOP DRAWINGS

A. Shop drawings shall be submitted with sufficient detail to fully describe the work included. Partial sets, if submitted without prior approval from the Engineer, shall be subject to rejection and / or holding until subsequent shop drawings are submitted.

B. Details included in shop drawings shall depict actual project conditions related to the assembly. Details depicting generic substrates or interfacing work shall be subject to rejection.

C. All dimensions indicated on the drawings are based on the specific models and manufacturers of products, equipment, fixtures and miscellaneous items specified or used as a design basis.
01 If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these specifications, the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings and miscellaneous items – all subject to approval by the Engineer.
02 When dimensional changes are required in these situations, the Contractor shall submit a proposed modification drawing to the Engineer for approval prior to proceeding with the work. All causes and effects of the dimensional change shall be indicated on the Contractor's drawing submittal.

2.5 SAMPLES

A. Finish Samples: Submit full range of manufacturer's standard colors, textures, and patterns for Engineer's selection.
01 Submit samples for selection of finishes in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other Contractor.
02 Prior to submission of samples, provide all relative information to the Engineer, including but not limited to manufacturer, model no. , series, patterns, colors, etc. necessary to fully describe materials proposed to be furnished. At Engineer's option sample submittals may be waived if Engineer already has samples of proposed materials in the interiors library. Coordinate with Engineer as required.

B. Selection of finishes from paper or digital representations shall not be accepted. Samples requiring selection of a color, pattern or similar finish shall be submitted in one of the following methods:

01 Whenever possible, submit actual material product samples (i.e. carpet, aluminum, glass, plastic laminate, sealants, etc.)
02 Paint colors for pre-finished materials shall be submitted on actual samples of substrate materials (i.e. paint on sheetmetal).
03 Manufacturer's standard color wheels or similar shall be acceptable for paint selections for field painted items; however, the Engineer may require to see / approve an actual application of paint on the intended material in the field.

C. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.

D. Submittals shall contain:
01 Date of submission and dates of any previous submissions
02 Project title and number
03 Contract identification
04 Names of Contractor, Supplier, Manufacturer
05 Identification of sample, with specification section number

E. Resubmission Requirements for Samples:
01 Make any corrections or changes in the submittals required by the Engineer and resubmit until approved.
02 Submit new samples as required for initial submittal.

F. Submit a minimum of two samples and more if specified in the respective Specification section; one will be retained by Engineer. Reviewed samples may be used in the work if so indicated in the specification section.

G. Selection of materials, finishes and color selections shall be finalized ONLY after samples of all key items are received. Color selections of key items shall NOT be done piece meal.

2.6 MANUFACTURER'S CERTIFICATIONS AND WARRANTIES

A. Manufacturer's Test Reports and Certifications: Where applicable, submit test reports and certifications demonstrating compliance with the referenced standards and requirements.

B. Prior, and conditional to Contract Close-Out, provide original copies of all required certificates, warranties and guarantees. Refer to other sections for specific requirements.

C. Submit required certificates and warranties with original signatures. Documents shall be accompanied by the name of the manufacturer / guarantor, contact name, address, email address, phone number and fax number.

PART 3 – EXECUTION

3.1 SUBMITTAL COORDINATION

A. Group or package submittals relative to the assembly which are dependent upon each other for a thorough review (i.e. doors, frames and hardware).
01 Time periods for proper and complete submittal reviews which are contingent on or must be coordinated with separate but related submittals shall begin at the time of the Engineer's / Consultant's receipt of the last required submittal. Contractors are urged to group submittals appropriately in this regard.

B. Finishes and samples shall NOT be selected piecemeal. Selection of finish samples will begin only after receipt of all finish selection samples, including exterior and interior finishes.

C. No extensions of Contractor Time or Cost shall be allowed due to lack of submittal coordination by the Contractor.

3.2 SCHEDULE

A. The Contractor shall schedule to complete the submittal process within a timeframe he establishes to achieve Substantial Completion of the entire Project on or before the stipulated completion date.

B. The Contractor shall formulate and provide a submittal schedule to the Engineer within fourteen (14) days after execution of the Owner – Contractor Agreement, to allow for proper coordination and scheduling reviews.

C. In formulating the submittal schedule, the Contractor shall allow the following review periods:
   01 Engineer – allow fourteen (14) calendar days response time, after Engineer's receipt, for all submittals made to and reviewed by the Engineer.
   02 Engineer's Consultant – Allow twenty (20) calendar days response time, after Consultant's receipt, for all submittals which must be reviewed by Engineer's Consultants.
   03 All Consultant submittals shall be returned to the Engineer for delivery to the Contractor.

3.3 PROCEDURES

A. Transmit each item with approved form identifying project, contractor, subcontractor, major supplier; identify pertinent drawing sheet and detail number and specification section number, as appropriate.

B. Transmit Consultant submittals directly to respective Consultant with a copy sent to the Engineer.

C. Sub-Contractor's / Supplier's Conveyance to the General Contractor: Each sub-contractor / supplier shall be required to review their own submittal and apply a signed and dated stamp certifying review, verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
   01 Submittals forwarded to the Engineer / Consultant without the sub-contractor / supplier review stamp shall be automatically rejected without review and returned to the General Contractor.

D. Contractor's Conveyance to the Engineer / Consultant: The Contractor is required to thoroughly review and check all submittals received from sub-contractors / suppliers.
   01 Upon completion of review and checking, apply signed Contractor's stamp to each item submitted, certifying that review, verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
   02 Submittals forwarded to the Engineer / Consultant without the Contractor's review stamp shall be automatically rejected without review and returned to the Contractor.

E. If, in the opinion of the Engineer / Consultant, the submittal indicates a lack of review or the contractor's / sub-contractor's review is incomplete, the submittal will be returned, unchecked, to the General Contractor for correction of any / all deficiencies for subsequent re-submittal.

F. Revise and resubmit submittal as required; clearly identify all changes made since previous submittal.

G. After review, distribute copies to all concerned parties.

H. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of shop drawings, product data, samples or similar submittals until the respective submittal has been reviewed by the Engineer / Consultant without request for re-submittal.

3.4 CLAIM NOTIFICATION

A. If the submitter or contractor issues submittals for which an additional cost is anticipated, the submittal must clearly indicate such cost including all supporting information.
   01 Lack of accompanying cost information known at the time of the original submittals shall be grounds for disallowance of such cost.

B. Upon return of submittal(s) to the originator of the submittal(s), the submitter shall thoroughly review all mark-ups and / or comments prior to proceeding with the work.

C. Based on the mark-ups and / or comments returned, the submitter shall have fifteen (15) calendar days to submit a claim notification for additional costs the submitter may feel is warranted by the mark-ups / and or comments of the Engineer or Consultant.
   01 The fifteen (15) calendar day period shall commence upon Contractor's receipt of the submittal from the Engineer.

D. In the absence of any claim notification within the specified time period, it shall be agreed the submitter shall provide the work in accordance with the final, reviewed submittal at no additional cost.

E. In the event a claim notification is submitted to the general contractor / construction manager, the submittal process shall not be complete until all such claim notifications have been fully resolved.

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Digital submittal of Shop Drawings and Product Data
   2. Delivery of samples to Engineer and Consultants

B. Related Requirements:
   1. Document 00 61 27 - General Conditions of the Contract for Construction
   2. Document 00 73 00 – Supplementary Conditions to the Contract for Construction
   3. Section 01 31 00 - Project Management and Coordination
   4. Section 01 32 16 - Construction Progress Schedules
   5. Section 01 50 00 - Temporary Facilities and Controls

1.2 GENERAL

A. Refer to General Conditions, Paragraph 3.12 (*Shop Drawings, Product Data and Samples*).

B. Within 30 calendar days of the Contract Date, prepare and submit with the Schedule of Values a comprehensive list of Shop Drawings, Product Data and Samples including products proposed for substitution. Include the estimated date of each submittal and anticipated date of submittal return. Allow the Engineer reasonable time to review submittals.

C. Prepare list based on each Specification Section.

D. Include the following for products specified under reference standards:
   1. Name and address of manufacturer
   2. Trade name
   3. Model or catalog designation
   4. Manufacturer's data, including performance and test data, reference standards

1.3 SHOP DRAWINGS

A. Prepared by a qualified detailer. Prepare project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Include supplier’s / detailer’s / manufacturer's title block.

B. Identify details by reference to sheet and detail numbers shown on Contract Documents.

C. Present in a clear and thorough manner original drawings which illustrate the portion of the work showing fabrication, layout, setting, or erection details, prepared by a qualified detailer. Title each drawing with Project and Contract name and number; identify each element of drawings by reference to sheet number and detail, schedule, or room number of Contract Documents.

1.4 PRODUCT DATA

A. Manufacturer's standard schematic drawings and diagrams:
   1. Modify drawings to delete information which is not applicable to the work.
   2. Supplement standard information to provide additional information specifically applicable to the work.

B. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data:
   1. Clearly mark each copy to identify pertinent materials, products or models.
   2. Show dimensions and clearances required.
   3. Show performance characteristics and capacities.
   4. Show wiring or piping diagrams and controls.

C. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to specification section and Article number. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

1.5 SAMPLES

A. Office samples shall be of sufficient size and quantity to clearly illustrate:
   1. Functional characteristics of product or material, with integrally related parts and attachment devices.
   2. Full range of color samples.

B. Field Samples and Mock-ups:
   1. Erect at project site at location acceptable to Engineer.
   2. Construct each sample or mock-up complete, including work of all trades required in finish work.
   3. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work.

C. Submit full range of manufacturer's standard finishes except when more restrictive requirements are specified, indicating colors, textures and patterns, for Engineer selection.

D. Submit samples to illustrate functional characteristics of products, including parts and attachments.

E. Approved samples which may be used in the work are indicated in the specification section.

F. Label each sample with identification required for transmittal letter.

1.6 CONTRACTOR REVIEW

A. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, quantities and details, manufacturer's catalog numbers and conformance of submittal with requirements of Contract Documents.

B. Coordinate submittals with requirements of work and of Contract Documents.

C. Sign or initial in a rubber-stamped review block format, each sheet of shop drawings and product data and each sample label to certify compliance with requirements of Contract Documents. Notify Engineer in writing at time of submittal, of any deviations from requirements of Contract Documents.

D. Do not fabricate products or begin work which requires submittals until return of submittal with Engineer acceptance.

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

F. Contractor's responsibility for deviations in submittals from requirements of contract documents is not relieved by Engineer's review of submittals, unless Engineer gives specific written acceptance of deviations. Engineer will review submittals for general conformance to design intent only.

1.7 SUBMITTAL REQUIREMENTS

A. Submit shop drawing and product data as soon as practicable after award of contract but not later than 30 days before dates reviewed submittals will be needed.

B. Digital Submittals: Submit to the Engineer, or applicable consultant, shop drawings, product data, and samples required by specification sections. Do not submit illegible fax copies or carbon copies of shop drawings and product data.
   1. Submittals to be reviewed by consultants shall be submitted directly to the applicable consultant with a copy of only the digital transmittal simultaneously copied to the Engineer. Submittals will be reviewed by the consultant and then delivered/transmitted to the Engineer for his review prior to transmitting them to the contractor. Submittals to be reviewed by the testing lab shall be handled in the same manner.
   2. Color Selections & Samples: Provide one sample or cut sheet for the Engineer’s records.

C. Submit all office samples as soon as practicable but not later than 20 days after award of contract in order to facilitate color selections and coordination of the various materials. Final color selections and release of shop drawings contingent upon color selection will not be made until all office samples have been submitted, coordinated and approved.

D. Contractor is responsible for the costs associated with the digital delivery of all submittals, and hard copy where required, to the Engineer and the Engineer's consultants and retrieval of all submittals from the Engineer, when necessary.

E. Accompany submittals with transmittal letter containing:
   1. Date.
   2. Project title and number.
   3. Contractor's name and address.
   4. Identification of specification section and submittal numbers.
   5. The number of each shop drawing, product data and sample submitted.
   6. Notification of deviations from contract documents.
   7. Other pertinent data.

F. Submittals shall include:
   1. Date and revision dates.
   2. Project title and number.
   3. Names of Engineer, Contractor, subcontractor, supplier and manufacturer.
   4. Identification of product or material and specification section number.
   5. Relation to adjacent structure, materials or other critical features.
   6. Field dimensions, clearly identified as such.
   7. Applicable reference standards.
   8. A blank space 3x4 inches for Engineer's stamp.
   9. Identification of deviations from contract documents.
   10. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements, compliance with contract documents, and coordination with requirements of the work. Note: Absence of the Contractor's stamp shall constitute grounds for rejection of the submittal until such time as the submittal has been processed in accordance with this requirement.
   11. Other pertinent data required by specifications.

1.8 RESUBMITTAL REQUIREMENTS

A. Re-submittal: For shop drawings and product data not approved by Engineer, make corrections and changes in submittals required by Engineer and resubmit until approved.

B. Shop Drawings:
   1. Revise initial drawings and resubmit as specified for initial submittal.
   2. Indicate on drawings any changes which have been made, other than those requested by Engineer.

C. Product Data and Samples: Submit new data and samples as specified for initial submittal

1.9 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

A. Distribute reviewed copies of Shop Drawings and Product Data which carry Engineer's review stamp as follows: Contractor's file, project site file, record documents file, other prime contractors.

B. Keep and maintain a full set of submittals throughout the construction phase to be submitted to the Engineer with other Close-out documents for delivery to the Owner for his permanent record. Set of submittals shall be delivered to the Engineer in cardboard file boxes with string and button type closures. Organize submittals by CSI divisions, utilizing neatly labeled pressboard dividers to separate the sections. Neatly label short end of box with project name, contents and duration of construction.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01 35 23

BEAUMONT INDEPENDENT SCHOOL DISTRICT
CONTRACTOR SITE RULES

DELIVERY AND SITE RULES WITH STUDENTS IN SCHOOL:

Should a purchase order or contract specify delivery/work which requires visitation to an Beaumont ISD facility, the following site rules shall be followed:

All contractor's and their employees, subcontractors and their agents and employees, must be cleared in advance in each building front office/receptionist area before entry into any Beaumont ISD building via the Raptor System. Visitors will be required to scan their Driver's License or other state issued ID.

What is the "Raptor System?" The Raptor System is a system that instantly screens for registered sex offenders in all 50 states and can also screen for individuals with restraining orders, custody issues, suspended or expelled students, known gang members, or for any custom alert.

When a visitor is cleared, the system prints a badge featuring the visitor's name, photo, date and time, and destination. If a potential threat is identified, the Raptor system sends instant alerts to designated officials, including administrators and law enforcement, via email, text messaging and/or page.

No visitors are allowed on campuses without this custom badge.

If work will be done while students are on campus, each of the employees from the vendor will need to be registered with the FAST system for a full and complete background check.

A. No foul language or spitting on the floor.

B. No tobacco products on school property.

C. The possession or use of alcohol or illegal drugs is strictly prohibited.

D. No tank tops – workers must be fully clothed.

E. No workers with a history of felony convictions or warrants.

F. No parking on grass, under shade trees, sidewalks or non-vehicular paved areas.

G. Contractor's employees, Subcontractors and their agents and employees working on any District facility must wear picture identification with the company name. Any exceptions must be approved in advance with the designated District representative.

H. Keep the premises free from accumulation of waste, materials or rubbish caused by the work under this contract at each site. Boxes must be broken down prior to removal from the building. Upon completion of the work, and prior to the final inspection, have the premises in a neat and clean condition.

I. Take all precautions necessary for the safety of, and provide protection to prevent damage, injury or loss to:
   a. All employees on the project and all other persons who may be affected thereby.
   b. All the work and all materials to be incorporated therein, whether in storage on or off the site.
   c. All property at the site and adjacent thereto including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and any other school property.

J. A competent supervisor who understands the full scope of the work shall be on site at all times.

K. School administrative services shall at all times have priority over the Contractor's use/service/etc.

L. Any work that may interfere with school activities must be authorized in advance through administrative channels. A management plan will be devised to minimize the effect of the interference.

M. The Contractor shall be responsible to BEAUMONT ISD for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the work under the contract.

N. No work within the confines of a secured building will be allowed without at least one District employee present. The contractor must pay the BEAUMONT ISD Custodial Department in advance for the cost of adding a custodian to a building for after-hours work.

O. Doors must not be propped open when working after-hours.

END OF SECTION

SECTION 01 36 13

CUTTING AND PATCHING

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Instructions to Proposers for substitutions.

B. Scope of Work:
   01 Provide cutting and patching of existing work as required for the proper installation of new work, including proper interface with existing work.
   02 Cutting and patching includes, but is not limited to:
      a. Gypsum board assemblies
      b. Finish flooring
      c. Wall finishes
      d. Doors and frames
      e. Ceiling assemblies

C. Related Work:
   01 Section 01 36 16 – Remodeling and Alteration Procedures
   02 Section 02 41 19 – Selective Demolition.

1.2 SUBMITTALS

A. Provide all submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit written request in advance of cutting or alteration which affects:
   01 Structural integrity of any element of the project
   02 Integrity of weather-exposed or moisture-resistant element
   03 Efficiency, maintenance, or safety of any operational element
   04 Visual qualities of sight-exposed elements
   05 Work of Owner or separate contractor
   06 Any work in or around any known or potential area in which asbestos or lead based products exist.

C. Procedural Proposal for Cutting and Patching: Where prior consent for cutting and patching is required, submit proposed procedures for this work well in advance of the time work will be performed, and request consent to proceed. Include the following information, as applicable, in the submittal:
   01 Describe the nature of the work and how it is to be performed, indicating why cutting and patching cannot be avoided. Describe anticipated results of the work in terms of changes to and effects upon existing work, including structural, operational and visual changes, as well as other significant elements.
   02 List products to be used and firms that will perform work.
   03 Give dates when work is expected to be performed.
   04 List utilities that will be disturbed or otherwise be affected by work, including those that will be relocated and those that will be temporarily out of service. Indicate how long utility services will be disrupted.
   05 Where cutting and patching of structural work involves the additional reinforcement, submit details and engineering calculations to show how that reinforcement is integrated with the original structure to satisfy requirements.

06 Consent by the Engineer to proceed with cutting and patching work does not waive the Engineer's right to later require complete removal and replacement of work found to be cut and patched in an unsatisfactory manner.

1.3 DESCRIPTION OF REQUIREMENTS

A. Definition: "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting, and patching required to restore surfaces to their original condition.
   01 Cutting and patching is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed, to remove and replace work not conforming to Contract requirements, or for other similar purposes.
   02 Cutting and patching performed during the manufacture of products, or during the initial fabrication, erection of installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be cutting and patching.

B. Refer to other sections of these specifications for specific cutting and patching requirements, and limitations applicable to individual units or work.
   01 Unless otherwise specified, requirements of this Section apply to mechanical and electrical work. Refer to Divisions, 21, 22, 23, 26, 27 and 28 sections for additional requirements and limitations on cutting and patching of mechanical and electrical work.

1.4 RELATED REQUIREMENTS

A. Individual Specifications Sections:
   01 Cutting and patching incidental to work of this Section.
   02 Advance notification to other trades of openings required in work of those trades.
   03 Limitations on cutting structural members.

1.5 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural work in a manner that would result in a reduction of load-carrying capacity or load-deflection ratio.

B. Before cutting and patching the following categories of work, submit a written request and obtain the Engineer's consent to proceed with cutting and patching, as described in the procedural proposal for cutting and patching.
   01 Structural steel
   02 Miscellaneous structural metals, including lintels, equipment supports, stair systems and similar categories of work
   03 Structural concrete
   04 Foundation construction
   05 Shoring assemblies
   06 Bearing and retaining walls
   07 Structural decking
   08 Exterior wall construction
   09 Piping, ductwork, vessels and equipment

C. Operational and Safety Limitations: Do not cut and patch operational elements or safety related components in a manner that would result in a reduction of their capacity, to perform in the manner intended, including energy performances, or that would result in increased maintenance, or decreased operational life, or decreasing safety. Before cutting and patching the following elements of work, and similar work elements where directed, obtain the Engineer's consent to proceed with cutting and patching.

01 Shoring, bracing, and sheeting
02 Primary operational systems and equipment
03 Water/moisture vapor/air/smoke barriers, membranes and flashings
04 Noise and vibration control elements and systems
05 Control, communication, conveying, and electrical wiring systems

D. Visual Requirements: Do not cut and patch work exposed on the building's exterior or in its occupied spaces, in a manner that would, in the Engineer's opinion, result in lessening the building's aesthetic qualities. Do not cut and patch work in a manner that would result in substantial visual evidence of cut and patch work. Remove and replace work judged by the Engineer to be cut or patched in a visually unsatisfactory manner. If possible, retain the original installer or fabricator, or another recognized, experienced and specialized firm to cut and patch the following categories of exposed work:
01 Architectural concrete finishes
02 Brick and concrete unit masonry
03 Ornamental metal
04 Roofing
05 Preformed metal panels
06 Window system
07 Gypsum or cement plaster
08 Acoustical ceilings
09 Carpeting
10 Wall covering
11 HVAC enclosure, cabinets or covers

1.6 PAYMENT FOR COSTS

A. Cost for work necessary to accommodate installation of new work shall be borne by the Contractor or subcontractor responsible for installing new work.

B. Costs caused by ill-timed or defective work, or work not conforming to contract documents, including costs for additional services of the Engineer and other Design Consultants shall be borne by the party responsible in the judgment of Engineer, for ill-timed, rejected or non-conforming work.

C. Costs for work performed on instruction of Owner, other than the correction of defective or non-conforming work shall be responsibility of the Owner, who shall issue an appropriate Change Order for the increase in costs.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Except as otherwise indicated, or as directed by the Engineer, use materials for cutting and patching that are identical to existing materials. If identical materials are not available or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible, with regard to visual effect. Use materials for cutting and patching that will result in equal-or-better performance characteristics.

B. For any change in material, submit a request for substitution under the provisions of Instructions to Proposers.

PART 3 - EXECUTION

3.1 GENERAL

A. Execute cutting, fitting, and patching to complete work, and to:
   01 Fit several parts together which will integrate with other work.
   02 Uncover work to install ill-timed work.
   03 Remove and replace defective and non-conforming work.
   04 Remove samples of installed work for testing.
   05 Provide openings in elements of work for penetrations of mechanical and electrical work.
   06 Fill and refinish existing holes and damaged areas.

3.2 INSPECTION

A. Before cutting, examine the surface to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.

3.3 PREPARATION

A. To prevent failure, provide temporary support of work to be cut.

B. Protect other work during cutting and patching to prevent damage. Provide protection from adverse weather conditions for that part of the project that may be exposed during cutting and patching operations.

C. Take precautions not to cut existing pipe, conduit or duct serving the building, but scheduled to be relocated until provisions have been made to bypass them.

3.4 PERFORMANCE

A. Employ skilled workmen to perform cutting and patching work. Except as otherwise indicated or as approved by the Engineer, proceed with cutting and patching at the earliest feasible time and complete work without delay.

B. Cut the work using methods that are least likely to damage work to be retained or adjoining work. Where possible, review the proposed procedures with the original installer; comply with original installer's recommendations.
   01 In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chipping. Cut through concrete and masonry using a cutting machine such as a carborundum saw or core drill to ensure a neat hole. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces. Temporarily cover the opening when not in use.
   02 Comply with requirements of applicable sections of Division 2 when cutting and patching, excavating and backfilling.
   03 Bypass utility services such as pipe and conduit, before cutting, where such utility services are shown or required to be removed, relocated or abandoned. Cut-off conduit and pipe in walls or partitions to be removed. After bypassing and cutting, cap, valve or plug, and seal tight the remaining portion of pipe and conduit to prevent entrance of moisture or other foreign matter.

C. Patching: Patch with seams which are durable and as visible as possible. Comply with specified tolerances for the work.
   01 Where feasible, inspect and test patched areas to demonstrate integrity of work.
   02 Restore exposed finishes of patched areas, and where necessary, extend finish restoration into retained adjoining work in a manner which will eliminate evidence of patching and refinishing.
   03 Where removal of walls or partitions extend one finished area into another finished area, patch and repair floor and wall surfaces in the new space to provide an even surface of

uniform color and appearance. If necessary to achieve uniform color and appearance, remove the existing floor and wall coverings and replace with new materials.

04 Where a patch occurs in a smooth painted surface, extend final paint coat over the entire unbroken surface containing the patch, after the patched area has received prime and base coat.

05 Patch, repair or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

D. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

E. At penetrations of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated material, full thickness of the construction element.

F. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

3.5 CLEANING

A. Thoroughly clean areas and spaces where work is performed or used as access to work. Completely remove paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finish is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 01 36 16

REMODELING AND ALTERATION PROCEDURES

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Instructions to Proposers for substitutions.

B. Scope of Work:
01 This Section contains general provisions and requirements pertaining to all remodeling, removal and relocation work in the existing building, and becomes a part of each Section and Division performing remodeling, removal and relocation work for this project, with the same force and effect as if written in full therein.
02 Take all necessary precautions to keep trespassers out of the work areas. Secure work areas from entry when work is not in progress.
03 Perform all remodeling, demolition, removal and relocation work in strict accordance with Owner's instructions and applicable Federal, State and local health and safety standards, codes and ordinances. Where conflicts occur, the more restrictive requirement shall govern.

1.2 EXISTING CONDITIONS

A. Obvious existing conditions, installations and obstructions affecting the work shall be taken into consideration as necessary. Work to be done is the same as though they were completely shown or described.

B. Items of existing construction indicated to remain upon completion of the Contract, but which require removal to complete the work, shall be carefully removed and replaced as required. The replaced work shall match its condition at the start of the work, unless otherwise required.

C. Visit the site and inspect all existing conditions, including access to the site, the nature of structures, objects and materials to be encountered, and all other facts concerning or affecting the work. Information on the drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered.

D. Utilities: Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the A in writing two weeks in advance. Provide temporary services during interruptions to existing utilities.

E. Stop work and notify Engineer and owner immediately if any hazardous materials are encountered (especially asbestos or lead based products).

PART 2 - PRODUCTS

2.1 SALVAGED MATERIALS

A. The Owner reserves the right of first refusal on all salvaged items. Remove remaining items from the site as work progresses. Storage or sale of items on site is not permitted. Burning of removed materials on site is not permitted.

B. Store salvaged items in a dry, secure place on site.

C. Salvaged items not required for use in repair of existing work shall remain the property of the Owner.

D. Do not incorporate salvaged or used material in new construction, except with permission of the Engineer.

2.2 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

A. Contract documents do not define products or standards of workmanship present in existing construction. Determine products by inspection and by use of the existing construction. Provide same or similar quality products or types of construction such as the existing structure, where needed to patch or extend existing work.

B. If reasonably matched products are not obtainable, improve appearance by minor relocating some of the existing products, and grouping new ones in a pattern arranged by the Engineer. Do not replace products scheduled for retaining because matching ones are not obtainable, except as directed by a Change Order.

PART 3 - EXECUTION

3.1 PROTECTION OF WORK TO REMAIN

A. Protect existing work from damage by use of barricades, tarpaulins, temporary walls, plywood, planking, masking, or other suitable means and methods as approved by the Engineer.

B. If work to remain in place is damaged, restore to original condition at no additional cost to the Owner.

C. Concealed Conditions: If conditions cause changes in the work from requirements of the Contract Documents, the Contract Sum will be adjusted in accordance with the General Conditions.

3.2 PROCEDURES

A. Refinishing at Removed Work: Cut below the surface of substrate materials and patch over the area of removal with finish materials so removal is not apparent.

B. Remove and replace existing ceilings, cut, patch, or replace existing walls, partitions and floors, as may be necessary for access to valves, piping, conduit and tubing by mechanical and electrical trades, as directed and approved by the Engineer. Work involved shall be performed by the appropriate subcontractor, or by other properly qualified subcontractors.

C. Patch and extend existing work using skilled mechanics who are capable of matching existing quality of workmanship. Quality of patched or extended work shall not be less than that specified for new work.

D. Cutting:
   01 Concrete and Masonry: Saw cut where feasible.
   02 Plaster: Cut back to sound plaster on straight lines, and back-bevel edges of remaining plaster. Trim and prepare existing lath for tie-in of new lath.
   03 Woodwork: Cut back to a joint or panel line. Undamaged removed materials may be reused.
   04 Resilient Tiles: Remove in whole units to natural breaking points or straight joint lines, with no damaged or defective existing tiles remaining where joining new construction.

05 Salvaged Materials: Carefully remove to avoid damage, thoroughly clean and reinstall as indicated, or store as directed.

06 Doors: Remove in such manner as to facilitate filling in of openings or installation of new work, as required by the drawings.

07 Structural Elements: Remove only as shown on the Structural drawings. If not specifically shown, but removal is required, perform such removal or alteration only upon written approval of the Engineer. Do not damage or alter any structural element of the existing building.

E. Patching:

01 Match existing work where possible; if unavailable, use salvage material for patching, and provide totally new material in areas where salvage has been removed. Consult with the Engineer concerning locations for salvaging materials.

02 Repairs or continuations of existing work shall be relatively imperceptible in the finished work when viewed under finished lighting conditions from a distance of 6 feet.

03 Patching, Repairing, and Finishing of Existing Work: Perform in compliance with the applicable requirements of the specification section covering the work to be performed and the requirement of this Section.

F. Erect scaffolding as necessary to gain access to the various parts of the work. Provide structurally sound, rigidly braced and properly constructed scaffolding, shoring and bracing as necessary to positively protect the affected elements and building, and to support the activities or workmen and loads. Design and construction of scaffolds and supports shall be in accordance with applicable safety regulations. Material used shall be adequate to support anticipated loads with a properly calculated margin of safety.

G. Noise Producing Equipment: Minimize use of noise producing equipment. Limit excessive noise to periods of vacancy or provide sound control. Arrange schedules in advance with the Engineer.

3.3 PAINTING AND FINISHING

A. Preparation: Prepare patched areas as required for new work. Wash existing painted surfaces with neutral soap or detergent, thoroughly rinse, and sand when dry.

B. Painting and Finishing: Conform to the applicable provisions of the Painting Section. Prepare bare areas and patches in existing painted surfaces with specified primer and intermediate coats, sanded smooth and flush with adjoining surfaces.

3.5 DISPOSAL OF DEBRIS

A. Remove material, debris and rubbish resulting from work of this Section from the building and site as it accumulates. Keep all areas of work in “broom clean” condition as the work progresses.

B. At completion of renovation and remodeling work in each area, provide final cleaning and return space to a condition suitable for use by the Owner.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Instructions to Proposers for substitutions.

B. Scope:
1. Provide temporary facilities adequate to facilitate the requirements to complete the Work.
2. Temporary facilities shall only be for the duration of construction, unless noted otherwise, and all temporary facilities shall be completely removed at the completion of the project.
3. Any areas disturbed by the placement of temporary facilities shall be repaired / replaced to a finished condition consistent with the surrounding finished area.
4. Maintain operation of existing fire alarm and security systems throughout the progress of the Work

PART 2 - GENERAL

2.1 UTILITIES

A. Owner shall allow usage of 110 / 120 V power existing in the building(s).
1. For voltages higher than 110 / 120V, Contractor shall provide temporary power. Coordinate with the local power provider as required.
2. The Contractor is responsible for overloading or excess use, or any damage resulting from overloading or excess use, or any damage resulting from his use of utilities.

B. Owner shall allow usage of existing water supplies and hose bibbs in / at the building(s).
1. The Contractor is responsible for overloading or excess use, or any damage resulting from overloading or excess use, or any damage resulting from his use of utilities.

C. The Contractor shall provide and maintain all other required sources of temporary utilities as may be necessary.

2.2 SANITARY FACILITIES

A. Use of Owner’s sanitary facilities is strictly prohibited.

B. Furnish temporary sanitary facilities and maintain in compliance with regulations of State Department of Health and other authorities having jurisdiction.

C. Maintain a regular service schedule for the facilities.

2.3 STORAGE FACILITIES

A. Provide and maintain adequate weather tight, lockable, enclosed storage facilities as required to securely house materials and equipment stored on the job site.
1. Coordinate with the Owner and Engineer for acceptable location(s).

B. Replace materials improperly stored and damaged by weathered conditions.

C. Allow for temporary freeze protection as required.

D. Remove storage facilities at completion of work or when materials are stored within the structure in a weather tight condition.

2.4 SIGNS

A. Contractor shall not erect any signs without Owner's authorization.

B. Other signs permitted at the site:
1. Warning signs.
2. Directional signs.
3. Identification signs at field offices.

C. Secure and pay for all sign permits as required by local authorities.

2.5 BARRIERS

A. Provide temporary walls to separate invasive work from on-going school operations within the building. Such types of work areas include:
1. New entry vestibule wall assemblies
2. New cross corridor wall assemblies
3. Other areas where modifications are being made to existing architecture.

B. Temporary walls shall be sufficient to be self-supporting and prevent any access into the Work area by unauthorized people.
1. Provide temporary egress doors as required by the governing authority having jurisdiction (i.e. fire marshal's office).
2. Verify conditions and implement as required.

C. Coordinate with Owner and Engineer for composition, location, and duration of all temporary walls prior to installation.

D. At completion of the work relative to the temporary wall, completely remove it and restore all affected existing finishes to original condition.

2.7 SECURITY

A. Determine if and when watchmen are necessary for protection to the work, and provide such services when necessary.

B. Neither the provision of watchmen nor the failure to provide watchmen shall relieve the Contractor of responsibility in event of injury to persons or damage to property.

2.8 CLEANING

A. Trash Removal:
1. Clear the building and site of trash a minimum of once a week.
2. When rapid accumulation occurs, make more frequent removals.
3. Remove highly combustible trash such as paper and cardboard daily.
4. Dumpsters will not be allowed to overflow and should be emptied on a regular basis.
5. Use of Owner's dumpsters and trash receptacles is strictly prohibited.

B. Disposition of Debris:

1. Remove debris from the site and legally dispose of in strict accordance with local ordinances and regulations.
2. Locations for disposal shall be of the Contractor's choice within the above restriction.
3. No debris or material may be buried or burned at the site.
4. Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.

C. Cleaning:
1. Maintain installed work in a manner that will protect the work.
2. Thoroughly clean the work, including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, dust, lint, discolorations, and other foreign materials.

2.9 TEMPORARY FIRST AID FACILITIES

A. Provide first aid equipment and supplies, with qualified personnel continuously available to render first aid at the site.

B. Provide a sign, posted at the telephone, listing the telephone numbers for emergency medical services: physicians, ambulance services and hospitals.

2.10 TEMPORARY FIRE PROTECTION

A. Provide a fire protection and prevention program for employees and personnel at the site.
1. For work on existing campuses or buildings, coordinate with the Owner and Engineer to develop a program that will facilitate the Owner’s needs (i.e. building evacuation and similar).
2. Where existing building users must evacuate into a work area, coordinate with the local fire marshal having jurisdiction to implement temporary measures required to maintain life safety code compliance.

B. Provide and maintain fire extinguishing equipment ready for instant use at all areas of the project, and at specific areas of critical fire hazard.

C. Equipment:
1. Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
2. Barrels of water with buckets designated for fire control purposes.
3. Water hoses connected to an adequate water pressure and supply system.
4. Construction period use of permanent fire protection system.

D. Enforce Fire-safety Discipline:
1. Store volatile materials in an isolated, protected location.
2. Avoid accumulations of flammable debris and waste in or about the Project.
3. If allowed on site at all, prohibit smoking in the vicinity of hazardous conditions.
4. Closely supervise welding and torch-cutting operations.
5. Supervise locations and operations of portable heating units and fuel.

E. Maintain fire extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.

2.11 CONSTRUCTION AIDS

A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the work; including, but not limited to scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other equipment.

B. When permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.

C. Maintain all equipment in a first-class, safe condition.

2.12 ACCESS ROADS AND PARKING AREAS

A. For work performed on existing, occupied site, coordinate with the Owner and Engineer for location(s) of temporary access and construction parking.
   1. Where Contractor is allowed to use existing access roads, paving, parking, sidewalks and similar, Contractor shall thoroughly photographs or video all such areas to document existing conditions.
   2. Contractor shall repair / replace any area(s) damaged as the result of construction activities.

2.13 FIRE ALARM SYSTEM

A. Throughout the progress of the Work, maintain continuous operation of the existing, operational fire alarm system.

B. Fire alarm devices shall be protected as required; however, such protection shall not render the device inoperable. Provide temporary devices to be removed at the completion of the Work if necessary to maintain a fully functional and operational fire alarm system.

C. If wiring or connections to the fire alarm system components are disrupted as a result of construction activities, immediately make all necessary repairs and / or replacements necessary to restore full operation.

D. The fire alarm system shall be tested at the end of each work day to verify it is fully functional. Coordinate with Owner as required.

END OF SECTION

SECTION 01 74 00

CONSTRUCTION CLEANING

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Administrative and procedural requirements for final cleaning at Substantial Completion.

1.2 RELATED DOCUMENTS

A. Drawings, Specifications and provisions of Construction Contract, including General, Special and Supplementary Conditions and other General Requirements.

1.3 RELATED SECTIONS

A. Other Division 1 Specifications including, but not limited to:
01 Section 01 50 00 – Temporary Facilities
02 Section 01 77 00 – Closeout Procedures
03 Special cleaning requirements for specific construction elements are included in appropriate Sections of Divisions 2 through 16

1.4 QUALITY ASSURANCE

A. Multiple Prime Contracts: Each prime contractor is responsible for final cleaning its own work. Project Manager is responsible for coordinating final cleaning of an area or piece of equipment where more than one prime contractor is involved.

1.5 SITE CONDITIONS

A. Environmental Requirements: Conduct cleaning and waste disposal operations in compliance with applicable laws, including, without limitation, Environmental Laws.
01 Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
02 Burning or burying of debris, rubbish, or other waste material on premises is not permitted.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Employ experienced workers or a professional cleaning service for final cleaning. Clean each surface or unit of Work to condition expected from commercial building cleaning and maintenance program. Comply with manufacturer’s instructions.

B. Complete following cleaning operations applicable to project before requesting inspection for certification of Substantial Completion for entire Project or portion of Project.

01 Clean site, yard and grounds in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, litter, and foreign substances.

02 Sweep paved areas broom clean. Utilize magnetic sweeps on parking lots to remove all metallic debris capable of causing vehicle tire damage.

03 Remove petrochemical spills, stains, and other foreign deposits.

04 Remove tools, construction equipment, machinery, and surplus material from Site.

05 Clean exposed exterior and interior hard-surfaced finishes including doors, hardware and casework, to dirt-free condition, free of stains, films and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to original condition.

06 Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

07 Broom clean concrete floors in unoccupied spaces.

08 All carpeting in work areas shall be cleaned by a professional carpet cleaning company acceptable to the owner. Carpet shall be thoroughly vacuumed prior to the use of hot water extraction.

09 Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

10 Remove labels that are not permanent labels.

11 Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

a. Do not paint over “UL” and similar labels, including mechanical and electrical name plates.

12 Wipe surfaces of mechanical and electrical equipment, elevator equipment and similar equipment. Remove excess lubrication, paint and mortar droppings and other foreign substances.

13 Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.

14 Replace disposable air filters and clean permanent air filters; clean exposed surfaces of diffusers, registers, and grilles.

15 Clean ducts, blowers and coils if units were operated without filters during construction.

16 Clean any construction related soiled food-service equipment to sanitary condition, ready and acceptable for intended use.

17 Clean light fixtures, lamps, globes and reflectors to function with full efficiency. Wipe handprints and paint clean in the ceiling grids following testing and balancing of HVAC system.

18 Thoroughly clean the work, including the removal of smudges, marks, stains, fingerprints, soil, dirty, paint spots, dust, lint, discolorations and other foreign materials.

19 Disposition of Debris: Remove debris from site and make legal disposition. Locations for disposal shall be of the Contractor’s choice within the above restriction. No debris or material may be buried or burned at the site. Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.

20 Trash Removal: Clear the building and site of trash at least once a week. When rapid accumulation occurs, make more frequent removals. Remove highly combustible trash such as paper, cardboard, daily.

21 Leave Site and Work clean and ready for occupancy.

C. Remove temporary protection and facilities installed during construction to protect previously completed installations during remainder of construction period.

D. Comply with applicable laws governing cleaning operations. Remove waste materials from site

and dispose of lawfully.

END OF SECTION

SECTION 01 77 00

CLOSE-OUT PROCEDURES

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Certain procedures have been developed and are required to fulfill all provisions of the Owner-Contractor Agreement with respect to contract Final Completion and Contract Close-Out for the Work / project to be 100% complete.

B. Refer to Section 00 61 27 – General Conditions and Section 00 73 00 – Supplementary Conditions for additional information and requirements.

PART 2 – SUBSTANTIAL COMPLETION

2.1 GENERAL

A. Projects that involve phased sequential construction of major definable areas or projects that involve separate work on multiple campuses shall have Certificates of Substantial Completion issued for each phase or campus, as applicable and agreed upon by the Owner and Contractor. All conditions for Substantial Completion, including liquidated damages, shall apply for each date of Substantial Completion for each phase or campus, as applicable.

B. Individual Substantial Completion Dates for each phase or campus shall be determined and agreed upon by the Owner, Engineer and Contractor. Where an Alternative Proposal dictating a required, guaranteed completion date (dates) is included in the Proposal Form and accepted by the Owner, the date(s) stated therein shall establish the Substantial Completion Dates to be incorporated into the Agreement.

C. The following items are a partial list of requirements, as applicable to the Project, which must be completed prior to establishment of a Substantial Completion date.

01 All work as identified in each section of the Specifications must be 100% complete.
02 All fire alarm system components must be completed, demonstrated to the Owner and approved by the governing authority.
03 Local fire marshal approval must be delivered to the Owner.
04 Health Department approval and certificate, where applicable, must be delivered to Owner.
05 All HVAC air and water balancing must be complete.
06 All energy management systems, security and surveillance systems and low voltage systems and controls must be complete, fully operational and demonstrated to the Owner.
07 All final lockset cores must be installed and all final Owner directed keying completed.
08 All room plaques and exterior signage must be complete.
09 All Owner demonstrations must be completed.
10 A final Certificate of Occupancy must be signed by the governing authority and delivered to the Owner.
11 Operation and Maintenance Manuals. Manuals must be submitted prior to Owner training and orientations of equipment and systems.
12 Scanned Record Drawings. Provide a full size, scanned copy of the record drawings maintained at the site in PDF format.
13 All exterior clean-up and landscaping must be complete, including required stand of grass mowed and edged.

D. Final Cleaning:
   01 The work area shall be thoroughly cleaned inside and outside. Cleaning includes removal of smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces.
   02 Remove all temporary facilities.

E. In order for the project, a major portion thereof, a project phase or project campus to be considered Substantially Complete, the following conditions must be met:
   01 All inspections by governmental authorities having jurisdiction over the project must have been finalized; any remedial work required by them must have been completed; and Certificates of Occupancy and similar governmental approval forms must have been issued and copies delivered to the Owner and Engineer.
   02 All work, interior and exterior, shall have been completed and cleaned except minor items (Punch List) which, if completed after occupancy, will not, in the Owner's opinion, cause any interference to the Owner's use of the building or any portion thereof.
   03 All items stipulated in 2.1-C above.

F. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner, at his sole discretion, may make (partial) payment of retainage applying to such Work or designated portion thereof which is 100% complete and accepted by the Owner. Such payment, if made at all, shall be adjusted in the Owner's favor for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

G. The date of Substantial Completion shall represent day one (1) of the thirty (30) day period to complete all work and correct all deficiencies contained in the Punch List and the sixty (60) day period allowed for complete Contract Close-Out as described below.

2.2 PUNCH LIST

A. A comprehensive list prepared by the Contractor prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of work to be completed, if any. This list is intended to represent a limited number of items needing attention.

B. Punch lists shall be furnished to the Engineer in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
   01 Room number or other suitable location identifier
   02 Description of the work
   03 Sub-contractor / trade sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
   04 Sub-contractor / trade sign-off date
   05 General contractor sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
   06 General contractor / trade sign-off date
   07 A/E consultant sign-off
   08 A/E consultant sign-off date
   09 If requested by the Owner, provide two additional similar columns for their sign-off.
   10 In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes / items" that shall be applied to the entire project; and it shall be the responsibility of the contractor / sub-contractor to thoroughly examine the entire project and make corrective measures at all applicable locations.

C. Should the Engineer determine that the Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for re-inspection and

revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.

D. A significantly large number of items to be completed or corrected will preclude the Engineer from issuing a Certificate of Substantial Completion. The Owner and Engineer will be the sole judge of what constitutes a significantly large number of items. It is anticipated that the detailed list of items of work to be completed or corrected at the Date of Substantial Completion will be no longer than five (5) typed pages.

E. The Contractor's superintendent shall participate in the preparation of the Contractor's punch list that is submitted to the Engineer and Owner for supplementation. Upon receipt, the Engineer and Consultants shall perform a spot review to determine the adequacy and completeness of the Contractor's punch list.

F. Upon receipt of an acceptable Contractor's punch list, the Contractor's Superintendent shall accompany the Engineer, his Consultants and the Owner (at his discretion) during their observation and the preparation of their supplements to the Contractor's punch list.
   01 The Superintendent shall record or otherwise take note of all supplementary items.
   02 The Engineer will endeavor to furnish to the Contractor typed, hand written or recorded supplements to the punch list in a prompt manner; however, any delay in the Contractor's receiving said supplements from the Engineer will not be cause for a claim for additional cost or extension of time as the Contractor's Superintendent shall have been in attendance during the inspections of the Engineer and his Consultants and will have been expected to take his own notes.

2.3 OPERATIONS AND MAINTENANCE MANUALS

A. Operation and Maintenance (O&M) Manuals shall be delivered prior to, and are a condition of, Substantial Completion to allow the Owner the benefit of having the manuals for on-site training and start-up procedures provided by the Contractor.

B. Refer to Section 01 78 23 – Operating and Maintenance Manuals.

2.4 SUBSTANTIAL COMPLETION SCHEDULE

A. After the date of Substantial Completion of the project as evidenced by the Certificate of Substantial Completion, AIA document G704-2000, the Contractor will be allowed a period of thirty (30) days, unless extended by mutual agreement or provision of the Contract, within which to complete all work and correct all deficiencies contained in the Punch List attached to the Certificate of Substantial Completion.

B. It is incumbent upon the Contractor to request Substantial Completion only when there is assurance that all work included on the Punch List shall be completed within the thirty (30) day time frame.
   01 In the event the Owner must take occupancy of the project prior to Contractor's completion of the punch list, the Contractor shall make all adjustments necessary to schedule the work to allow full and normal operation of the project by the Owner.
   02 Where this requires work outside of normal business hours, the work shall be provided at no additional costs to the Owner.

C. Upon Contractor's and sub-contractor's verification that all punch list items have been 100% completed, the Contractor shall notify the Engineer; and the Engineer and consultant(s) shall conduct an on-site observation to verify that all items are 100% complete.
   01 On-site verifications for partial completions, if any, shall be conducted by the Engineer at the Engineer's sole discretion.

02 If any items shown to be complete by the Contractor are found not to be complete by the Engineer, the observation shall be stopped, with such notification to the Contractor.

03 Contractor's requested punch list observations by the Engineer shall be limited to a maximum of two (2) per punch list.

PART 3 – CONTRACT CLOSE-OUT

3.1 GENERAL

A. Upon issuance of the (final) Certificate of Substantial Completion, and per the Owner-Contractor Agreement, the Contractor will be allowed a period of sixty (60) days within which to complete all Contract Close-Out requirements, unless extended by mutual agreement or provision of the Contract.

B. In addition to all work and requirements described for Substantial Completion, in order to achieve Contract Close-Out, the Contractor shall submit the following Close-Out documents:

01 Tab 1: Copy of executed Certificate of Substantial Completion. And copy of all final punch lists showing final approval / acceptance of each item by sub-contractor, Contractor and Engineer / Engineer's Consultant.

02 Tab 2: Copy of all building permits.

03 Tab 3: Copy of all Certificates of Occupancy.

04 Tab 4: Final list of sub-contractors - alphabetical listing. List shall contain company name, address, phone number, contact person, relative specification section number, and description of work provided.

05 Tab 4: Final list of sub-contractors - specification section number listing in order. List shall contain company name, address, phone number, contact person, and description of work provided.

06 Tab 5: AIA G707-1994 Consent of Surety to Final Payment. Must be notarized.

07 Tab 5: AIA G706-1994 Contractor's Affidavit of Payment of Debts and Claims. Must be notarized.

08 Tab 6: AIA G706A-1994 Contractor's Affidavit of Release of Liens. Must be notarized.

09 Tab 7: Subcontractors' Affidavit of Release of Liens. Must be notarized.

10 Tab 7: Material / Equipment Suppliers Affidavit of Release of Liens. Must be notarized.

11 Tab 8: General Contractor's written warranty / guarantee.

12 Tab 9: Subcontractors' written warranties / guarantees.

13 Tab 10: Manufacturer's written warranties to the Owner for each product / assembly / system warranty required in individual specification sections. Organize each manufacturer's written warranty in numerical order corresponding to specification sections and identify each warranty with the specification section.

14 Tab 11: If asbestos abatement was performed, provide a copy of all applicable governmental forms, final test reports and certifications.

15 Tab 12: Contractor's Affidavit of Hazardous Material Must be notarized.

16 Tab 13: Subcontractors and suppliers Affidavits stating that no asbestos products have been installed in this project. Must be notarized.

17 Tab 14: Owner demonstration and / or training verification. Provide sign-in sheet for all demonstrations and training sessions conducted for the Owner.

18 Tab 15: Extra stock verifications of product delivery to Owner.

19 Record Drawings. Refer to section 3.4 below. Not bound in close-out manual(s).

20 Owner's set of record submittals. Not bound in close-out manual(s).

C. Final / 100% release of retainage will not be authorized by the Engineer until the Contractor completes all of the requirements for Contract Close-out; and until all expenses incurred and to be paid by the Contractor have been paid in full.

D. It is the Contractor's sole responsibility <u>prior to submission</u> to verify that Close-Out documents proposed to be furnished for review and acceptance are 100% complete and accurate.

01 If during review the Engineer or Engineer determines the Close-Out documents are incomplete and / or inaccurate, the review shall cease and the Contractor shall be so notified to retrieve the Close-Out Documents, make corrections and resubmit.

02 It is not the A/E Consultants' responsibility to return a list of missing and / or incorrect items.

E. It is desirable and beneficial to submit all Close-Out documents as a single submission; Close-Out documents may be submitted separately in four (4) deliverables as follows:

01 Close-Out Manual

02 Operations and Maintenance Manuals (required prior to Substantial Completion)

03 Record Drawings

04 Owner's Record Copy of Submittals

3.2 CLOSE-OUT MANUAL(S) FORMAT

A. All close-out documents shall be submitted in three ring binders with detailed table of contents, index tabs corresponding to the table of contents.

01 Documents shall be separated by tabs as indicated in section 3.1 above.

02 The close-out documents must be neatly organized and easily useable, as determined by the Engineer and Owner.

03 Each binder shall include an insert cover with the following information

a. Project name

b. Binder Title: Close-Out Manual

c. Engineer's name

d. Engineer's project number

e. Contractor's name, address and phone number

04 Each binder shall include an insert in the binder spine with the following information

a. Project name

b. Binder Title: Close-Out Manual

05 Inside cover page containing the following:

a. Project name

b. Contractor's address and contact information

c. Contractor's project manager and superintendent name and contact information.

d. Engineer's project manager name and contact information.

e. Each consultant's project manager name and contact information.

06 Table of Contents and corresponding section tabs shall be in the same order as described in section 3.1-B above.

07 Number of binders required: two.

08 Number of CD's required: three.

3.3 WARRANTIES

A. All guarantees and warranties required by the Contract Documents shall establish the date of Substantial Completion as day one (1) of the required warranty period; regardless of how long the product, assembly or work has been installed or in operation prior to Substantial Completion.

01 Coordinate with subcontractors and material suppliers to account for provision in their original proposal / bid amount, if necessary.

B. Contractor's One-Year Warranty: The Contract requires the General Contractor to warrant ALL materials and work provided / furnished for a period of one (1) year following the date of Substantial Completion.

01 The one year general warranty shall include all labor, material and delivery costs required to correct defective material or installation during the Warranty period.

C. Sub-Contractor's One-Year Warranty: each sub-contractor that performed work on the project shall be required to submit a one-year warranty similar to the above Contractor's One-Year Warranty for their specific work provided.

D. Extended Warranties: In addition to the General Contractor's and subcontractors' one-year warranty, other required guarantees shall be included in the Close-Out Binder in original issue form. All extended warranties shall begin on the Substantial Completion date; and shall include all labor, material and delivery costs required to correct defective material or installation. Guarantees include but are not limited to:

01 Roofing – Certification from the Roofing Manufacturer that the work performed as part of this Contract is accepted and incorporated into the existing roof warranty. Provide separate certification for each campus.
02 Glazing - 2 Years
03 Dampproofing and Waterproofing - 2 Years
04 Sealants - 2 Years
05 Plastic-Faced Wood Doors - life of the doors
06 Painting and Staining -2 Years
07 Carpeting -10 Years
08 Division 22 - Plumbing Systems - as specified
09 Division 23 - Mechanical Systems - as specified
10 Division 26 - Electrical Systems - as specified

3.4 RECORD DRAWINGS:

A. Upon Substantial Completion, the Contractor shall be furnished, at no charge, a complete set of electronic files in AutoCAD release 2010 or later, or Revit if applicable, of all drawings included in the Contract Documents. The title blocks shall be stripped of all logos, disclaimers and licensed seals of the Engineer and Consultants.

01 Applicable CTB or plot files shall be furnished by the Engineer and each Consultant.
02 Throughout the construction phase, Engineer's and Consultant's supplemental drawings / sketches provided to the Contractor in AutoCAD or Revit format shall already be incorporated in the electronic files provided to the Contractor.

B. Upon request, the Engineer and / or Consultants shall assist the Contractor with understanding the structure and composition of the electronic files to facilitate the generation of the Record Drawings.

C. The Contractor shall modify the title block on each / every sheet to include only the project name, project address, school district, consultants' name and address, date, and clearly identify the set as "Record Drawings".

D. All electronic Record Drawing work shall be performed in a professional manner using AutoCAD or Revit, as applicable, and shall maintain the format / structure / composition of the original Contract Document drawings.

E. All modifications, additions, deletions and revisions made to the project during the construction phase shall be reflected on the Record Drawings; and shall include, but not necessarily limited to:

01 All as-built dimensions (different than original dimensions)
02 All as-built locations and conditions relative to underground plumbing, sanitary and storm piping installations, natural gas piping and electrical conduits; shown accurately to within twelve inches (12"). Notes shall indicate approximate depth of all underground piping and utilities.
03 All as-built conditions relative to ductwork installations; shown accurately to within six inches (6").
04 All as-built conditions relative to HVAC water piping installations; shown accurately to within six inches (6").

05 All as-built conditions relative to underground electrical conduit installations; shown accurately to within six inches (6").
06 Record drawings shall include a copy of fire sprinkler layout of piping and equipment.
07 All approved CPR's resulting in a physical change in the Work.
08 All RFI's resulting in a physical change in the Work.
09 All AEA's resulting in a physical change in the Work.
10 All Minor Changes resulting in a physical change in the Work.
11 All Construction Change Directives resulting in a physical change in the Work.
12 Update the list of drawings as necessary to reflect added and deleted sheets.

F. All modifications shall be represented by actually deleting the original work and accurately depicting the revised as-built modifications / configurations. "X-ing out" deleted work shall not be accepted

G. Provide the Record Drawings with all revision clouds and other change identifiers removed.

H. Upon completion of all revisions to the Record Drawings, including the Engineer's acceptance, the Record Drawings shall be copied to a CD ROM disc maintaining the exact folder / file structure originally furnished to the Contractor. Submit to the Engineer for review before proceeding with deliverables.

I. Deliverables: Upon review and acceptance of the documentation, including format, the Engineer shall direct the Contractor to proceed with delivery of the following:
01 Three (3) CD's containing the entire set of Record Drawings in PDF format. Each sheet shall be a separate PDF file. The CD's shall be organized to duplicate the order of drawings as they were issued for bidding and construction, with record drawing modifications.
02 Three (3) CD's containing the entire set of Record Drawings in AutoCAD or Revit format as applicable. Each sheet shall be a separate AutoCAD or Revit file. The CD's shall be organized to duplicate the order of drawings as they were issued for bidding and construction, with record drawing modifications.
03 One (1) full-size, complete set of black-line copies on minimum 20 lb. bond paper. The set shall be plotted using the Contractor's CD to assure the files plot correctly. The set shall be screw-post bound.

3.5 RECORD SUBMITTALS

A. The Contractor shall maintain and submit a separate set of final submittals to be delivered to the Owner as a condition of Contract Close-Out.

B. Include only the final version of each submittal, including all submittal review comment sheets from the Engineer and Consultant. Versions of submittals that were rejected or required to be revised and resubmitted are not required.

C. Deliverables:
01 Deliver one (1) hard copy set of Record Submittals in file boxes, organized in order by specification division, with tabs included for each section of specifications.
02 Deliver three (3) copies of all Record Submittals in PDF electronic format on three (3) CD's.

3.6 TERMINAL INSPECTION

A. Approximately one (1) month prior to expiration of the one-year guarantee period, the Contractor shall notify the Engineer and Owner to schedule an inspection of the work in the company of the Engineer and the Owner. The Engineer and the Owner shall be given not less than ten (10) days' notice prior to the anticipated date of terminal inspection.

B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work, and shall execute such work without delay until completed to the satisfaction of the Engineer and the Owner, even though the date of completion of the corrective work may extend beyond the expiration date of the guarantee period.

C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner, nor the replacement of parts necessitated by normal wear in use.

END OF SECTION

SECTION 22 01 00

PLUMBING OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.

B. Instruct Owner's personnel in operation and maintenance of equipment and systems.

C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
1. Table of Contents for each element.
2. Contractor information.
3. All submittals, coordination drawings and product data, reviewed by the Architect / Engineer; bearing the Architect / Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
4. All parts and maintenance manuals for items of equipment.
5. Warranties (without starting dates)
6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
7. Operating and maintenance procedures.
8. Form of Owner's Training Program Syllabus (including times and dates).
9. Control operations/equipment wiring diagrams.
10. Other required operating and maintenance information that are complete.

B. Copy will be returned to the Contractor within 15 days with comments for corrections.

C. Submit three (3) completed manuals in final form to the Architect / Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.

D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.

E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.

F. Two (2) complete Manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.1 BINDERS

A. Commercial quality black three-ring binders with clear overlay plastic covers.

B. Minimum ring size: 1 inch; Maximum ring size: 3 inches.

C. When multiple binders are used, correlate the data into related groupings.

D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

A. Form for Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
2. Format:
a. Size: 8-1/2 inch x 11 inch.
b. Text: Manufacturer's printed data or neatly typewritten.
3. Drawings:
a. Provide reinforced punched binder tab and bind in text.
b. Fold larger drawings to size of text pages.
4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
a. Title of Project
b. Identity of separate structures as applicable.
c. Identity of general subject matter covered in the manual.
6. Binder as specified.

B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
a. Contractor, name of responsible principal, address and telephone number.
b. A list of each product required to be included, indexed to content of the volume.
c. List with each product, name, address and telephone number of:
1) Subcontractor or installer.
2) Maintenance contractor as appropriate.
3) Identify area of responsibility of each.
4) Local source of supply for parts and replacement.
d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
a. Include those sheets pertinent to the specific product.
b. Annotate each sheet to:
1) Identify specific product or part installed.
2) Identify data applicable to installation.
3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
3. Drawings:
a. Supplement product data with drawings as necessary to illustrate:
1) Relations of component parts of equipment and systems.
2) Control and flow diagrams.
b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
c. Do not use Project Record Documents as maintenance drawings.
4. Written text, as required to supplement product data for the particular installation:
a. Organize in consistent format under separate headings for different procedures.
b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued.
a. Provide information sheet for Owner's personnel, giving:
1) Proper procedures in event of failure.

2) Instances that might affect validity of warranties or bonds.

6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems.

1. Content for each unit of equipment and system as appropriate:
   a. Description of unit and component parts.
      1) Function, normal operating characteristics, and limiting conditions.
      2) Performance curves, engineering data and tests.
      3) Complete nomenclature and commercial number of replaceable parts.
   b. Operating procedures:
      1) Start up, break-in, routine and normal operating instructions.
      2) Regulation, control, stopping, shut down and emergency instructions.
      3) Summer and winter operating instructions.
      4) Special operating instructions.
   c. Maintenance procedures:
      1) Routine operations
      2) Guide to trouble-shooting.
      3) Disassembly, repair and reassembly.
      4) Alignment, adjusting and checking.
      5) Routine service based on operating hours.
   d. Servicing and lubrication schedule. List of lubricants required.
   e. Manufacturer's printed operating and maintenance instructions.
   f. Description of sequence of operation by control manufacturer.
   g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      1) Predicted life of part subject to wear.
      2) Items recommended to be stocked as spare parts.
   h. As installed control diagrams by controls manufacturer.
   i. Complete equipment internal wiring diagrams.
   j. Each Contractor's coordination drawings.
   k. As installed color coded piping diagrams.
   l. Charts of valve tag number, with location and function of each valve.
   m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
   n. Other data as required under pertinent sections of the specifications.
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 22.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.
10. Provide gas piping pressure test reports.

END OF SECTION

SECTION 22 05 00

PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 22 Plumbing.

B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Plumbing work shall comply with applicable inspection services:
1. Underwriters Laboratories
2. National Fire Protection Association
3. State Health Department
4. Local Municipal Building Inspection Department
5. Texas Department of Licensing & Regulations (TDLR)
6. Texas Accessibility Standards (TAS Based on ADA)

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
2. Able to furnish evidence of having contracted for and installed not less than three systems of comparable size and type that has served their Owners satisfactorily for not less than three years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain three sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (two sets are for the Owner's use and one set is for the Architect / Engineer's records). Delivery of these as-built prints and reproducibles is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex mylar film positives) and AutoCad 2012 / Revit CAD files on disk (CD Rom).

C. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
2. Remove Engineer’s seal, name, address and logo from drawings.
3. Mark documents RECORD DRAWINGS.
4. Clearly indicate: DOCUMENT PRODUCED BY
5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
6. Indicate exact location of all underground plumbing and flow line elevation.
7. Indicate exact location of all underground plumbing piping and elevation.
8. Indicate exact location of all underground electrical raceways and elevations.
9. Correct schedules to reflect (actual) equipment furnished and manufacturer.
10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

A. Guarantee work for one year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 22 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit three copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

A. Submit three copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each subcontractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.

B. Concrete work as specified in Division 3.

C. Concrete pads:
1. 4 inch high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
2. Chamfer strips at edges and corner of forms.
3. Smooth steel trowel finish.
4. Doweled to existing slab

D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

A. Provide a handle for each loose keyed operated valve and hose bibb on the project.

B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner two suitable tools for use with each type of fastener used.

C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
1. Provide the training during the Owner's regular working day.
2. The Instructors shall each be experienced in their phase of operation and maintenance of

building plumbing systems and with the project.

B. Time to be allocated for instructions.
   1. Minimum of 8 hours dedicated instructor time.
   2. 4 hours on each of 2 days.

C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
   1. One copy to the Owner.
   2. One copy to the Architect / Engineer.

D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.

E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
   1. Designation approved by Architect / Engineer.
   2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
   3. Submit schedule of equipment to be included and designations.

B. Provide nameplates with ½ inch high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
   1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
   2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute

existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

SECTION 22 05 10

PLUMBING CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
   1. Field conditions.
   2. Condition of installation.
   3. Quality of workmanship.
   4. Start-up of equipment.
   5. Testing, adjusting, and balancing of equipment.

B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

SECTION 22 05 12

PLUMBING SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by Division 1.

B. The term submittal, as used herein, refers to all:
1. Shop Drawings
2. Coordination Drawings
3. Product data

C. Submittals shall be prepared and produced for:
1. Distribution as specified
2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.

C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.

D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: ¼ inch = 1 foot - 0 inch.

B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.

C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
1. Actual mechanical equipment and components to be furnished
2. Service clearance
3. Relationship to other equipment and components
4. Roof drains and leader piping
5. Fire protection piping and equipment

D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

E. Related requirements:
1. Ductwork shop drawings

2. Coordination drawing specified in Division 26

F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.

B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.

C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: “Comply, ”Do Not Comply”, or “Not Applicable”. Explain all “Do Not Comply” statements.

F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
1. Field measurements
2. Field construction criteria
3. Manufacturer's catalog numbers
4. Conformance with requirements of Contract Documents

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect/Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect/Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect/engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
1. Proper sizes and capacities
2. That the item will fit in the available space in a manner that will allow proper service
3. Construction methods, materials and finishes

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.

B. Number of submittals required:
1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.

C. Accompany submittals with transmittal letter, in duplicate, containing:
1. Date
2. Project title and number
3. Contractor's name and address
4. The number of each Shop Drawing, Project Datum and Sample submitted
5. Other pertinent data

D. Submittals shall include:
1. The date of submission
2. The project title and number
3. Contract Identification
4. The names of:
    a. Contractor
    b. Subcontractor
    c. Supplier
    d. Manufacturer
5. Identification of the product
6. Field dimensions, clearly identified as such
7. Relation to adjacent or critical features of the work or materials
8. Applicable standards, such as ASTM or federal specifications numbers
9. Identification of deviations from contract documents
10. Suitable blank space for General Contractor and Architect/Engineer stamps
11. Contractor's signed and dated Stamp of Approval

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

A. Every submittal document shall bear the following information as used in the project manual:
   1. The related specification section number
   2. The exact specification section title

B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

A. Make re-submittals under procedures specified for initial submittals.
   1. Indicate that the document or sample is a re-submittal
   2. Identify changes made since previous submittals

B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.

D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT/ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

A. The Architect/Engineer will:
   1. Review identified submittals with reasonable promptness and in accordance with schedule
   2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
   3. Return submittals to Contractor for distribution or for resubmission

B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect/Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
   1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
   2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

A. Do not make requests for substitution employing the procedures of this Section.

B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 22 05 13

ELECTRICAL PROVISIONS OF PLUMBING WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electrical provisions to be provided as plumbing work are indicated in other Division 22 sections, on drawings, and as specified.

B. Types of work, normally recognized as electrical but provided as plumbing, specified or partially specified in this Section, include but are not necessarily limited to the following:
1. Motors for plumbing equipment.
2. Starters for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
3. Wiring from motors to disconnect switches or junction boxes for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
4. Wiring of field-mounted float control switches, flow control switches, and similar plumbing-electrical devices provided for plumbing systems, to equipment control panels.
5. Pipe heat tracing.

C. Refer to Division 22 sections for specific individual plumbing equipment electrical requirements.

F. Refer to Division 26 sections for motor starters and controls not furnished integrally with plumbing equipment.

G. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of plumbing equipment.

1.2 RELATED WORK

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

A. Wherever possible, match elements of electrical provisions of plumbing work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.

B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.1 MOTORS

A. Provide motors for plumbing equipment manufactured by one of the following:

1. Baldor Electric Company.
2. Century Electric Div., Inc.
3. General Electric Co.
4. Louis Allis Div.; Litton Industrial Products, Inc.
5. Lincoln Electric
6. Marathon Electric Mfg. Corp.
7. Reliance Electric Co.
8. Westinghouse Electric Corp.

B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of plumbing equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of plumbing work:

C. Temperature Rating. Rated for 40 deg. C environment with maximum 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).

D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.

E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for ¾ hp and larger, and provide capacitor-start single-phase motors for ½ hp and smaller, except 1/6 hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 22 requirements. For 2-speed motors provide two separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.

F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.

G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
1. Frames. NEMA #56.
2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 22 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 22 for other enclosure requirements.
4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: Provide "Quiet" rating on motors.

H. All motors shall be premium efficiency.

2.2 EQUIPMENT FABRICATION

A. Fabricate plumbing equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in plumbing work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Verify voltage with Electrical Plans.

END OF SECTION

SECTION 22 05 14

PLUMBING ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Inspect and service existing equipment and materials that are to remain or to be reused.

B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.

C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Material used to upgrade and repair existing equipment shall conform to that specified.

B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.

C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.

B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.

C. Verify field measurements, above and underground piping connections and flows.

D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.

E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Use pipe inspection camera system to field verify existing sanitary / grease waste connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.2 APPLICATION

A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems prior to installation and reuse.

B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.

C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.

D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.

E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner’s review and salvaged by Contractor.

F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner’s use.

G. Clean and repair existing materials and equipment that remain or are to be reused.

H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

A. Coordinate utility service outages with Utility Company, Architect and Owner.

B. Provide additional or temporary valves, piping and connections to maintain existing systems in service during construction.

C. Existing Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.

D. Remove and replace existing Plumbing systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.

E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.

F. Remove and replace existing piping coincident with the construction.

G. Remove or relocate existing piping or housekeeping pads as occasioned by new or remodeled construction. Cap unused domestic piping beyond the new finish line.

H. Relocate all domestic piping as required to accommodate new work requiring precedence.

I. Remove concrete housekeeping pad where materials or equipment have been removed.

J. Remove all known utilities that do not provide service to the buildings that remain.

K. Remove existing plumbing vent penetrations through roof not to be reused.

3.4 DEMOLITION AND EXTENSION OF EXISTING PLUMBING WORK

A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.

D. Plumbing, piping and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.

E. Repair adjacent construction and finishes damaged during demolition and extension work.

F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.

G. Extend existing installations using materials and methods compatible with existing plumbing installations, or as specified.

H. Existing plumbing piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.

B. Provide devices and methods to protect other portions of work from damage.

C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description “existing”. Provide new nameplates for all existing plumbing equipment in renovated areas as specified in Section 22 05 00 Plumbing General Provisions.

END OF SECTION

SECTION 22 05 15

PLUMBING EARTHWORK

PART 1 - GENERAL

A. Excavate and backfill for pipe trenches for underground piping, and excavate for structures installed as part of plumbing work.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavate trenches for underground piping to the required depth to ensure 2 foot minimum coverage over piping.

B. Cut the bottom of the trench or excavation to uniform grade.

C. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp well.

D. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.

3.2 BACKFILL

A. Backfill shall not be placed until the work has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.

B. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in 8 inch maximum layers, loose measure. Compact to not less than 95 percent of maximum soil density as determined by ASTM D-698 Standard Proctor.

C. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.

D. Provide 6 inch stabilized sand bed with 4 inch stabilized sand cover around each pipe.

3.3 DISPOSAL OF EXCESS MATERIAL

A. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by the Owner/Architect.

END OF SECTION

SECTION 22 05 16

EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES OUTSIDE BUILDING SLAB

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 apply to this section.

B. Refer to Instructions to Bidders for substitution of materials and products.

C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

A. Coordinating all excavating and backfilling for the underground storm sewer, sanitary sewer, water distribution lines, and all related appurtenances.

B. The extent of lines, excavation, and backfill shall be in conformance with the locations, lines, elevations and grades shown on the drawings prepared by the MEP Engineer.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Earthwork

B. Water Distribution

C. Sanitary Sewer

D. Plumbing

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM) Use current edition.
   1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)
   2. ASTM D1556, Standard Test method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
   3. ASTM D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
   4. ASTM D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

B. City Standards

C. Local Governing Agencies

D. Texas Health and Safety Code, Chapter 161, Subchapter Q, as amended by House Bill No. 1927.

1.5 WARRANTY

A. Provide written warranty against defects in the material and workmanship for the work of this Section for a period of one year from the Date of Substantial Completion of the Project. Refer to Division 1 for Warranty form.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cement-Stabilized Sand: Clean, local sand mixed with not less than 1-1/2 sacks of Portland cement per ton; mix in a mill-type mixer.

B. Sand: Clean, local sand

C. Earth Backfill: Clean local material consistent with the surrounding earth material and free of large clods, roots, rocks or other debris.

PART 3 – EXECUTION

3.1 EXCAVATION

A. General:
1. All utility trenches shall be constructed in conformance with OSHA trench safety standards.
2. Sheeting and shoring shall be accomplished to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period for trenches five feet in depth or deeper. Where approved, trench sides may be laid back in lieu of shoring to meet OSHA safety standards.
3. Utilities shall not be constructed or laid in a trench in the presence of water. All water shall be sufficiently removed from the trench prior to the line placing operation to ensure a dry, firm bed on which to place the utility line.

B. Sanitary Sewer Trenches:
1. For pipe sizes less than 42 inches in diameter, the minimum trench width shall be outside diameter of pipe plus 18 inches.
2. Trenches shall be excavated to a depth of at least 6 inches below the barrel of pipe.

C. Appurtenances:
1. Any overdepth excavation below appurtenances shall be refilled with cement-stabilized sand.

3.2 PIPE BEDDING AND BACKFILL

A. Sanitary Sewer Trenches:
1. The cement-stabilized sand bedding shall not extend from a point 6 inches below the bottom of the pipe to the level of the spring line. This material shall not be used after it loses its moisture content.
2. The cement-stabilized sand shall be thoroughly rodded after being placed in the trench.
3. Bedding, sewer pipe, and initial backfill over the pipe must be placed in a single day for any given portion of pipe. Initial backfill shall be placed to one foot above the top of pipe for earth backfill and 6 inches over the top of pipe for cement-stabilized sand backfill.
4. Remainder of trench backfill shall be placed the next day or later in 8 inch lifts.
5. Backfill shall be placed in uniform layers not to exceed 8 inches loose depth, and compacted to a minimum of 95 percent of Standard Maximum Density (ASTM D698).
6. Backfill, under pavement and to one foot from outer edge, shall b e cement-stabilized sand, up to one foot below subgrade elevation. Remainder of backfill to subgrade to be as specified in paragraph 5 above and stabilized where required.

B. Natural Gas Trenches:
1. Natural gas lines shall not be installed under slabs on grade unless pipes are sleeved and vented as per Section 22 63 11.

2. Natural gas lines shall not be installed in trenches with other utilities.

C. Utility Locators:

1. Provide metallic locator over all underground utilities, including irrigation piping, plumbing, control wiring, conduit, data, etc. Locator tape shall be a maximum of 12 inches below grade and centered over the utility(s).

END OF SECTION

SECTION 22 05 23

VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing Valves

B. Pipe strainer and suction diffusers.

PART 2 - PRODUCTS

2.1 VALVES

A. Pressure Ratings:
1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450 deg. F.
2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.

B. Ball Valves
1. Provide ball valves with:
a. Blowout proof stem.
b. Full size port, 316 stainless steel ball and stem.
c. Cast bronze body.
d. Threaded ends.
2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
3. Service rating:
a. 150 psi saturated steam.
b. 600 psi WOG.
4. All valves for domestic use must be lead free.

C. Valve Connections
1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
2. Thread pipe sizes 2 inches and smaller.
3. Flange pipe sizes 2-1/2 inches and larger.
4. Use screw to solder adapters for copper tubing.
5. Use grooved body valves with mechanical grooved jointed piping.
6. Use press valves when using copper press systems.

D. Valve Operators
1. Provide suitable hand-wheels for gate, globe, angle or drain valves and inside hose bibbs.
2. When cocks and valves are furnished with square head stem:
a. Provide one wrench for every ten cocks or valves sized 2 inches and smaller, minimum of two.
b. Provide each cock or valve size 2-1/2 inches and larger with a wrench with setscrew.
3. Where butterfly valves are provided:
a. Provide gear operators on valves 6 inches and larger.
b. Where valves are located 7 feet or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5 feet above floor and hook to clips, arrange to clear walking space.

c. Lever lock handle with toothed plate for shut-off service and infinitely

adjustable handle with lock and nut and memory stop for throttling service on valves 4 inches and smaller.

E. Acceptable Manufacturers (All listed must be lead free):
1. Apollo
2. Crane
3. Dezurik
4. Jenkins
5. Keystone
6. Kitz
7. Milwaukee Valve
8. Nibco
9. Stockham

F. Backflow Preventer (All valves for domestic use must be lead free):
1. BFP-1 (2 inches and smaller) bronze body, reduced pressure zone type with two inline independent check valves with an intermediate relief valve, complete with two full port ball valve shut-offs and ball type test cocks. Bronze strainer on inlet. Provide air gap fitting with full size drain piped to nearest floor drain. Watts 909-QT-S-LF.
2. BFP-2 (2-1/2 inches and larger) stainless steel or FDA epoxy coated ductile iron reduced pressure zone type with two inline independent check valves with reverse relief valves, two non-rising stem resilient sealed gate valves, cast iron strainer on inlet. Provide air gap fitting piped full size to nearest floor drain. Apollo RP4ALF-YS or Watts 909-NRS-BB-S-LF.

G. Provide valves of same manufacturer throughout where possible.

H. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.

I. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.

J. Provide valve, seat and trim materials suitable for the intended service.

K. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, globe or ball type.

2.2 PIPE SYSTEMS STRAINERS

A. Body:
1. Bronze "Y" pattern or basket as shown on the drawings.
2. Line size.
3. Threaded strainer blow down port.
4. ASTM A #126 Class B Cast Iron Body.

B. Construction:
1. 2 inch size and smaller with screw connections rated 400 psi WOG.
2. Over 2 inch size with flanged connections, rated 125 psi WOG.

C. Fabricate screens of Monel or type 304 stainless steel:
1. With 20 mesh woven wire in piping systems through 2 inches.
2. With 0.045 perforations in piping systems 2-1/2 inches and 3 inches.
3. With 0.125 perforations in piping systems 4 inches and larger.

D. Start-up:
1. Provide an additional fine mesh disposable screen for use during start-up operations.
2. Remove after 30 days.
3. Attach to piping for Owner's review.

E. Acceptable Manufacturers (All listed must be lead free):
1. Apollo
2. Crane
3. Keckley
4. Kitz
5. Mueller
6. McAlear
7. Muesco
8. Nibco
9. Zurn

2.3 VALVE SCHEDULE

A. Domestic Service
1. Gas shut-off service: UL approved for natural gas service.
a. Nibco Ball Valve, full port through 1 inch: T-585-70-UL
b. Nibco Ball Valve conventional port 1-1/4 inch through 3 inch: T-580-70-UL
c. Resun 2-1/2 inch and larger: 143 - 1-UL
d. DeZurick 2-1/2 inch and larger: Series 425 or 435
e. Locking Type: Rockford ¾ inch and 1 inch PNP-400
Mueller 1-1/4 inch through 4 inch: Lub-O-seal
f. Conbraco Ball Valve, full port through 4 inch: 64-100 Series
h. Milwaukee Full Port ¼ inch-2 inch
i. Milwaukee Standard Port 2-1/2 inch & 3 inch
j. Kitz Full Port 2 inch =- #68
2. Cold and Hot water service (all listed must be Lead Free):
a. Nibco Ball Valve full port through 2 inch: T-585-66-LF
b. Nibco Ball Valve 2-1/2 inch and 3 inch conventional port: T-580-66-LF
c. Nibco Butterfly Valve 4 inch and larger: LD-2000 EDPM Gaskets
d. Watts Ball Valve 4 inch and larger: G-4000-FDA
e. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used)
f. Kitz Full Port through 2 inch - #868M Lead Free
h. Milwaukee Full Port ¼ inch-2 inch
i. Milwaukee Standard Port 2-1/2 inch & 3 inch
j. Apollo Ball Valve Full Port through 2-1/2 inch 77CALF
k. Apollo Ball Valve Standard Port 3 inch 70LF
l. Apollo Butterfly Valve 4 inch and Larger LD141
m. Apollo Press Bronze Ball valves – 77 WLF

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.

C. Use butterfly valves and ball valves in domestic hot water and domestic cold water systems interchangeable in place of gate and globe valves.

D. Use butterfly valves and ball valves in circulating water systems, for balancing duty.

E. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
   1. 1 inch valve for pipes 6 inch and larger.
   2. 3/4 inch valve for pipes smaller than 6 inch.
   3. Terminate with pipe plug.
   4. Drain valves shall be ball valves.

F. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on the drawings.

G. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.

H. Provide clearance for installation of insulation and access to valves.

I. Provide access where valves are not exposed.

3.2 VALVE TAGS

A. Furnish valves with 1-1/2 inch diameter brass valve tags with stamped, black or red-filled numbers. Service designations shall be 1/4 inch letters, and valve numbers shall be 2 inch letters. Engineer shall approve Service designations. Secure tags to valves by use of brass "S" hooks or brass chain. Secure chain to valve by use of copper or Monel meter seals. Valve tags are not required if the valve is located within 3 feet of the equipment being served and the service is obvious.

B. Mount charts and drawings listing functions of each valve and its location in a metal and glass frame. Place charts and drawings as directed; in addition, on the record drawings mark the symbols and furnish a valve schedule properly identifying the valve number, service, exact location, the material being piped, and the room number of area that the valve services. This schedule shall be furnished on reproducible drafting paper or film suitable for reproduction on an Ozalid machine. The Owner shall approve the size of drafting paper. Provide a copy of the valve chart in the Operating and Maintenance Manuals.

3.3 PIPE SYSTEMS STRAINERS

A. Provide strainers in supply piping to circulating pumps, thermostatic mixing valves, before solenoid valves and trap primer valves.

END OF SECTION

SECTION 22 13 16

SOIL, WASTE AND SANITARY DRAIN PIPING, VENT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install piping in buildings and underground laterals to 5 foot outside of building.

1.2 RELATED WORK

A. Site Work:
1. Sanitary Sewers
2. Excavation, Trenching and Backfilling for Utilities

B. Division 22 Plumbing:
1. Pipe and Pipe Fittings
2. Plumbing Fixtures and Fixture Carriers
3. Drains, Cleanouts and Hydrants
4. Earthwork

1.3 REFERENCES

A. CISPI - Cast Iron Soil Pipe Institute

B. ASTM - American Society for Testing and Materials

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. All No-Hub clamps must have 4 bands minimum. Sizes 5” through 10” shall have six bands minimum.
1. No-Hub Clamps – Sanitary Waste:
a. Husky SD 4000
2. No-Hub Clamps - Vents
a. Husky SD – 2000
b. Mission Rubber Co., LLC Heavy Weight Couplings
3. Clamp-All Hi-TorQ 80 or approved equal

B. Provide Fernco “Pro-flex” shielded couplings Series 3000 with one piece neoprene gasket for all cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 1-1/2” through 8” Series 3000.

C. Cast Iron Soil Pipe and Fittings:
1. AB&I
2. Charlotte Pipe and Foundry Co.
3. Tyler Pipe / Soil Division

2.2 DRAIN PIPE AND FITTINGS

A. Above Slab Pipe:
1. No-hub cast iron soil pipe and fittings shall conform to CISPI 301 and ASTM A888.
2. Pipe shall conform to ASTM A74.
3. No-hub couplings shall meet or exceed the latest specification standard CISPI 310 or

ASTM C-1540 and conform to FM 1640. CISPI 310 Couplings shall be listed by NSF International.

4. Rubber Gaskets for cast iron soil pipe and fittings shall conform to ASTM C564
5. All Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute

B. Below Slab on Grade Piping:
1. Schedule 40 PVC plastic pipe and DWV fittings.
2. Solvent welded DWV joints shall conform to IAPMO Installation Standard IS-9.
3. Pipe and fittings shall conform to ASTM D 1784, ASTM D 1785, ASTM D 2665, ASTM D 3311 and NPS Standard 14 & 61.

2.3 VENT PIPE AND FITTINGS

A. Above Slab Pipe:
1. No-hub cast iron soil pipe and fittings shall conform to CISPI 301 and ASTM A888.
2. Pipe shall conform to ASTM A74.
3. No-hub couplings shall conform to CISPI 310 and shall be listed by NSF International
4. Rubber gaskets for cast iron soil pipe and fittings shall conform to ASTM C564

B. Below Slab on Grade Piping:
1. Provide Schedule 40 PVC with DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D1784-82.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All above and below slab soil, waste, sanitary drain and vent piping installation methods shall be in accordance with Cast Iron Soil Pipe Institute Standards.

B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot or hubless type). Hangers are to be placed within 18” of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15’-0”.

C. All above and below slab PVC sanitary waste and vent piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer’s recommendations and applicable standards.

D. Tracer wires shall be installed on all underground PVC sanitary sewer lines installed outside the building slab.

E. All PVC underground shall be installed in accordance with ASTM D2321.

3.2 GRADE

A. Give horizontal pipe grade of ¼-inch per foot where possible, but not less than 1/8 inch per foot unless otherwise shown.

3.3 DRAIN PIPE AND FITTINGS

A. Offsets and Fittings.
1. Use reduction fittings to connect two pipes of different diameter.
2. Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and

sixth-, eights-, and sixteenth-bends. Sanitary tees can be used on vertical stacks. Use long sweeps at the base of risers.

3. Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a deep seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.
4. Refer to Sanitary Drainage Code section for acceptable fittings to be used for changes in direction of drainage flow. Double combo sanitary fittings or double wye and 1/8th bend fittings are not allowed for horizontal to horizontal piping systems per Code.

B. Cleanouts. Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4 inches in diameter.

1. Where cleanouts occur in pipe chases, bring the cleanouts through the walls and install covers. Where cleanouts occur in floor slabs, set flush. Reference drawing schedule.
2. Provide cleanouts where soil lines change direction, every 50 foot on long runs, or as shown on the drawings, at the end of each horizontal waste line, and at the base of each riser (and at each increase in pipe size).
3. Cleanouts shall occur at the end of each battery of water closets, urinals, lavatories, sinks, and single water closets. Cleanouts shall be installed so as to access the main sanitary or soil line. Extend and offset above flood rim of water closet.
4. Double sanitary tees and double quarter bends do not allow for easy access to main lines, therefore these types of fittings are not allowed.

C. Floor Drains. Locate floor drains 1/2-inch below finish floor elevation unless otherwise shown.

3.4 VENT PIPING

A. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 6 inches above the roof.

B. Flash the roof penetration with 6 lb. lead flashing approximately 24 inches square. Flange the flashing to the lead sleeve. Extend the flashing up and around the vent pipe. Turn the flashing down inside the pipe at least 2 inches to make a watertight joint. Flashing shall comply with the roofing manufacturer's requirements. Reference the Architectural Drawings for exact requirements.

C. Locate vent piping through roof a minimum horizontal distance of not less than 20 feet from any air intake opening or supply fan.

3.5 TESTING

A. Below Slab on Grade and All Floors in Multi-Story Buildings:

1. Test pipe below slab on grade before backfilling and connecting to city sewers.
2. Maintain not less than 10 foot of hydrostatic head for1 hour without a leak.
3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
6. Test drainage and waste piping hydraulically by filling system to its highest point or, whichever is greater, at a static head of 10 feet. Leaks at any joint shall be sufficient cause for rejection.

7. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.
8. Under any of the previously described tests, the water height shall remain constant, after stabilization, for not less than 15 minutes without any further addition of water.

B. System Test. After the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:
1. Plugging outlets.
2. Filling vertical sections of multiple story buildings of not less than three floors at a time with water. Provide wyes as required to facilitate plugging.
3. Test for 6 hours without any drop in the water level.

3.6 RODDING SEWERS

A. All sanitary soil and waste lines, both in the building and out, shall be rodded out and flushed out after completion of construction and prior to finish floor being installed. All work must be completed prior to substantial completion. All floor drains and cleanout locations must be included in this work.

B. All sanitary soil and waste lines below building 3" and larger shall be internally videotaped at time of substantial completion. All videotaping shall include on-screen date and time, and include audio narration. All videotaping shall be provided by experienced individual in videotaping piping systems. An Owner's Representative shall be present during video-taping. Three copies of the videotape shall be delivered to the Owner for future records.

C. This work shall be done in the presence of the Owner's Representative, as part of the Contract, to ensure all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing the proper rotary head to clear sewer. Pipe sizes 8 inches and larger shall be hydro-flushed.

3.7 SMOKE TESTING

A. Interior Plumbing Piping:
1. Contractor shall perform smoke testing on all interior sanitary sewer piping and sanitary vent piping above and below floor prior to cover-up..
2. Artificially created smoke used must be a persistent white tracer smoke and produced by thermogenic chemical reaction. All smoke candles or smoke pencils to be used must be non-toxic and EPA approved. Provided by Superior Signal Smoke Candles.
3. All plumbing fixtures must be installed including floor drains with wetted trap seals.
4. Smoke testing shall be performed after completion of any videotaping, rodding or flushing of the sanitary system. Test must be performed prior to ceiling installation in new construction projects. Smoke is usually injected into the building through the two-way cleanout in the main sewer line leaving the building or a plumbing roof vent or fixture. Smoke will travel through the sanitary sewer and vent system and through the air spaces in the sewer lines and emanate from any leaks in the system. The smoke must reach the last roof vent in the system to indicate the entire system has been completely filled with smoke. The smoke must travel the full length of the piping system. Contractor must provide manpower as necessary to visually trace the flow of smoke through the wall cavities, annular floor/ceiling spaces, inject the smoke, observe the roof vents and to identify the integrity problems.
5. Contractor shall provide a detailed list of findings and a drawing indicating the location, fixture type, type and size of pipe, and or description of type of problems found.
6. Typical findings from indoor smoke testing may include:
   a. Dry traps in floor drains
   b. Improperly capped sewer lines or vents
   c. Broken sewer lines or vents

d. Cross connected sewer vents and drains
e. The drawing of air emanating from sewer vents into intakes of air exchange systems
f. Poorly glued pipe joints
g. Loose no-hub couplings

7. An Owner's Representative shall be present during smoke testing.

3.8 SMOKE TESTING – LIQUID SMOKE SYSTEM

A. Interior Plumbing Piping:

1. Contractor shall perform smoke testing for finding leaks in all interior of building sanitary sewer piping and sanitary vent piping above and below building slab prior to cover up.
2. Contractor must use a laboratory tested safe liquid smoke with a patented liquid smoke generating system. The liquid smoke must be contained in a pressure tank with inline filter and quick disconnect.
3. Smoke generating system must generate up to 3 hours or more of continuous and constant smoke. Generating system must have a metering valve to precisely control smoke flow and density. Smoke generating system must have a 4" x 6" industrial flexible mining duct for connection to vent stack or cleanout.
4. Smoke generating system must be power full enough to push smoke through the smallest leaks.
5. The liquid smoke must not leave any stains or odors.
6. The liquid smoke shall not contain Zinc Chloride, a listed toxic compound in OSHA 1915,1000 – Air contaminants.
7. Smoke generating system must have a means to atomize the liquid smoke and have an enclosed fan system capable of up to 700 cfm with adjustable inlet damper control to adjust cfm as necessary for the size of system.
8. Provide Hurco "Power smoker " with Hurco "LiquiSmoke" system or approved equal.
9. All plumbing fixtures must be installed including floor drains with wetted trap seals.
10. Smoke testing shall be performed after completion of any videotaping, rodding or flushing of the sanitary system. Test must be performed prior to ceiling installation in new construction projects. Smoke is usually injected into the building through the two-way cleanout in the main sewer line leaving the building or a plumbing roof vent or fixture. Smoke will travel through the sanitary sewer and vent system and through the air spaces in the sewer lines and emanate from any leaks in the system. The smoke must reach the last roof vent in the system to indicate the entire system has been completely filled with smoke. The smoke must travel the full length of the piping system. Contractor must provide manpower as necessary to visually trace the flow of smoke through the wall cavities, annular floor/ceiling spaces, inject the smoke, observe the roof vents and to identify the integrity problems.
11. Contractor shall provide a detailed list of findings and a drawing indicating the location, fixture type, type and size of pipe, and or description of type of problems found.
12. Typical findings from indoor smoke testing may include:
    a. Dry traps in floor drains
    b. Improperly capped sewer lines or vents
    c. Broken sewer lines or vents
    d. Cross connected sewer vents and drains
    e. The drawing of air emanating from sewer vents into intakes of air exchange systems
    f. Poorly glued pipe joints
    g. Loose no-hub couplings
13. An Owner's Representative shall be present during smoke testing.

END OF SECTION

SECTION 22 20 00

PLUMBING PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install pipe and pipe fittings for piping systems specified in Division 22 - Plumbing.

1.2 RELATED WORK

A. Division 22 Plumbing
1. Earthwork
2. Valves, Strainers and Vents
3. Insulation
4. Other Piping Sections

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.

B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.

C. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.

D. Flanged.
1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.
3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
6. Keep flange covers on equipment while fabricating piping. Remove when ready to install

in system.

E. No Hub. Hubless joints shall be made with wide body, neoprene sealing sleeve with stainless steel sleeve, coupling joints conforming to ASTM C 1277.
   1. 4" pipe size and smaller coupling housing minimum of 3" width; 24 gauge Series 300 stainless steel with hi-torque clamps; neoprene coupling gasket.
   2. 6" through 10" pipe size coupling housing minimum of 4" width.
   3. Tighten clamps to within manufacturer's tolerances using preset torque wrench.

F. Compression Joints for Cast Iron Water Pipe. Use Beltite, Tyton or Grip-Tite compression joints. Install in accordance with the manufacturer's recommendations for compression joints. Provide adequate concrete thrust blocks at changes of direction, as recommended by the manufacturer.

G. Compression Gasket System. Bell and spigot cast iron pipe 4" and smaller, use flax-base lubricant, Tyler Ty-Seal Lubricant or Charlotte Regular Lubricant. 6" and larger use a neoprene base lubricant, Charlotte Adhesive Lubricant.

H. Ring-Tite Joints: Ring-Tite gasketed sewer fittings for sanitary and storm. Furnish joints for installation manufactured per ASTM/CSA, Ipex, and J.M Eagle C900. Provide adequate concrete thrust blocks at changes in direction, as recommended by manufacturer. JM Eagle pressure rated PVC water pipe. ASTM D2241 pressure rating, ASTM D3219 joints, gaskets ASTM F477.

I. Ball Joints. Where shown, provide flexible ball joints, made of carbon steel. Ball joints must have 15° of angular flexibility. Use welded or flanged ends, as required. Furnish with 11N gaskets.

J. Press fittings for copper pipe 1/2” to 4”: Copper press fittings shall conform to the material and sizing requirements of ASTM B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Pro-Press System manufactured by VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

2.3 UNIONS

A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
   1. Where pipe materials of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

A. Pipe 2" and Smaller. For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.

B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

A. High Temperature Piping. Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.

B. Other Piping. Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.7 DOMESTIC MANUFACTURE

A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America unless specifically named in these specifications.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufactured, for maintenance.

B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.

C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.

D. Install piping without tapping out of the bottom of pipe.

E. Press Connections: Copper and steel press fittings ½” through 4” shall be applied in accordance with the manufacturer’s installation instructions. The tubing/pipe shall be fully inserted into the fitting and the tubing/pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing/pipe to assure the tubing/pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. If soldering (thread adapters, etc.) near press fittings, take precautions to not damage the O-ring fittings. Maintain three pipe diameters or use a cooling agent. Viega-“Pro-Press”.

3.2 WELD

A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.

B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.

F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.

B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.

B. Provide supports both sides of elbows for pipe 6" and larger.

C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On cold water pipe, supports shall be outside the insulation.

D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.

E. Install trapeze hangers, properly sized, to support the intended load without distortion.

F. Use electro-galvanized or zinc plated threaded rods, nuts, washers and hangers.

G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.

H. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Feet	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.5 PIPE SUPPORTS

A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.

B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.

C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 ANCHORS

A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.7 FLOOR PENETRATIONS

A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.8 PIPE SLEEVES

A. Sleeves through masonry and concrete construction:
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
   2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.

B. Sleeves through gypsum wall construction.
   1. Fabricate sleeves of 16 gauge galvanized sheet metal.

C. Sleeves through elevated slab construction.
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.

D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2” above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.

E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.

F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.

G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.

H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.9 ISOLATION VALVES

A. Provide piping systems with line size shutoff valves located at the risers, at main branch

connections to mains for equipment, to isolate central plant, and at other locations.

3.10 DRAIN VALVES

A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.11 CLEANING OF PIPING SYSTEMS

A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.

B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.

C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until “potable water clear” and particles larger than 5 microns are removed.

D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.

E. Dispose of water in approved manner.

F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Flush system and replace with clean water.

G. Phase Three: Final flushing and rinsing: Flush and rinse until “potable water clear” and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.

H. Submit status reports upon completion of each phase of work on each system.

3.12 TESTING

A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.

B. Do not insulate or conceal piping systems until tests are satisfactorily complete.

C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.

D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.13 PIPE MARKERS

A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

C. Install identification in the following locations:
   1. Both sides of penetrations through walls, floors and ceilings.
   2. Close to valves or flanges.
   3. Intervals on straight pipe runs not to exceed 50 feet
   4. Apply marker where view is obstructed.

D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 “Scheme for Identification of Piping Systems”.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES AND FIXTURE CARRIERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install water closets, urinals, lavatories, electric drinking fountains, fixture carriers and plumbing appurtenances.

1.2 RELATED WORK

A. Division 22 Plumbing
1. Drains, Hydrants and Cleanouts.
2. Domestic Water Piping.
3. Soil, Waste and Sanitary Drain Piping and Vent Piping.

1.3 JOB REQUIREMENTS

A. Furnish plumbing fixtures and trim as shown and specified. Provide faucets, fittings, supply stops and similar devices of a single manufacturer. Furnish faucets and supply stops with renewable seats. Porcelain to steel and enameled cast iron fixtures shall be acid resistant. Wall hung fixtures shall be installed with a fixture carrier.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Floor Drains:
1. Wade
2. J.R. Smith
3. Josam
4. Zurn
5. Watts
6. Sioux Chief
7. MIFAB

B. Cleanouts:
1. Wade
2. J.R. Smith
3. Josam
4. Zurn
5. Watts
6. MIFAB

C. Backflow Preventors
1. Watts
2. Febco
3. Wilkins
4. Beeco

D. Hose Bibbs
1. Wade
2. Chicago
3. Josam

4. Woodford
5. Zurn
6. J.R. Smith
7. MIFAB

2.2 REQUIREMENTS

A. Refer to the drawings for equipment to be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer's instructions.

B. Make rough-in and final connection of service to each fixture provided under this Section and other Sections or Architectural or Plumbing Drawings.

C. Provide necessary stops, valves, traps, unions, vents, cold water, hot water, sanitary, etc. for a complete installation.

D. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on drawings.

E. Remove piping and services roughed-in incorrectly and install correctly, without cost.

F. Exposed piping, fittings and appurtenances shall be chrome-plated brass.

G. Coordinate with the Contractor for locations and service required for each plumbing fixture.

H. All floor drains and floor sinks shall have Pro-Set “Trap Guard” for trap seal protection.

I. All floor drains and floor sink locations are to be coordinated with all equipment. Locate drains in mechanical equipment spaces to conform to drain locations of equipment furnished. Coordinate drain location with food service equipment and Architectural Drawings.

J. All floor drains, floor sinks and cleanout covers are to be provided with stainless steel vandal resistant screws.

K. Trap primer valves installed in concealed spaces shall have approved access doors for accessibility.

END OF SECTION

SECTION 22 63 11

GAS PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install steel gas pipe inside buildings, including the supply line from the meter, service lines to gas equipment and appliances, termination of the service line with a plug valve, drip leg, and final connection to equipment and appliances with unions.

B. Coordinate service line from utility main and extend to meter. Coordinate installation of the service line and meter with Gas Company.

C. Extend steel gas piping from meter to inside the building to all fixtures, appliances and equipment requiring gas.

1.2 RELATED WORK

A. Division 22 Plumbing
   1. Plumbing Pipe and Fittings
   2. Valves and Vents

1.3 UTILITY CONNECTIONS

A. Make arrangements for and pay all fees and connection charges for obtaining service to the building.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS - ABOVE GRADE

A. Pipe 2 inch and Smaller:
   1. Schedule 40 ASTM A 53 black steel pipe
   2. Factory fabricated socket weld fittings.

B. Pipe Larger than 2 inch:
   1. Schedule 40 ASTM A 53 black steel pipe.
   2. Factory fabricated butt weld fittings for welded steel pipes shall conform to ASTM A-234 WPB (seamless weld fittings).

C. Unions:
   1. Standard 150 lb. (300 lb. water, oil or gas) malleable iron.
   2. Ground joint unions, with bronze seat.
   3. Flange joints for pipe larger than 2 inch in diameter.

D. Flanges:
   1. Steel flanges. ANSI B16.5 and ASTM A-105.

2.2 PIPE AND FITTINGS - BELOW GRADE OUTSIDE BUILDING

A. Polyethylene pipe shall be ASTM D3350 Grade PE24 cell classification and ASTM D1248 Class B material classification.

B. Pipe shall be medium density polyethylene PE 2406 and PE 2708 manufactured by Poly Pipe Industries, Inc. or Performance Pipe.

C. Polyethylene yellow molded butt fittings for use with medium density polyethylene pipe shall meet testing requirements of ASTM D2513 and resin material listing of ASTM D3350 with PPI designation of PE 2406 as manufactured by Central Plastics Co.

2.3 VALVES

A. See Section 22 05 23.

2.4 GAS PRESSURE REGULATOR

A. Size the gas pressure regulator in accordance with the manufacturer's recommendations for flow quantities and reduced pressure as required for all equipment. Coordinate final equipment gas pressure requirements prior to ordering regulators. Provide American Meter Company regulators or approved equal, suitable for outdoor installation. Regulators outside exposed to weather shall be installed with vent in vertical down position.

B. All line pressure regulators shall be listed in accordance with ANSI (American National Standard) Z21.80 and CSA (Canadian Standards Association Standard) 6.22.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation Standards: Install gas piping in accordance with recommendations of the National Fire Protection Association.

B. Drip Legs: Install a capped drip leg 6 inches long at the base of each vertical rise.

C. Coating and Wrapping. Coat and wrap underground piping in accordance with the service utility company standards.

D. Sleeves.
1. Encase gas piping running in or through solid partitions with thin wall metal conduit. Sleeve piping and fittings shall be two pipe sizes, but not less than 1 inch larger than encased gas piping.
2. Encase gas piping running below slab in Schedule 40 PVC, minimum size two pipe sizes larger than gas pipe. Vent sleeve to atmosphere with a 1-1/2 inch vent with 1-1/2 inch return bend above building roof. Seal ends of sleeve with UL fire rated caulk.

E. Do not install gas piping exposed to view inside public area, or occupied spaces, without prior written approval.

F. Weld all gas piping above grade.

G. Provide test ports and isolation valves to enable proper testing of system in the future.

H. Provide isolation valve and unions across regulators for proper removal.

I. Provide transition risers where below grade polyethylene pipe changes to steel pipe above grade.

J. Gas Pressure Regulators / Vents:
1. Piping shall be sized in accordance with the regulator manufacturer’s instructions. Never use pipe sizes smaller than the vent size; smaller pipe sizes restrict the gas flow. Where there is more than one regulator at a location, each regulator shall have a separate vent to the roof / outdoors. Headers with various installed devices can cause regulator malfunction.
2. Support the vent pipe to eliminate strain on the regulator diaphragm case.

3. Install vent piping from regulators to location to prevent gas smells from entering building. Do not locate the vent line terminus near windows, fans, or other ventilation equipment. See the installation instructions furnished with the regulator.
4. Install double elbows and insect screen at end of piping to prevent moisture and insects from entering. Always point outdoor vent pipes in the downward position to reduce the possibility of rain, snow, sleet, and other moisture entering the pipe.
5. When installed inside building route vents horizontally and terminate through building sidewall. The vent must be piped to the outside atmosphere using the shortest length of pipe, the fewest possible pipe elbows, and a pipe diameter as large as the vent size or larger. If a long gas run must be used, increase the pipe one nominal size every ten feet to keep the flow restriction as low as possible. Vents terminating through roof must have prior approval from Architect before installation. Through roof penetrations shall be minimized.
6. Regulators installed outside or on roof top: Install regulator vent turned downward with insect screen over vent opening. The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.
7. Ensure the end of the vent line is away from ANY potential ignition sources. It is the installer's responsibility to ensure the vent line is exhausting to a safe environment
8. Adhere to all applicable codes and regulations.

3.2 TESTING GAS PIPING

A. Preliminary gas test as required by Code, but minimum test pressure of 50 PSI held for not less than eight hours without noticeable drop.

B. Test joints with a soap solution while lines are under pressure.

C. Repair leaks.

D. Final gas test shall be with a 24 inch column of mercury or a diaphragm gauge with a minimum dial size of 3-1/2 inches with a set hand and a pressure range not to exceed twenty (20) psig with 2/10-pound increments. The minimum test pressure shall not be less than ten (10) psi and the maximum test pressure shall not exceed twelve (12) psig. This test will be observed for no less than (30) thirty minutes with no drop in pressure.

E. Provide copy of gas pressure test reports in Operations & Maintenance Manual.

F. Provide Railroad Commission of Texas Pipeline Safety Form PS-86B.
1. To find form online, go to: Texas School Gas Test Form

G. School renovations projects shall have all gas piping tested. Report and document gas leaks found to the Architect and Engineer. Repair leaks at no additional cost to the Owner.

3.3 IDENTIFICATION CONDUCTOR

A. Spiral A #12 AWG insulated copper conductor the full length of the thermoplastic piping system. Fasten to the pipe at 3 foot intervals with plastic tie wraps.

B. Terminate at each end in a 12 inch x 12 inch x 4 inch FRP junction box.
1. Bolted gasketed cover with stainless steel screws.
2. Screw type terminal strip.
3. Legend on cover "gas pipe identification conductor."

C. Set in concrete pad.

3.4 UNDERGROUND STEEL PIPE

A. Reference Specification Section 22 20 02, Underground Steel Pipe Corrosion Protection.

3.5 PAINT EXPOSED OUTSIDE GAS PIPE

A. Interior and Exterior Gas piping shall be protected from rust.

B. Paint pipe with a flat alkyd coating, clean pipe prior to painting by preparing surface by hand tool cleaning per SSPC-SP2-82, applying one coat of Glidden Y-590 Rustmaster Metal Primer White and top coat of Yellow Alkyd Flat Enamel.

END OF SECTION

SECTION 23 01 00

HVAC OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.

B. Instruct Owner's personnel in operation and maintenance of equipment and systems.

C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
   1. Table of Contents for each element.
   2. Contractor information.
   3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer; bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
   4. All parts and maintenance manuals for items of equipment.
   5. Warranties (without starting dates)
   6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
   7. Operating and maintenance procedures.
   8. Form of Owner's Training Program Syllabus (including times and dates).
   9. Control operations/equipment wiring diagrams.
   10. Schedule of filters for each item of equipment.
   11. Schedule of belts for each item of equipment.
   12. Other required operating and maintenance information that are complete.

B. Copy will be returned to the Contractor within 15 days with comments for corrections.

C. Submit three (3) completed manuals in final form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.

D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.

E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.

F. Two (2) complete Manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.1 BINDERS

A. Commercial quality black three-ring binders with clear overlay plastic covers.

B. Minimum ring size: 1"; Maximum ring size: 3".

C. When multiple binders are used, correlate the data into related groupings.

D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

A. Form for Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
2. Format:
   a. Size: 8-1/2" x 11".
   b. Text: Manufacturer's printed data or neatly typewritten.
3. Drawings:
   a. Provide reinforced punched binder tab and bind in text.
   b. Fold larger drawings to size of text pages.
4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
   a. Title of Project
   b. Identity of separate structures as applicable.
   c. Identity of general subject matter covered in the manual.
6. Binder as specified.

B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
   a. Contractor, name of responsible principal, address and telephone number.
   b. A list of each product required to be included, indexed to content of the volume.
   c. List with each product, name, address and telephone number of:
      1) Subcontractor or installer.
      2) Maintenance contractor as appropriate.
      3) Identify area of responsibility of each.
      4) Local source of supply for parts and replacement.
   d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
   a. Include those sheets pertinent to the specific product.
   b. Annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
3. Drawings:
   a. Supplement product data with drawings as necessary to illustrate:
      1) Relations of component parts of equipment and systems.
      2) Control and flow diagrams.
   b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.

4. Written text, as required to supplement product data for the particular installation:
    a. Organize in consistent format under separate headings for different procedures.
    b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued.
    a. Provide information sheet for Owner's personnel, giving:
        1) Proper procedures in event of failure.
        2) Instances that might affect validity of warranties or bonds.
6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems.
1. Content for each unit of equipment and system as appropriate:
    a. Description of unit and component parts.
        1) Function, normal operating characteristics, and limiting conditions.
        2) Performance curves, engineering data and tests.
        3) Complete nomenclature and commercial number of replaceable parts.
    b. Operating procedures:
        1) Start up, break-in, routine and normal operating instructions.
        2) Regulation, control, stopping, shut down and emergency instructions.
        3) Summer and winter operating instructions.
        4) Special operating instructions.
    c. Maintenance procedures:
        1) Routine operations
        2) Guide to trouble-shooting.
        3) Disassembly, repair and reassembly.
        4) Alignment, adjusting and checking.
        5) Routine service based on operating hours.
    d. Servicing and lubrication schedule. List of lubricants required.
    e. Manufacturer's printed operating and maintenance instructions.
    f. Description of sequence of operation by control manufacturer.
    g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
        1) Predicted life of part subject to wear.
        2) Items recommended to be stocked as spare parts.
    h. As installed control diagrams by controls manufacturer.
    i. Complete equipment internal wiring diagrams.
    j. Schedule of filters for each air handling system.
    k. Schedule of belts for each item of equipment.
    l. Each Contractor's coordination drawings.
    m. As installed color coded piping diagrams.
    n. Charts of valve tag number, with location and function of each valve.
    o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
    p. Other data as required under pertinent sections of the specifications.
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 23.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide extended compressor warranty certificates.

END OF SECTION

SECTION 23 05 00

MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23 Mechanical.

B. Applicable provisions of this section apply to all sections of Division 23, Mechanical.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Mechanical work shall comply with applicable inspection services:
1. Underwriters Laboratories
2. National Fire Protection Association
3. State Health Department
4. Local Municipal Building Inspection Department
5. Texas Department of Licensing & Regulations (ADA)

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various

elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducibles is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex mylar film positives) and AutoCad 2014 / Revit CAD files on disk (CD Rom).

C. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
2. Remove Engineer’s seal, name, address and logo from drawings.
3. Mark documents RECORD DRAWINGS.
4. Clearly indicate: DOCUMENT PRODUCED BY
5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
6. Indicate exact location of all underground mechanical piping and elevation.
7. Indicate exact location of all underground electrical raceways and elevations.
8. Correct schedules to reflect (actual) equipment furnished and manufacturer.
9. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
10. Exact location of all electrical equipment in and outside of the building.
11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
12. Cloud all changes.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 23 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 AIR FILTERS AND PIPE STRAINERS

A. Immediately prior to substantial completion of the project, inspect, clean and service air filters and strainers. Replace air filters.

3.3 LUBRICATION, REFRIGERANT AND OIL

A. Provide a complete charge of correct lubricant for each item of equipment requiring lubrication.

B. Provide a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify for proper operation as required.

C. Provide a complete charge of special oil for refrigeration use, suitable for operation with refrigerant, in each system.

3.4 HOUSEKEEPING PADS

A. Provide equipment housekeeping pads under all floor mounted and ground mounted HVAC equipment, and as shown on the drawings.

B. Concrete work as specified in Division 3.

C. Concrete pads:
1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
2. Chamfer strips at edges and corner of forms.
3. Smooth steel trowel finish.
4. Doweled to existing slab

D. Install concrete curbs around duct penetrations or multiple pipe penetrations.

3.5 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
1. Provide the training during the Owner's regular working day.
2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.

B. Time to be allocated for instructions.
   1. Minimum of 40 hours dedicated instructor time.
   2. 8 hours on each of 5 days.

C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
   1. One copy to the Owner.
   2. One copy to the Architect/Engineer.

D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.

E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.6 EQUIPMENT IDENTIFICATION

A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
   1. Designation approved by Architect/Engineer.
   2. Equipment includes, but is not limited to, air handling units, fan coil units, variable volume boxes, fans, pumps, boilers and chillers.
   3. Submit schedule of equipment to be included and designations.

B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.7 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
   1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
   2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing

services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.8 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.9 INDOOR AIR QUALITY

A. All equipment and ductwork shall be installed to allow sufficient space for testing, maintenance, and commissioning functions. Access doors or panels shall be installed in ventilation equipment, ductwork, and plenum enclosures for inspection and cleaning of outdoor air intakes, mixing plenums, up and downstream of coils, filters, drain pans and fans.

B. Practice source control and eliminate potential contaminants in material selection, installation, and maintenance.

C. Provide installation and disposal instructions for all materials and chemicals that are potential contaminants.

D. Obtain and conform to the requirements of the Material Safety Data Sheets (MSDSs) in the use of materials.

E. Utilize manufacturer’s recommendations and provide installation instructions for all chemicals, compounds, and potential contaminants including pre-installation degassing if required.

F. Ventilate completed building prior to final completion using no less than design outside air for at least 48 hours before occupancy.

G. Make provisions for controls to prevent the entry of air contaminants into the HVAC air distribution system.

H. Steps shall be taken to ensure that the HVAC system continues to function effectively and are not damaged or contaminated during construction activities.

END OF SECTION

SECTION 23 05 10

HVAC CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
   1. Field conditions.
   2. Condition of installation.
   3. Quality of workmanship.
   4. Start-up of equipment.
   5. Testing, adjusting, and balancing of equipment.

B. Representative shall make written report of observations and recommendations to Architect / Engineer.

1.7 MOCK-UPS

A. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.

B. Do not proceed with any work involving a mock-up, until the related mock-up has been approved in writing.

C. Acceptable mock-ups in place shall be retained in the completed work.

D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
   1. Rough-in.
   2. Finish with all appurtenances in place.
   3. Insulation installed.
   4. Demonstrations.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 FAN/COIL UNITS (WATER SOURCE HEAT PUMPS)

A. Mock-up a fan/coil unit (water source heat pump) completely installed, including:
   1. Primary, secondary and auxiliary drain pans.
   2. Piping connections; including all piping appurtenances.
   3. Pipe insulation.
   4. Condensate drain piping.
   5. Electrical connections.
   6. Duct connection beyond first transition.
   7. Block valves, balancing valves, and control valves.
   8. Cabinet/internal vibration isolation.
   9. Suspension system.

B. Tests: Air flow at scheduled static pressure.

C. Demonstrate:
   1. Filter accessibility.
   2. Accessibility to drain and components for service.
   3. Controls sequence.

3.2 AIR HANDLING UNIT

A. Mock-up an air handling unit, completely installed, including:
   1. Piping connections; including thermowells, test stations, test wells and other piping appurtenances.
   2. Pipe insulation.
   3. Condensate drain piping.
   4. Electrical connections.
   5. Ductwork beyond the first transition.
   6. Control valves and bypass.

7. Cabinet/internal vibration isolation.
8. Block valves and balancing valves.
9. Duct insulation.
10. Instrumentation.

B. Tests: Air flow at scheduled static pressure.

C. Demonstrate:
1. Filter accessibility.
2. Accessibility to drain and components for service.
3. Controls sequence.

3.3 CONSTANT VOLUME TERMINAL BOX

A. Mock-up a Constant Volume Terminal Box completely installed, including:
1. Piping connections, including all piping appurtenances.
2. Pipe insulation.
3. Electrical connections.
4. Duct connection beyond first transition.
5. Block valves, balancing valves, and control valves.
6. Cabinet/internal vibration isolation.
7. Suspension system.

B. Tests: Air flow at scheduled static pressure.

C. Demonstrate:
1. Control Sequence.
2. Accessibility to components for service.

3.4 HOT AND CHILLED WATER CIRCULATING PUMPS

A. Mock-up one each system pump, completely installed including:
1. Pump mounted on housekeeping pad.
2. Auxiliary drain pan. (Chilled water only)
3. Piping to a point beyond the complete valve and instrumentation assemblies.
4. Strainers with blowdown.
5. Flexible piping connection.
6. Pipe supports.
7. Pipe insulation.
8. Pump painting.
9. Electrical connections.

3.5 PROTECTION OF EQUIPMENT

A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

SECTION 23 05 11

MECHANICAL ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Inspect and service existing equipment and materials that are to remain or to be reused.

B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.

C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) which do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Material used to upgrade and repair existing equipment shall conform to that specified.

B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.

C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.

B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.

C. Verify field measurements, above and underground piping connections and flows.

D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.

E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Use pipe inspection camera system to field verify existing sanitary / grease waste connections. Verify actual HVAC supply and return piping connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.2 APPLICATION

A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems and HVAC coils prior to installation and reuse.

B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.

C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.

D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.

E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner’s review and salvaged by Contractor.

F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner’s use.

G. Clean and repair existing materials and equipment that remain or are to be reused.

H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

A. Coordinate utility service outages with Utility Company, Architect and Owner.

B. Provide additional or temporary valves, piping, ductwork and connections to maintain existing systems in service during construction.

C. Existing HVAC and Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.

D. Remove and replace existing Mechanical systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.

E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.

F. Remove and replace existing piping, grilles, boxes and ductwork coincident with the construction.

G. Remove or relocate existing piping, grilles, ductwork or housekeeping pads as occasioned by new or remodeled construction. Cap unused HVAC or domestic piping and duct beyond the new finish line.

H. Relocate all HVAC and or domestic piping, grilles, boxes and ductwork as required to accommodate new work requiring precedence.

I. Remove concrete housekeeping pad where materials or equipment have been removed.

J. Remove all known utilities, which do not provide service to the buildings that remain.

K. Remove existing plumbing or mechanical vent penetrations through roof not to be reused.

3.4 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.

D. HVAC, Plumbing, piping, ductwork and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping and ductwork not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.

E. Repair adjacent construction and finishes damaged during demolition and extension work.

F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.

G. Extend existing installations using materials and methods compatible with existing mechanical installations, or as specified.

H. Existing mechanical piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.

B. Provide devices and methods to protect other portions of work from damage.

C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description “existing”. Provide new nameplates for all existing mechanical equipment in renovated areas as specified in Section 23 05 00 Mechanical General Provisions.

3.7 REFRIGERANT DISPOSAL

A. Contractor shall dispose of refrigerant from all DX equipment including refrigerant piping per OSHA, EPA, Federal, State and Local Codes.

3.8 ADDITIONAL REQUIREMENTS

A. Temporary Climate Control: Provide temporary climate control (heating, cooling and humidity control) required for construction of Work.
   1. Prior to disabling any HVAC system in any building, the contractor shall place temperature and humidity measuring and recording devices in all areas of the building where the temperature and/or humidity levels may potentially be affected due to the HVAC system(s) being disabled. The contractor shall with a similar, separate measuring and recording device measure and record outside (ambient) temperature and humidity conditions at all times when the indoor values are being recorded. Temperature and humidity levels shall be measured and recorded at a maximum interval of 5 minutes (adjustable).
   2. The contractor shall on a weekly basis submit an electronic file copy and print and submit one hard file copy to the engineer of all recorded values. Temperature and humidity values shall be submitted separately from each other (not overlapping). Values shall be printed 2 ways. They shall be displayed in a “graphed” format and in a straight text format. The format of the electronic file shall be a “standard” format and shall not require any special program or equipment to read and/or print. Additionally, the electronic file shall not “expire” and remove itself once copied to electronic memory.
   3. Throughout the duration of the project, it shall be the responsibility of the contractor to ensure that at no time shall the temperature in any part of the building be less than 60 degrees (f) or greater than 80 degrees (f). The contractor shall also ensure that at no time the relative humidity in any part of the building shall reach or exceed 60%. Should this or any condition outside these stated allowable values occur, the contractor shall immediately notify the engineer and investigate / correct the situation. The contractor shall be responsible for correcting any condition (mold, discoloring, odors, etc.) that

occurs during such time that the temperatures and humidity levels are outside the allowable values. This shall be done at no additional expense to the Owner.

4. Each building shall not be without conditioned air for more than 48 hours. Contractor is responsible for all phasing, rental equipment, and related power. NO EXCEPTIONS. Whenever a system is to be shut down for any time the owner shall be notified.
5. Whenever a central cooling or heating system is taken offline, all equipment that is dependent on such system shall also be deactivated. For example, when the chilled water central plant is taken offline, all AHUs/WSHPs shall be deactivated to ensure untreated air is not entering building.
6. Rental equipment and systems must be in place to maintain the temperature at 75 degrees and relative humidity at 55% while the school is occupied during the school year.
7. **PROVIDE RENTAL FLUID COOLER, PUMP/S AND BOILERS FOR EACH CAMPUS LISTED BELOW THAT INCLUDES SCOPE FOR FLUID COOLER, PUMPS AND BOILER, <u>NO EXCEPTIONS</u>. RENTAL EQUIPMENT SHALL BE ON SITE, CONNECTED TO THE EXISTING SYSTEMS AND READY TO BE SWITCHED ON IMMEDIATELY UPON REMOVING EXISTING FLUID COOLER, PUMP/S AND BOILER FROM SERVICE. CONTRACTOR IS ALSO RESPONSIBLE FOR ALL TEMPORARY PIPING TAPS AND TEMPORARY POWER FOR RENTAL EQUIPMENT.**
   a. **TAYLOR CAREER AND TECHNICAL EDUCATION CENTER**

END OF SECTION

SECTION 23 05 12

SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by these specifications as outlined below.

B. The term submittal, as used herein, refers to all:
1. Shop Drawings
2. Coordination Drawings
3. Product data

C. Submittals shall be prepared and produced for:
1. Distribution as specified
2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.

C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.

D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: ¼” = 1’-0”.

B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.

C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
1. Actual mechanical equipment and components to be furnished
2. Service clearance
3. Relationship to other equipment and components
4. Roof drains and leader piping
5. Fire protection piping and equipment

D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

E. Related requirements:
1. Ductwork shop drawings

2. Coordination drawing specified in Division 26

F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.

B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.

C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, or NOT APPLICABLE. Explain all DO NOT COMPLY statements.

F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
1. Field measurements
2. Field construction criteria
3. Manufacturer's catalog numbers
4. Conformance with requirements of Contract Documents

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
   1. Proper sizes and capacities
   2. That the item will fit in the available space in a manner that will allow proper service
   3. Construction methods, materials and finishes

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.

B. Number of submittals required:
   1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
   2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.

C. Accompany submittals with transmittal letter, in duplicate, containing:
   1. Date
   2. Project title and number
   3. Contractor's name, address and contact number.
   4. The number of each Shop Drawing, Project Datum and Sample submitted
   5. Other pertinent data

D. Submittals shall include:
   1. The date of submission
   2. The project title and number
   3. Contract Identification
   4. The names of:
      a. Contractor
      b. Subcontractor
      c. Supplier
      d. Manufacturer
   5. Identification of the product
   6. Field dimensions, clearly identified as such
   7. Relation to adjacent or critical features of the work or materials
   8. Applicable standards, such as ASTM or federal specifications numbers
   9. Identification of deviations from contract documents
   10. Suitable blank space for General Contractor and Architect/Engineer stamps
   11. Contractor's signed and dated Stamp of Approval

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
   1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
   2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

A. Every submittal document shall bear the following information as used in the project manual:
   1. The related specification section number
   2. The exact specification section title

B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

A. Make re-submittals under procedures specified for initial submittals.
   1. Indicate that the document or sample is a re-submittal
   2. Identify changes made since previous submittals

B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.

D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

A. The Architect / Engineer will:
   1. Review identified submittals with reasonable promptness and in accordance with schedule
   2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
   3. Return submittals to Contractor for distribution or for resubmission

B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
   1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
   2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

A. Do not make requests for substitution employing the procedures of this Section.

B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 23 05 13

ELECTRICAL PROVISIONS OF HVAC WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.

B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
   1. Motors for mechanical equipment.
   2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
   5. Wiring of smoke detectors for shutdown of air handling equipment when a fire alarm system is not included in the project.
   6. Wiring of oil pump, vibration and oil level limit switches for cooling towers.
   7. Refrigerant monitor/sensor/alarming and field installed visual/audible display alarms.
   8. Pipe heat tracing.
   9. Cooling tower vibration switch/interlock/reset.
   10. Field interlock wiring from chiller: flow switches, pump aux. Contacts, pump start/stop.
   11. Power supply 120 VAC and control signal from chiller control panel to condenser water flow control valve installed in piping leaving chiller.
   12. Wiring of all related circulating water system chemical treatment devices.
      a. Low voltage electric contacting water meter
      b. Solenoid valve/blow-down assembly
   13. Radiant heater timer switches and/or thermostats
   14. Low Voltage thermostat wiring

C. Refer to Division 23 Controls Sections for related control system wiring.

D. Refer to Division 23 sections for specific individual mechanical equipment electrical requirements.

E. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment.

F. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

1.2 RELATED WORK

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

A. Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.

B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.1 MOTORS

A. Provide motors for mechanical equipment manufactured by one of the following:
1. Baldor Electric Company.
2. Century Electric Div., Inc.
3. General Electric Co.
4. Louis Allis Div.; Litton Industrial Products, Inc.
5. Lincoln Electric
6. Marathon Electric Mfg. Corp.
7. Reliance Electric Co.
8. Westinghouse Electric Corp.
9. WEG

B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of mechanical equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of mechanical work:

C. Temperature Rating. Rated for 40 Degrees C environment with maximum 50 Degrees C temperature rise for continuous duty at full load (Class A Insulation).

D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.

E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 23 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.

F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.

G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
1. Frames. NEMA #56.
2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.

3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 23 for other enclosure requirements.
4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: Provide "Quiet" rating on motors.

H. All motors shall be premium efficiency.

I. Provide an inverter duty motor on all equipment that utilizes a variable frequency drive.

2.2 EQUIPMENT FABRICATION

A. Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

2.3 GENERAL REQUIREMENTS – SHAFT GROUNDING RINGS

A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR’s Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, or approved equal.

B. Application Note: Motors up to 100 HP shall be provided with one shaft ground ring installed on either the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors on motor mounting systems in accordance with motor manufacturer’s instructions, anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Verify voltage with Electrical Plans.

END OF SECTION

SECTION 23 05 14

HVAC CONDENSATE DRAIN PIPING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide and install air conditioning condensate drains.

1.2 RELATED WORK

A. Division 23 - Mechanical
   1. Insulation
   2. Fan/Coil Units
   3. Air Handling Units
   4. Chilled Water Pumps
   5. Air Compressor Storage Tanks
   6. Equipment Drain Pans
   7. Heat Pump Units

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

A. Type “L” copper with drainage pattern fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the system to facilitate easy removal.
   1. Use threaded plugged tee at each change of direction to permit cleaning.
   2. Install a cleanout every 50 feet of straight run piping
   3. Maintain a positive slope on all piping

B. Install a water seal trap leg based on the fan pressure.
   1. Size the length of the trap leg 1 inch larger than the actual system pressure.

C. Install traps and cleanout as shown in the drawing details.
   1. Confirm requirements with manufacturer's installation instructions

3.2 SIZE PIPE AS SHOWN ON DRAWINGS.

A. Do not install piping sized smaller than the unit drain connection size.

3.3 SECONDARY DRAINS

A. Provide secondary drains where required by code, shown on the drawings, or where equipment has secondary drain connections.

END OF SECTION

SECTION 23 05 18

VARIABLE FREQUENCY INVERTER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a variable frequency inverter for the following equipment items.
   1. Variable Volume Air Handling Units.
   2. Pumps.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Electrical Provisions of Mechanical Work.
   2. Air Handling Units
   3. Pumps
   4. Building Management Control System Sequences

1.3 COOPERATION WITH OTHER TRADES

A. Coordinate this work with work under Division 26 Electrical to ensure that intended functions are achieved.

B. Coordinate the size of the variable frequency inverter with the equipment being served by the inverter. The rated current output amps are to be equal to or greater than motor rated full load amps.

1.4 SUBMITTALS

A. Submit manufacturer's information and shop drawings as specified.
   1. Complete technical details.
   2. Dimensions and manufacturer's installation manual.
   3. Schematic diagrams of the circuitry and field connections.
   4. Manufacturer's start-up manual.

1.5 STANDARDS

A. UL.

B. CSA.

C. ISO 9001

D. NEC.

E. FCC.

1.6 WARRANTY

A. The manufacturer shall provide a full parts and labor warranty for a period of five (5) years from substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. ABB

B. Danfoss Graham

2.2 CABINET

A. The inverter and all accessories shall be provided within a wall mounted UL Listed NEMA 12 enclosure with deadsides and removable hinged, gasketed doors with provisions for locking. Cabinet shall be constructed of metal for reduction of radio frequency interference (RFI) and electromagnetic frequency interference.

2.3 INTERFERENCE WITH OTHER SYSTEMS

A. The inverter shall be designed and constructed to comply with IEEE Standard 519-1993 with respect to line noise and RFI generation. All units shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in Table 1.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

B. Dual DC Bus filtered chokes (factory installed and wired in the drive enclosure) equivalent to 5% input line reactors shall be provided to minimize harmonics reflected onto the input line.
   1. Shall not interfere with computer and other electronic systems in the building.
   2. If not inherently protected, provide a suitable isolation transformer.
   3. The system shall not produce spikes on the incoming line.

C. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.

2.4 PROTECTIVE CIRCUITS

A. Provide the following protection:
   1. Input line fuses or molded case circuit breaker rated at 100 AIC.
   2. Input line noise suppression with MOV's (metal oxide varistors) and snubber circuits. MOV's shall be provided across incoming line terminals, AC input reactors, DC choke filters, and transistors to protect inverter from voltage surges and spikes.
   3. Protection of solid state inverter devices by limiting output current to 110% of inverter rating, automatically prevent overcurrent trip due to momentary overload conditions.
   4. Current limiting DC buss fuse between input and output sections of inventor.
   5. Input overvoltage trip at 480 vac + 10% trip.
   6. Input undervoltage at 480 vac – 10% trip
   7. Instantaneous overcurrent protection of solid state inverter devices.
   8. Individual overcurrent protection of solid state inverter devices.
   9. Output overvoltage trip.
   10. Loss of input phase, phase reversals, or blown fuse.
   11. Thermal overload trip for overload protection of solid state devices.
   12. Ground fault protection on start-up.
   13. Output line to line short circuit protection.
   14. Phase to phase short circuit or severe overload conditions of output.
   15. Overload of motor.
   16. Frequency stall.
   17. DC buss high voltage.

18. Control function error.
19. Heatsink over temperature (Max. operating ambient: 122 degrees F)
20. Controller able to operate without a motor or any other equipment connected to the output (To facilitate startup and troubleshooting).
21. Capable of restarting into a rotating motor without component damage.
22. Shut down safely without component failure in the event of a sustained power loss, and will automatically return to normal operation, if start is "on" and power is restored.
23. Shut down safely without component failure in the event of a momentary power loss. Automatically return to normal operation if the start is "on", and normal power is restored. Capable of establishing speed control without shutdown or component failure.
24. Designed for input power contactor opening or closing while control is activated, without damage to the controller.
25. Automatically reset trip resulting from overcurrent, undervoltage, overvoltage, or over temperature, and automatically restart after removal, or correction of the faulty condition.
26. Provide status lights or digital display for indication of failure conditions, and form C relay provided for remote indication. Digital display or status lights to indicate power on, at speed, and drive enabled.
27. Operation and fault diagnostic function circuits shall be built into each inverter that provides information in determining the cause and source of a fault. Diagnostics to provide the following information:
    a. Operating mode at trip (Accel, Decel, Constant speed).
    b. Output current at trip.
    c. Output voltage at trip.
    d. Additional faults that occurred simultaneously of immediately before displayed tripped.

    Any drive requiring separate card to provide this information shall provide a diagnostic card for each drive.
28. DC link reactor.
29. Input power disconnect, lockable type.
30. Input power disconnect switch / circuit breaker, with lockable type handle.

2.5 OPERATOR DEVICES

A. The following operator devices shall be door or remote mounted:
1. Digital keypad and LCD provided to perform all parameter adjustments, operation monitoring, and operation programming.
2. Power on indication light.
3. Flush mounted meters or digital display to indicate output voltage, output frequency, and output current, in percent of maximum 0 to 100%.
4. Manual/Off/Auto 3 position selector switch (hand-off-auto) and manual speed setting control to provide the following control sequences:
    a. In automatic mode, controller shall follow an external control signal and respond to remote start-stop contact.
    b. In manual (hand) mode, controller shall follow speed signal set via door mounted keypad and start/stop switch. Switching from “hand” to “auto” and vice versa shall require a single keystroke to a dedicated changeover key. Inverters requiring multiple keystrokes and/or reprogramming of internal parameters to accomplish changeovers are not acceptable.
    c. An integral "safety interlock" protection shutdown circuit shall be provided for interface with firestats, smoke detectors, high static pressure limit switches, vibration switches, etc.
5. Programmable lockout code to prevent unauthorized programming.
6. Critical frequency avoidance capability (up to 3 resonant points).

2.6 FIELD ADJUSTMENTS

A. The following shall be adjustable in the field:
   1. Maximum Speed: 0 to 125% adjustable.
   2. Minimum Speed: 0 to 100% adjustable.
   3. Acceleration/deceleration rates: 0 to 3600 sec.
   4. Instantaneous overcurrent trip: 50% to 2000%.
   5. Volts/hertz ratio: Field adjustable to 16 patterns or set for automatic selection of proper V/F load profile to operate motor without overdriving or overloading.
   6. Current limit circuit: 60 to 100%.
   7. Carrier frequency: 6 to 16 KHZ.
   8. Control interface: selectable to follow a 0-5 VDC, 0-10 VDC, 4-20 MA, either direct or indirect acting.
   9. Control signal Bias: 0 to 80 HZ.
   10. Control signal gain: 0 to 80 HZ.
   11. Calibration of remote speed signal: 0 to 80 HZ.

2.7 ELECTRICAL CONSTANT SPEED BYPASS

A. Provide all components and circuitry necessary to provide manual bypass of the inverter. The bypass package shall be mounted in a cabinet common with the inverter and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode. Manual bypass shall contain the following:
   1. Two contactors mechanically interlocked via a three position through the door selector switch to provide the following control:
      a. "Inverter" Mode connects the motor to the output of the inverter.
      b. "Bypass" Mode connects the motor to the input sine wave power. Transfer must occur with input disconnect open. Motor is protected via thermal overload.
      c. "Off" Mode disconnects motor from all input power.
   2. A molded case circuit breaker or fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
   3. An input contactor, interlocked with both the thermal motor overload and external safeties which disconnects power to the motor regardless of the mode of operation (either "inverter" or "bypass" mode).
   4. A thermal overload to provide protection of motor in the bypass mode.
   5. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation – “inverter” or “bypass”) in response to a signal from the thermal overload and/or external safety circuits.
   6. Line voltage to 24 volt DC power source, fused per NEC, shall provide power to all bypass control circuits.

2.8 SERIAL COMMUNICATIONS

A. The VFD shall have the capability of communicating with the EMS control system via an RS-485 serial port.

B. VFD shall be provided with protocol information specific to the selected EMS control manufacturer and shall be pre-configured at the factory to automatic communications, without the need for field programming.

C. Serial communications capabilities shall be included, but not limited to: run/stop control, speed set adjustment, proportional/integral or PID control adjustments, current limit and accel/decel time adjustments. The drive shall also have the capability of allowing the DDC system to monitor the following feedback signals: process variable, output speed/frequency, current, torque, power (KW), operating hours, kilowatt hours; relay outputs, and diagnostic warning and fault information.

D. The VFD shall allow the DDC system to control the drive’s digital and analog outputs and

monitor all drive digital and analog inputs via the serial interface.

E. Provide BACnet interface card.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation as per manufacturer's recommendations and requirements.
1. Inverter chassis is properly grounded.
2. Line, Load, Control, and Fire/Safety wiring are installed in separate conduits.
3. Both ends of conduit entering and leaving VFD into AHU cabinets and motors must be sealed air tight.

3.2 MANUFACTURER START-UP SERVICE

A. Factory trained personnel shall be provided for start-up assistance, minimum (1) day per unit.
1. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents.
2. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
3. Adjustable devices, components, and assemblies to assure optimum performance.
4. Make final adjustments to the installed drive to assure proper operation of the fan system. Obtain performance requirements from installer of driven loads.
5. Assistance will be provided to the Owner (upon request) to determine the optimum capacitance for per factory correction and avoidance of potential resonance problems and will determine optimum line filter required.
6. A written report, duly signed by the technician detailing set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.

B. Input DC voltage to dry motor windings when fan is not in operation at the following locations:
1. Cooling tower fan motor
2. Motors downstream of coils
3. Rooftop unit motors

3.3 DEMONSTRATION AND TRAINING

A. Provide system demonstration to personnel, Owner, and/or Owner's selected representatives.

B. Demonstrate operation of controllers in the automatic and manual modes.

C. Provide a minimum of two days of technical training for the owner's operating and technical staff. Schedule training with owner's authorized representatives, during normal business hours and not less than 30 days prior to planned session.

D. Training may be consecutive or random, at Owner's option.

END OF SECTION

SECTION 23 05 19

HVAC PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.2 RELATED WORK

A. Division 23, Mechanical
   1. 23 05 00 - Mechanical General Provisions
   2. 23 20 00 - Pipe and Pipe Fittings, General
   3. 23 05 23 - Valves, Strainers and Vents
   4. 23 21 13 - Hot Water and Chilled Water Piping, Valves and Appurtenances

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

A. Trerice

B. Taylor

C. Marsh

D. Weksler

E. Marshalltown

F. Weiss

G. Miljoco

2.2 PRESSURE GAUGES

A. Case and Ring: 4" type 304 stainless steel; liquid filled case with stainless steel bayonet ring.

B. Dial: White aluminum with black markings

C. Window: Clear acrylic

D. Tube: Phosphor bronze and forged brass socket.

E. Gauge accuracy: +/- 1% over operating range.

F. For pulsating service, provide impulse dampers.

G. Without flange for pipe mounting.

H. With flange for wall mounting.

I. Weiss Model: LF44S-1B or equal.

2.3 THERMOMETER WELLS

A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.

B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.

C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.

D. Wells shall be sized to extend a minimum of 50% into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

A. Die cast aluminum case with baked epoxy finish.

B. Adjustable angle 9" scale length.

C. Clear acrylic window.

D. Brass stem, length to match well.

E. Red reading organic spirit filled-in magnifying glass column.

F. White background with black figures and markings.

G. Brass stems and union connections.

H Accuracy: +/- 1% of scale range.

I. Range:
1. Hot water lines: 30°F to 240°F.
2. Chilled water lines: 0°F to 100°F or 120°F
3. Condenser water: 0°F to 100°F.

2.5 PRESSURE AND TEMPERATURE TEST STATIONS

A. "Test Station" fitting to receive either a temperature or pressure probe. Fitting shall be solid brass with two valve cores of Nordel.
1. Fitted with a color coded cap strap with gasket.
2. Acceptable Manufacturer: Peterson Equipment Company.
3. Provide with extension neck to match insulation thickness.

B. Provide to the Owner a fitted case with:
1. Two 0-100 psi pressure gauges as specified and adapters with 1/8" OD probe.
2. Four 5" stem pocket testing thermometers.
   a. Two with range 25°F to 125°F for chilled water and condenser water.
   b. Two with range 0°F to 220°F for hot water.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with drawing details and manufacturer's recommendations.

B. Provide a ball valve at each gauge.

C. Locate gauges and thermometers to be easily readable from the floor at a 5'-6" eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.

D. Install gauges in the following locations: across pumps, chiller cooler and condenser, storage tanks, heat exchangers.

E. Test wells for automatic temperature controls shall be furnished by Building Management Control Section and installed by Mechanical Contractor.

F. Install thermometer in the following locations: Across chiller cooler and condenser, storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, common chilled and hot water lines.
   1. Hot water lines: 30°F to 240°F.
   2. Chilled water lines: 0°F to 100°F or 120°F
   3. Condenser water 0°F to 100°F.

END OF SECTION

SECTION 23 05 23

HVAC VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC Valves

B. Pipe strainer and suction diffusers.

PART 2 - PRODUCTS

2.1 VALVES

A. Pressure Ratings:
1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450°F.
2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.

B. Butterfly Valves
1. Butterfly valves shall conform to MSS-SP67.
2. Liners, inserts and discs shall be suitable for the intended service.
3. Valves shall have a full lug type body designed for installation between ANSI standard flanges, and shall be rated at full working pressure with downstream flange removed.

C. Balancing Valves
1. Provide balancing valves with:
   a. Corrosion resistant plug with resilient seal when required.
   b. O-ring stem seal.
   c. Permanently lubricated, corrosion resistant bearings.
2. Connections
   a. Through 2" pipe size use threaded connections.
   b. For valves 2-1/2" pipe size and larger shall be provided with 150 psig flange connections.
3. Provide each valve with:
   a. Memory stop.
   b. Plastic drip cap.
   c. 1/8" gauge tap.

D. Ball Valves
1. Provide ball valves with:
   a. Blowout proof stem.
   b. Full size port, 316 stainless steel ball and stem.
   c. Cast bronze body.
   d. Threaded ends.
2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
3. Service rating:
   a. 150 psi saturated steam.
   b. 600 psi WOG.
4. Where piping is insulated, ball valves shall be equipped with 2” extended handles of non-thermal conductive material. Provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.

5. Provide with memory stop for balancing valves.

E. Valve Connections
1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
2. Thread pipe sizes 2" and smaller.
3. Flange pipe sizes 2-1/2" and larger.
4. Use screw to solder adapters for copper tubing.
5. Use grooved body valves with mechanical grooved jointed piping.

F. Valve Operators
1. Where butterfly valves are provided:
   a. Provide gear operators on valves 6" and larger.
   b. Where valves are located 7' or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5' above floor and hook to clips, arrange to clear walking space.
   c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4" and smaller.
   d. Provide worm gear operators on discharge side of pumps for balancing, for all sizes of valves.
   e. All valves 2-1/2” and larger provided by Milwaukee Valve shall be provided with gear operators.

G. Acceptable Manufacturers
1. Dezurik
2. Crane
3. Nibco
4. Keystone
5. Milwaukee Valve

H. Check Valves
1. Bronze body, 2" and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection.
2. Iron body, 2-1/2" and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug.
3. Acceptable Manufacturers
   a. Mission Duochek
   b. Nibco
   c. Keystone
   d. Milwaukee Valve

I. Provide valves of same manufacturer throughout where possible.

J. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.

K. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.

L. Provide valve, seat and trim materials suitable for the intended service.

M. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, caged or ball type.

N. Condenser Water Basin Float Valve:
1. Ductile Iron valve, body and cover
2. Stainless steel trim
3. Fully adjustable high and low level settings
4. Stainless steel float, float linkage and float rod
5. Flow clean strainer
6. CV Flow Control for opening and closing
7. ASTM A 536, B16.42, 150# Class
8. Stilling well
9. Acceptable Manufacturer: CLA-VAL

2.2 PIPE SYSTEMS STRAINERS

A. Body:
1. "Y" pattern or basket as shown on the drawings.
2. Line size.
3. Threaded strainer blow down port.
4. ASTM A #126 Class B Cast Iron Body.

B. Construction:
1. 2" size and smaller with screw connections rated 400 psi WOG.
2. Over 2" size with flanged connections, rated 125 psi WOG.

C. Fabricate screens of Monel or type 304 stainless steel:
1. With 20 mesh woven wire in piping systems through 2".
2. With 0.45 perforations in piping systems 2-1/2" and 3".
3. With 0.125 perforations in piping systems 4" and larger.

D. Start-up:
1. Provide an additional fine mesh disposable screen for use during start-up operations.
2. Remove after 30 days.
3. Attach to piping for owners review.

E. Acceptable Manufacturers
1. Crane
2. Keckley
3. Zurn
4. Mueller
5. McAlear
6. Muesco

2.3 SUCTION DIFFUSER

A. For each pump as shown on the drawing, provide an angle type suction diffuser. Body is to fit both the pump inlet and suction pipe size.

B. Components:
1. Inlet straightening vanes.
2. Removable end cap.
3. Gauge ports.
4. Threaded strainer blow down port.
5. Adjustable support foot.
6. Removable magnetic insert.

C. The screen shall be as specified for pipe system strainers.

D. Provide an additional fine mesh disposable strainer for use during start up operations.
1. Remove after 30 days operation and all flushing is complete.
2. Attach to piping for owners review.

E. Construction:
1. 2" size and smaller with screw connections rated 400 psi WOG.
2. Over 2" size with flanged connections, rated 125 psi WOG.

F. Fabricate screens of Monel or type 304 stainless steel:
1. With 20 mesh woven wire in piping systems through 2".
2. With 0.045 perforations in piping systems 2-1/2" and 3".
3. With 0.125 perforations in piping systems 4" and larger.

2.4 VALVE SCHEDULE

A. Hydronic Service
1. Chilled Water Service
a. Ball Valves up to 2": Nibco T-585-70-66 w/Nib-Seal insulated Handle
b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
2. Heating & Condenser Water Service
a. Ball Valves up to 2": Nibco T-585-70-66
b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
3. Check Valve:
a. Nibco Check Valve: T - 413 - B
b. Nibco Check Valve 2-1/2" and larger: F - 918 - B
c. Nibco Check Valve 2-1/2" and larger: W - 920 -W (Wafer)
d. Keystone Check 2-1/2" and larger: FIQ 810

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.

C. Use butterfly valves and ball valves in circulating water systems, for balancing duty. Provide infinite position gear operator with memory stop.

D. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
1. 1" valve for pipes 6" and larger.
2. 3/4" valve for pipes smaller than 6".
3. Terminate with pipe plug.
4. Drain valves shall be ball valves.

E. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.

F. Provide clearance for installation of insulation and access to valves.

G. Provide access where valves are not exposed.

H. Provide float valves / stilling wells in cooling tower or condenser water basins for water level control.

Provide stilling wells around float valve to prevent turbulence ripples or wind interference.

I. Butterfly valves shall be installed per ASME B31.3 Process Piping, and ASME B16.5 Pipe Flanges and Flanged.

3.3 PIPE SYSTEMS STRAINERS

A. Provide an additional fine mesh disposable strainer for use during start up operations.
   1. Remove after 30 days operation and all flushing is complete.
   2. Attach to piping for owners review.

B. Provide strainer in supply piping for all coil connections.

C. Provide strainer in condenser water piping entering chiller.

3.4 WATER SYSTEM AIR VENTS

A. Provide manual air vents at high points and at any other air pockets of closed circulating pipe systems. Extend 3/8" hard drawn copper tubing discharge drains to nearest floor or hub drain. Provide 1/4" Ball Valve as specified.

B. Where high point vents are not readily accessible provide additional valves at vent termination.

END OF SECTION

SECTION 23 05 33

HVAC PIPE HEAT TRACING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a complete industrial, constant wattage, UL listed system of electric pipe heat tracing and controls on all make-up water piping outdoors above grade to prevent freezing. The heat tracing system shall conform to ANSI/IEEE Standard 515-1989.

B. Protect the pipe, valves, fittings, meters and appurtenances. Apply sufficient cable and overheat thermostat to protect the entire system.

1.2 SUBMITTALS

A. Submit shop drawings and product data as specified in Section 23 05 12

B. Submit detailed calculations for length of heat tracing cable per foot of pipe, based on actual length of piping installed.

C. Submit manufacturer's certified capacity charts with selections plotted thereon.

D. Submit manufacturer's installation instructions.

E. Submit full load ampere requirement and voltage for branch circuit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Raychem Corporation

B. Thermon Manufacturing Company

2.2 COMPONENTS

A. Self-regulating heater.
1. The self-regulating heater shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed itself without overheating and to be cut in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.
2. In order to provide energy conservation, and to prevent overheating, the heater shall have a self-regulating factor of at least 90%.
3. The heater shall operate on a line voltage of 120 VAC without the use of transformers.
4. The heater shall be sized according to the following. The required heater output rating is in watts per foot at 50°F (heater selection based on 1-1/2 inch fiberglass insulation on metal piping).
5. The heater shall be XL-Trace as manufactured by Raychem Corporation or XL-Econotrace as manufactured by Thermon Manufacturing Company.
6. Power connection, end seal, splice and tee kits components shall be applied in the field.

7. The system shall be controlled by an ambient sensing thermostat set at 40°F either directly or through an appropriate contactor.
8. Provide an end-of-circuit voltage indicating light

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and start up the pipe heat tracing system in accordance with the manufacturer's Installation, Start-up and Service Instructions.

B. Install the pipe heat tracing cable under the pipe insulation.

C. Apply “Electrically Traced” signs to the outside of the thermal insulation.

D. Ground fault protection of the equipment shall be provided per the 1996 National Electrical Code, Article 427-22.

E. Provide a cast aluminum weatherproof NEMA-4 rated junction box for installation of the cable, with pilot light to indicate operation of the cable.

F. Use only electrical components as recommended by the manufacturer.

3.2 ELECTRICAL WORK

A. Furnish and install the wire, conduit and raceway systems required for the automatic operation of the pipe heat tracing system. Conform to the National Electrical Code.

B. The specified wiring work includes:
1. Wiring of control instruments between thermostat and junction boxes
2. Installation of thermostat and junction boxes
3. Wiring from the heat tracing cable to the junction boxes

C. Related branch circuit power wiring from the junction box to ground fault type circuit is specified to be provided in Division 26.

D. Provide devices and appurtenances as specified in Division 26.

E. Identify each circuit at each terminal with a separate tag.

F. Color code wires in accordance with IPCEA Standards.

G. Make all joints and connections with approved mechanical connectors.

3.3 TESTING OF THE PIPE HEAT TRACING SYSTEM

A. Test the pipe heat tracing system:
1. Simulate freezing outside air conditions
2. Measure the amperage draw of the heat tracing system
3. Compare to the manufacturer's capacity rating of the actual system
4. After installation and before and after installing the thermal insulation, subject heat to testing using a 1000 VDC megger. Minimum insulation resistance should be between 20 to 1000 megohms regardless of the length.

B. Submit records of test for approval prior to substantial completion; insert in the Owner's Manual.

END SECTION

SECTION 23 05 48

VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SCOPE

A. Furnish, install, and adjust vibration isolation.

1.2 RELATED WORK

A. Division 23 Mechanical.
   1. Refer to the Section on Ductwork for flexible connections between fans and ducts.
   2. Refer to the Section on Equipment Supports for equipment foundation pads.

1.3 SUBMITTALS

A. Submit product data showing type, size, load, deflection and other information required. Include clearly outlined procedures for installing and adjusting isolators.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Amber Booth
B. Kinetics
C. Mason
D. Korfund
E. VSI.
F. Vibration Eliminator Co., Inc.
G. Metraflex

2.2 ISOLATOR TYPES

A. Neoprene mountings shall have a minimum static deflection of 0.35 inches (9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.

B. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or ¼ inch (6mm) neoprene acoustical friction pad between the base plate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

C. Hangers shall consist of rigid steel frames containing minimum 1-1/4 inch (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification B seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.

D. Flexible spherical expansion joints shall employ Peroxide cured EPDM in the covers, tubes and frictioning of the reinforcement. Reinforcement must be DuPont Kevlar. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. No substitutions for the DuPont Kevlar or the solid steel embedded flange rings are acceptable. Sizes 2 inch (50mm) and larger shall have two spheres reinforced with a metal ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16 inch (400m) to 24 inch (600mm) may be single sphere. Sizes 3/4 inch (20mm) to 1-1/2 inch (40mm) may have threaded bolted flange assemblies, one sphere and cable retention. 14 inch (300mm) and smaller connectors shall be rated at 250 psi (17 BAR) up to 190°F (88°C) with a uniform drop in allowable pressure to 190 psi (13 BAR) at 250°F (121°C). 16 inch (400mm) and larger connectors are rated 180 psi (12 BAR) at 190°F (88°C) and 135 psi (9 BAR) at 250°F (121°C). Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.

High pressure joints shall be substituted for the above where operating pressures are higher than standard. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. Control rods are not desirable in seismic work. If control rods are used, they must have ½- inch (12mm) thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi (6.9 N/mm5) maximum on the washer area. Standard diameter bolt washers are not acceptable.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves.

2.3 ISOLATOR APPLICATION

EQUIPMENT	ISOLATOR TYPE	MINIMUM DEFLECTION
Pump (Above Grade)	B	1.5”
Suspended Fan Coil Units	C	0.5”
Floor Mounted Fan Coil Units	A	0.35”
Condensing Units	A	0.35”
In-Line Fans	C	0.5”

2.4 PIPING ISOLATOR APPLICATIONS

EQUIPMENT	ISOLATOR TYPE
Floor Mounted Pumps	D
Suspended Pumps	D

2.5 FLEXIBLE CONNECTIONS IN PIPING AT PUMPS

A. Provide flexible connections at suction and discharge of chilled water, and hot water pumps, piping

connections on chillers and where indicated on drawings. Refer to schedule above.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Stock Requirements. The isolation manufacturer's representative shall maintain an adequate stock of springs and isolators of type used so that changes required during construction and installation can be made.

B. Factory Representation. After installation, furnish factory-trained representative of the isolation manufacturer to check various isolators and report measured versus anticipated deflection on all isolators. Have the representative certify that isolators have been installed in accordance with manufacturer's recommendations and approved submittals. Provide written report to Engineer indicating compliance prior to final acceptance.

END OF SECTION

SECTION 23 05 93

TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Balance, adjust and test the air distribution system including the exhaust system.

B. Balance, adjust and test the hydronic system.

C. Verify and record the duct test results performed by the mechanical contractor.

1.2 RELATED SECTIONS

A. COORDINATION OF TESTING AND BALANCING

1.3 PAYMENT PROCEDURES

A. The work of this Section of the Specifications shall bid the project directly to the General Contractor.

1.4 SUBMITTALS

A. History of the TAB organization.

B. Agency certification.

C. Personnel qualifications.

D. TAB data forms.

E. Instrumentation list.

F. Name of the project supervising engineer.

G. Name and address and contact person of five successfully completed projects of similar size and scope.

H. To perform required professional services, the balancing agency shall have a minimum of one test and balance engineer certified by the Associated Air Balance Council.

1.5 TAB FIRM QUALIFICATIONS

A. The organization performing the work shall be a Certified member in good standing of the (AABC) Associated Air Balance Council.

B. Able to furnish evidence of having contracted for and completed not less than five systems of comparable size and type that have served their Owners satisfactorily for not less than five years.

C. A specialist in this field and have the personnel, experience, training, skill, and the organization to perform the work.

D. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the engineer to determine the balancing agency's performance

capability.

E. The balancing agency shall have operated for a minimum of five years under its current name.

F. Personnel:
1. The project supervisor shall be a Professional Engineer registered in Texas.
   a. Extensive knowledge of the work involved.
   b. At least five years experience conducting tests of the type specified.
   c. This test and balance engineer shall be responsible for the supervision and certification of the total work herein specified.
2. All work shall be conducted under the direct supervision of the supervising engineer.
3. Technicians shall be trained and experienced in the work they conduct.

1.6 WARRANTY

A. Provide (AABC) guarantee in writing.

B. Extended warranty.
1. Include an extended warranty of 2 years after completion of test and balance work, during which time the Architect/Engineer may request a retest or resetting of any outlet or other items as listed in the test report.
2. Provide technicians and instruments to assist the Architect/Engineer in making any tests he may require during this period.
3. The balancing agency shall perform an inspection of the HVAC system during the opposite season from that which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

PART 2 - PRODUCTS

2.1 PREFFERED PROVIDER

A. Costal Air Balance

B. Engineered Air Balance

C. Tab Technologies

PART 3 - EXECUTION

3.1 TAB TOLERANCES

A. The water, outside air, supply air, return air, and exhaust air for each system shall be adjusted to within +/- 5% of the value scheduled on the drawings.

3.2 SITE VISITS

A. During construction, the balancing agency shall inspect the installation of the piping systems, sheetmetal work, temperature controls, energy management system, and other component parts of the heating, ventilating, and air conditioning systems. One inspection shall take place when 60% of the ductwork is installed and another inspection shall take place when 90% of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the architect and engineer.

B. Upon completion of the installation and start-up of the mechanical equipment by the mechanical contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space of the building. If construction deficiencies are encountered

that preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the mechanical contractor within a reasonable period of time, the balancing agency shall cease testing and balancing services and advise the architect, engineer, general contractor and owner, in writing, of the deficiencies.

C. Note proper piping installation, location of valves, and flow measuring instruments.

D. Make one series of visits, phased as required by construction progress, prior to installation of the ceiling. Note proper installation of balancing dampers.

E. Continue the site visits up to completion of project. In each succeeding report, list corrections made from previous reports.

3.3 TESTING INSTRUMENTS

A. Submit a list of all instruments to be used for the test and balance procedures.
1. Catalog sheets
2. Certificate of last calibration
3. Calibration within a period of six months prior to balancing

B. Testing equipment shall be in good working order and tested for accuracy prior to start of work.

3.4 COORDINATION WITH OTHER SPECIFICATION SECTIONS

A. Review the related ductwork shop drawings and piping shop drawings. Make recommendations concerning suitability with respect to the testing, balancing and adjusting work.

B. Make tests to verify proper placement of the static pressure sensors for the variable air volume fan system control.

C. In cooperation with the work specified in Building Management and Control System section, a systematic listing of the testing and verification shall be included in the final TAB report. The TAB firm shall provide a laptop computer to operate with the Building Management and Control System. Building Management and Control System shall provide all necessary software and special interface cables, as required, to communicate with the DDC system:
1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of the intended control performance.
2. Verify that all control devices are properly connected.
3. Verify that all dampers, valves, and other controlled devices, are operated by the intended controller.
4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
5. Verify the integrity of valves and dampers in terms of tightness of close-off and full open positions. This includes dampers in multizone units, terminal boxes and fire/smoke dampers.
6. Observe that all valves are properly installed in piping system in relation to direction of flow and location.
7. Observe the calibration of all controllers.
8. Verify the proper application of all normally opened and normally closed valves.
9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
10. Observe the location of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control contractor will relocate as deemed necessary by the Engineer.
11. Verify that the sequence of operation for any control mode is in accordance with the approved shop drawings and specifications. Verify that no simultaneous heating and

cooling occurs.

12. Verify the correct operation of all interlock systems and installation is per the manufacturer recommendations.
13. Check all dampers for free operation.
14. Verify that all controller setpoints meet the design intent.
15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.

D. Upon completion of the testing and balancing, submit three days prior notice that the systems are ready for a running test. A qualified representative of the test and balance organization shall be present, with a representative from the engineers office, to field verify TAB report readings. Specific and random selections of data recorded in the certified test and balance report will be reviewed.

3.5 INSTRUMENT TEST HOLES

A. When it is required to make holes in the field to measure temperature, static pressure or velocity in the ducts:
   1. Drill holes, plug and tape external duct insulation.
   2. Repair damaged insulation to Engineer’s approval.

3.6 TESTING THE AIR DISTRIBUTION SYSTEM

A. The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set full open. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
   1. Supply Fans:
      a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
      b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
      c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main supply and return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
      d. Outside Air: Test and adjust the outside air on applicable equipment using a Pitot-Tube traverse. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. If a traverse is not practical, use the mixed air temperature method, if the inside and outside temperature difference is at least 20°F, or use the difference between Pitot-tube traverse of the supply and return ducts.
      e. Static Pressure: Test and record system static pressure, including the static pressure profile of each supply fan.
   2. All Other Fans:
      a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
      b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
      c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
      d. Static Pressure: Test and record system static pressure, including the static pressure profile of each return fan.

3. VAV Terminal Units:
    a. Set and record volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
    b. Identification: Identify the type, location, and size of each terminal unit. This information must be recorded on the terminal box data sheets.
4. Diffusers, Registers and Grilles:
    a. Tolerances: Test, adjust, and balance each diffuser, grille, and register to within 5% of design requirements. Minimize drafts. Observe throws are in direction as indicated on drawings.
5. Coils (including electric coils):
    a. Air Temperature: Once air flows are set to acceptable limits, take wet bulb (cooling coil only) and dry bulb air temperatures on the entering and leaving side of each coil. Calculate the sensible and latent (cooling coil only) capacity of the coil. Provide information in TAB report.

B. Record preliminary air handler data, including fan RPM and static pressures across filter, fans and coils.

C. Perform a velocity traverse of the main supply ducts using a pitot-tube and inclined manometer to establish initial air delivery. Perform a Pitot-tube traverse of main supply and return ducts, as applicable, to obtain total CFM. If a pitot-tube traverse is not practical, a detailed explanation of why a traverse was not made must appear on the appropriate data sheet.

D. Where air measuring stations are installed, use pitot tube traverse readings to verify and record the correct calibration of the stations output.

E. Make adjustments in fan RPM and damper settings, as required, to obtain design supply air, return air, and outside air.

F. Measure and adjust all supply and return branches to design air delivery.

G. Measure and adjust all diffusers to design air delivery to +/- 5% of design requirements.

H. Make a set of recordings showing final system conditions.

3.7 TESTING THE HYDRONIC SYSTEMS

A. The TAB agency shall, as applicable, verify that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; that water has been flushed and is in a clean condition, and that all balancing valves (except bypass valves) are set full open. As applicable, check air vents and expansion or compression tank for proper operation. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
1. Record preliminary pump data.
    a. Pump RPM.
    b. Pump shut-off differential head.
    c. Pump operating differential head.
    d. Check and verify pump alignment.
    e. Verify impeller diameter.

B. Adjust balancing valves in the pump discharge lines to obtain design water quantity as read from the manufacturer's pump curve and from a flow meter.

C. In variable flow systems, the water flow of the pump shall be set at the scheduled gpm, not the total of all the valves. Determine the diversity of the system and balance the individual coils with the maximum pump water quantity flowing in the system.

D. Balance flow through:
   1. Chillers.
   2. Coils.
   3. Boiler.
   4. Pumps
   5. Condensers.
   6. Cooling tower.
   7. Heat Exchanger.

E. Use flow meters, differential pressures and temperature relationships as required.

F. Balance by-pass lines to obtain the same pressure drop with systems on by-pass as full flow through the coil including the valve.

G. Repeat steps, as required, to obtain a final systems balance and make a set of recordings showing final systems conditions.

H. Pumps:
   1. Test and adjust pumps to meet design water flow requirements. Check pumps for proper operation. Pumps shall be free of vibration and cavitation Record appropriate gauge readings for final TDH and Block-Off\Dead head calculations. Check and verify pump alignment.
   2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.

I. Coils:
   1. Tolerances: Test, adjust, and balance all chilled water and hot water coils within 5% of design flow requirements.
   2. Verification: Verify the type, location, final pressure drop and water quantity (GPM) of each coil. Calculate the actual capacity of all coils. This information shall be recorded on coil data sheets.

J. Boilers:
   1. Verify that boilers have been filled and started by others, and are in operation.
   2. Current and Voltage: As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
   3. Test, adjust and record water flows through water boilers.
   4. Test and record water temperature profiles of each boiler.

K. Chillers:
   1. Verify that chillers have been started by the manufacture and are in operation. Test and adjust chiller water flows to within 5% of the design requirements by using a U-TUBE manometer and setting balancing valves.
   2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.
   3. Test and record temperature profiles of each chiller at design water flow.

L. Cooling towers:
   1. Verify that cooling towers have been filled and started by others and are in operation.
   2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure cooling tower fan motor is not in or above the service factor.
   3. Test and adjust water flows to balance tower cells and flows between towers.
   4. Test and record water temperature profiles of each condenser at design water flow for water and air side operation.

M. Heat exchangers:
1. Verify that heat exchangers have been filled and started by others, and are in operation.
2. Test and record temperature and pressure profiles of water and steam heat exchangers.

3.8 EQUIPMENT POWER READINGS

A. Record the following information for each motor:
1. Equipment designation.
2. Manufacturer.
3. Unit model number and serial number and frame.
4. Motor nameplate horsepower; nameplate voltage; phase and full load amperes.
5. Heater coil in starter.
a. Rating in amperes.
b. Manufacturer's recommendation.
6. Motor RPM/driven equipment RPM.
7. Power reading (voltage, amperes of all legs at motor terminals).

3.9 BOILERS

A. Check for proper operation and with operation at near design conditions, record the following:
1. Manufacturer, model number, serial number and nameplate.
2. If water type, water flow in GPM, entering and leaving water temperature and water pressure drop in feet.
3. Type of fuel and heating value.
4. Rate of fuel consumption.
5. Capacity in MBH.
6. Efficiency.
7. Flue gas analysis.
8. Motor data.

B. Observe demonstration that all controls and safety devices are functioning properly. Record observations.

3.10 CHILLERS (Water Cooled)

A. Balance flow of water thru each evaporator and condenser to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the manufacturer.

B. Verification of safety interlocks and controls are the responsibility of the manufacturer.

C. With each chiller operating at near design temperature and water flow conditions, measure and record the following:
1. Manufacturer, model number, serial number and all nameplate data.
2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
3. Condenser water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
4. Evaporator and condenser refrigerant temperatures and pressures (using instruments furnished with the machine by the manufacturer).
5. Volts and amps for each phase.
6. Power factor.
7. KW input.
8. Tons of cooling.
9. KW per ton of cooling.

D. Reference chiller specification for additional requirements.

3.11 CHILLERS (Air Cooled)

A. Balance flow of water through each evaporator to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the manufacturer.

B. Verification of safety interlocks and controls are the responsibility of the manufacturer.

C. With each chiller operating at near design temperature conditions, measure and record the following:
1. Manufacturer, model number, serial number and all nameplate data.
2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
3. Condenser air entering temperature, leaving temperature.
4. Evaporator and condenser refrigerant temperatures and pressures (using instruments furnished with the machine by the manufacturer).
5. Volts and amps for each phase.
6. Power factor.
7. KW input.
8. Tons of cooling.
9. KW per ton of cooling.

D. Reference chiller specification for additional requirements.

3.12 TESTING THE VARIABLE AIR VOLUME SYSTEM

A. All VAV boxes used are to be calibrated to produce the rated air quantity.

B. Set and record the supply air static pressure controller to provide actual design air flow at the most resistive terminal.

C. Measure and adjust the design air delivery at the inlet of each VAV box.

D. Measure and record the air quantity from each VAV box at its maximum flow. Manipulate the controller to achieve maximum flow.

E. Reset each box to yield and record minimum primary air flow.
1. DDC controllers record the correction factor required to establish actual desired air quantity as designed.
2. Pneumatic controllers adjust velocity controller as required to establish actual desired air quantity as designed.

F. If the box is operating with inlet static pressure in excess of the minimum cataloged pressure specified by the manufacturer and is not producing rated air quantity, field adjust the box to produce rated air quantity. Retest until approved results are obtained.

G. Position the VAV boxes to the proportion of maximum fan air volume to total installed box maximum volume.

H. Set the fan to deliver the AHUs scheduled design airflow.

I. Perform and record a total air traverse.

J. With the system terminal boxes set for full flow or diversity, the system will be delivering the scheduled design CFM with the most restrictive box in control. Make a speed increase if either or

both static and volume are low.

K. Set the boxes to minimum and adjust the inlet vanes and or speed controllers to prevent excessive static in the system.

L. Coordinate with the work specified in Building Management and Control System on the final location of the sensors for the static pressure controller. Locate in the supply duct far enough from the fan discharge to be truly representative of the average static pressure in the system.

M. Modulate the fan speed on the supply fan. Adjust as required to coordinate with the static pressure sensing network.

N. Make a set of recordings showing final system conditions including system duct static pressures and control system setpoint.

3.13 DUCT TEST

A. Test and Balancing Contractor shall verify and record the duct test results. A copy of the duct test results, as completed, shall be submitted to the engineer for review within five days. Provide a complete report of all the duct test results in the final TAB report.

3.14 DIRECT EXPANSION EQUIPMENT

A. With each unit operating at near design conditions, measure and record the following:
1. Manufacturer, model number, serial number and all nameplate data.
2. Ambient temperature, condenser discharge temperature.
3. Amperage and voltage for each phase.
4. Leaving and entering air temperatures.
5. Suction and discharge pressures and temperatures.
6. Tons of cooling.
7. Verification that moisture indicator shows dry refrigerant.

3.15 COOLING TOWERS

A. A complete CTI certified test of the cooling tower will be performed by others at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB Report. Balance the flow over and through bypass connections of the tower.

3.16 TAB REPORT

A. The activities described in this specification shall be recorded in a report form; and four individually bound copies shall be provided to the Architect and Engineer. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of the test instruments used and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy any incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. Provide a "Preface" which shall include a general discussion of the system and any abnormalities or problems encountered.

B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been recorded on site by the permanently employed technicians or engineers of the TAB firm.

C. Submit reports on forms approved by the engineer that will include the following data as a minimum:
1. Title Page
a. Company Name

b. Company Address
c. Company telephone number
d. Project name
e. Project location
f. Project Manager
g. Project Engineer
h. Project Contractor
I. Project Identification Number

2. Summary of the TAB report data
3. Index
4. Instrument List
   a. Instrument
   b. Manufacturer
   c. Model
   d. Serial Number
   e. Range
   f. Calibration Date
   g. What test instrument is to be used for:
5. Fan Data
   a. Location
   b. Manufacturer
   c. Model
   d. Air flow, specified and actual
   e. Total static pressure (total external) specified and actual
   f. Inlet pressure
   g. Discharge pressure
   h. Fan RPM
6. Return Air/Outside Air Data
   a. Identification/location
   b. Design return air flow
   c. Actual return air flow
   d. Design outside air flow
   e. Actual outside air flow
   f. Return air temperature
   g. Outside air temperature
   h. Required mixed air temperature
   I. Actual mixed air temperature
7. Electric Motors
   a. Manufacturer
   b. HP/BHP
   c. Phase, voltage, amperage, nameplate, actual
   d. PM
   e. Service Factor
   f. Starter size, heater elements, rating
8. V-Belt Drive
   a. Identification/location
   b. Required driven RPM
   c. Drive sheave, diameter and RPM
   d. Belt, size and quantity
   e. Motor sheave, diameter and RPM
   f. Center-to-center distance, maximum, minimum and actual
9. Duct Traverse
   a. System zone/branch
   b. Duct size
   c. Area
   d. Design velocity
   e. Design air flow

f. Test velocity
g. Test air flow
h. Duct static pressure
I. Air correction factor

10. Air Monitoring Station Data
    a. Identification/location
    b. System
    c. Size
    d. Area
    e. Design velocity
    f. Design air flow
    g. Test velocity
    h. Test air flow
11. Air Distribution Test Sheet
    a. Air terminal number
    b. Room number/location
    c. Terminal type
    d. Terminal size
    e. Correction factor
    f. Design velocity
    g. Design air flow
    h. Test (final) velocity
    i. Test (final) air flow
12. Pump Data
    a. Identification/number
    b. Manufacturer
    c. Size/model
    d. Impeller
    e. Service
    f. Design flow rate, pressure drop, BHP
    g. Actual flow rate, pressure drop, BHP
    h. Discharge pressure
    I. Suction pressure
    j. Total operating head pressure
    k. Shut off, discharge and suction pressures
    l. Shut off, total head pressure
    m. Pressure differential settings
13. Cooling Coil Data
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Entering air DB temperature, design and actual
    f. Entering air WB temperature, design and actual
    g. Leaving air DB temperature, design and actual
    h. Leaving air WB temperature, design and actual
    i. Water pressure flow, design and actual
    j. Water pressure drop, design and actual
    k. Entering water temperature, design and actual
    l. Leaving water temperature, design and actual
    m. Air pressure drop, design and actual
    n. Capacity - sensible and latent
14. Heating Coil Data
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer

e. Entering air DB temperature, design and actual
f. Leaving air DB temperature, design and actual
g. Water pressure flow, design and actual
h. Water pressure drop, design and actual
i. Entering water temperature, design and actual
j. Leaving water temperature, design and actual
k. Air pressure drop, design and actual
l. Capacity

15. Electric Coil Data
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Entering air DB temperature, design and actual
    f. Leaving air DB temperature, design and actual
    g. Electrical Characteristics
    h. Capacity
16. Sound Level Report
    a. Location (Location established by the design engineer)
    b. N C curve for eight (8) bands-equipment off
    c. N C curve for eight (8) bands-equipment on
17. Vibration Test on equipment having 10 HP motors or greater in size.
    a. Location of points:
        1) Fan bearing, drive end
        2) Fan bearing, opposite end
        3) Motor bearing, center (if applicable)
        4) Motor bearing, drive end
        5) Motor bearing, opposite end
        6) Casing (bottom or top)
        7) Casing (side)
        8) Duct after flexible connection (discharge)
        9) Duct after flexible connection (suction)
    b. Test readings:
        1) Horizontal, velocity and displacement
        2) Vertical, velocity and displacement
        3) Axial, velocity and displacement
    c. Normally acceptable readings, velocity and acceleration
    d. Unusual conditions at time of test
    e. Vibration source (if non-complying)
18. Control verification indicating date performed and any abnormalities identified.
    a. Point Location/Description
    b. EMS Readout (Setpoint and Actual)
    c. Actual Readout of all points
    d. Interlocks
    e. Safeties
    f. Variable speed drive tracking with EMS input
    g. Variable speed drive Bypass operation
    h. Sequence of operation

END OF SECTION

SECTION 23 05 94

COORDINATION OF TESTING AND BALANCING

PART 1 - TESTING, BALANCING AND ADJUSTING

1.1 WORK INCLUDED

A. Balancing and adjusting of the environmental systems is specified in Section 23 05 93.

B. Coordination of the work is specified in this Section.

PART 2 - PRODUCTS / NOT USED

PART 3 - EXECUTION

3.1 COORDINATION

A. Bring the work to a state of readiness for testing, balancing, and adjusting.
   1. Install air terminal devices.
   2. Provide specified filters in air handling equipment. Install clean filters just prior to the start of the test and balance work.
   3. Verify lubrication of equipment.
   4. Install permanent instrumentation.
   5. Clean piping systems and fill with clean water.
   6. Complete "Start-up" of equipment.
   7. Check rotation and alignment of rotating equipment and tension of belted drives.
   8. Verify ratings of overload heaters in motor starters.
   9. Verify that safety and operating control set points are as designed and automatic control sequences have been checked.
   10. Provide control diagrams and sequence of operation.
   11. Collect material for maintenance manuals and prepare one manual especially for use in testing and balancing.
   12. Verify that graphic operational data such as start/stop instructions, valve tag schedules, and piping identification schedules have been provided where needed.
   13. Verify that equipment and piping identification work has been completed with valve tags, schedules, and piping identification system.
   14. Comb out fins on extended-surface heat transfer coils where damaged.
   15. Clean all strainers as required.
   16. Remove construction strainers after water is cleaned and treated.
   17. Remove all temporary filters from HVAC equipment.
   18. Provide start-up reports listing all start-up information and manufacturer’s information attached.

B. Provide and install new pulleys and belts as required to effect the correct speed ratio. Adjustments where no belt or pulley change is required, is specified in Section 23 05 93.

C. Verify that the systems are ready for balancing and adjusting.

D. Submit a letter stating:
   1. The specified pieces of equipment have been checked, started, and adjusted by the manufacturer.
   2. Other equipment has been checked and started.
   3. The systems have been operated for the specified period of time.
   4. The automatic controls system has been adjusted, calibrated, and checked, and is operating as specified.

E. Provide the services of a technician full time at all times at the project when testing, balancing and adjusting work is being conducted.

F. Provide instrumentation and services to take readings of the required data for the refrigerant circuits.

G. Provide and install volume dampers required for balancing by the TAB Contractor.

3.2 START-UP OF EQUIPMENT

A. Pre-start & Start-up equipment using the procedures as recommended by the manufacturers.

B. Complete start-up of equipment prior to start of testing & balancing.

C. Submit start-up procedures as outlined by the manufacturers and complete the "HVAC FAN / AIR HANDLING / START-UP REPORT FORM" to Engineer.

HVAC FAN / AIR HANDLING UNIT / START-UP REPORT FORM														
Equipment Description	*Actual*			*Disc. Switch Wired*	*Rotation Correct*	*Belt*		*RPM Correct Submittal*	*Vibration Isolation Correct*	*Attachment To Roof Curb*	*List Of Damage Parts*	*Bearings Lubricated*	*Filter Installed*	*Interlocks & Dampers Operational*
	Voltage	*Amps*	*HP*			*Condition & Part #*	*Tension Correct*							

END OF SECTION

SECTION 23 07 13

EXTERNAL DUCT INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install external insulation on supply, return, and outside air ductwork.

B. External insulation of concealed and exposed ducts is included in this Section. Internal acoustic duct lining is specified under ductwork and not included in this Section.

1.2 RELATED WORK

A. Division 9 - FINISHES. Painting and Color Coding.

B. Division 23 - MECHANICAL.
1. Air Handling Units. Internal insulation for air units is specified in the sections on air handling units. The units do not require external insulation.
2. Internal Duct Liner. Internal duct liner is specified in the section on ductwork.
3. Insulation. Refer to specific sections on individual insulation types.
4. Refer to insulation and liner plan detail.

1.3 QUALITY ASSURANCE

A. The intent of insulation specifications is to obtain superior quality workmanship, resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.

B. An approved contractor for this work under this Division shall be:
1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

C. All duct insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.

D. Condensation on any insulated system is not approved.

E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.

F. Where existing insulated ductwork or other services are tapped, remove existing insulation back to undamaged sections and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.4 APPROVALS

A. Submittals. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location, and the manufacturer's installation instructions for each product.

B. Sample Application. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.1 INSULATION

A. Glass fiber rigid duct insulation.
1. Minimum density of 3 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.7 mil aluminum foil reinforced with glass yarn mesh and laminated to 40 lbs. fire-resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
2. Acceptable Manufacturers
   a. Schuller 814 spin-glas FSK.
   b. Owens-Corning Type 703 board RKF.
   c. Knauf 3 PCF FSK.

B. Glass fiber blanket duct insulation.
1. Minimum density of 1.0 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs. fire resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
2. Acceptable Manufacturers
   a. Manville R-series Microlite FSKL.
   b. Owens-Corning ED100 RKF.
   c. Knauf 1.0 PCF FSK.

C. Fiberglass reinforcing cloth mesh.
1. Acceptable Manufacturers
   a. Perma Glass Mesh.
   b. Alpha Glass Mesh.
   c. Childers Chil-Glas #10
   d. Foster Mast a Fab
   e. Vimasco.

D. Mastics, sealants, coatings and adhesives.
1. Acceptable Manufacturers
   a. Childers.
   B. Foster.
   c. Vimasco.

E. Fireboard Insulation
1. Totally encapsulated with foil facing.
2. Two hour rated fire protection.
3. Zero clearance to combustible protection.
4. System shall be listed and labeled by an NRTL.
5. Tested per ISO 6944, Type A Duct and achieve a 2 hour rating for stability, integrity and insulation.

6. Provided system is subject to the approval of the Local Authority Having Jurisdiction.
7. Acceptable Manufacturers
    a. Unifrax ON Fyrewrap Elite 1.5
    b. Partak Insulation, Inc. Paroc Fireboard
    c. Thermal Ceramics FireMaster 3M
    d. Premier Refractories International, Pyroscat.

F. Rigid Closed Cell Insulation
1. Acceptable Manufacturers
    a. Dow Trymer.
    b. Phenolic Foam.

G. Reinforced Foil Tape
1. Acceptable Manufacturers
    a. Venture 1525CW
    b. 3" FSK
2. Thickness 6.5 mils
3. Color: silver

2.2 COATING AND ADHESIVE

A. Coating. Provide Childers CP-38 or Foster 30-80 vapor barrier coating. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100ºF and 90% RH per ASTM E96.

B. Outdoors: Provide as insulation coating Childers Encacel X or Foster Monolar 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100ºF and 90% RH per ASTM F 1249.

C. Adhesive. Provide Childers CP-82 or Foster 85-20 vapor barrier adhesive.

D. Reinforcing Mesh. Provide 10 x 10 white glass or polyester reinforcing mesh.

2.3 OUTDOOR DUCT LAMINATED JACKETING

A. Rubberized bitumen compound material:
1. Ultraviolet resistant
2. Weatherproof
3. Vapor retarding jacketing
4. Laminated jacketing
5. Cross-laminated high strength polyethylene film
6. Laminated to aluminum foil
7. Minimum 60-mil thickness

B. Acceptable Manufacturers:
1. Alumaguard 60
2. Flex Clad 400
3. Venture Clad 1577CW

PART 3 - EXECUTION

3.1 FIRE SAFETY REQUIREMENTS

A. Do not extend duct coverings through walls or floors required to be fire-stopped or required to have a fire resistance rating. Interrupt duct coverings in the immediate vicinity of heat sources such as electric resistance or fuel-burning heater.

3.2 CONCEALED DUCT

A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing.

B. Standing Seams. Insulate standing seams and stiffeners, which protrude through the insulation with 0.6 lb. per cubic foot density, 1-1/2" thick, faced, flexible blanket insulation. Insulation shall not prevent adjustment of damper operators.

C. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on twelve inch centers to prevent sagging of insulation.

D. On circumferential joint, the 2" flange on the facing shall be stapled with 9/16" outward clinch steel staples on 2" centers and taped using 3" wide foil tape applied with additional adhesive of Foster 85-75. Cover all seams, joints, pin penetrations and other breaks with foil tape and glue.

E. Ductwork in mechanical rooms is considered concealed spaces.

3.3 EXPOSED DUCT INSULATION

A. Ductwork in exposed locations is to be insulated with fiberglass rigid / semi-rigid board insulation.
   1. Apply fabric and mastic to provide a smooth surface for painting.

B. Standing Seams: Insulate standing seams and stiffeners which protrude through the insulation with 0.6 lb per cubic foot density, 1-1/2 inch thick, faced insulation. As a vapor seal, use reinforcing mesh with vapor barrier coating. Insulation shall not prevent adjustment of damper operators.

C. Insulation shall be wrapped tightly on the ductwork. Adhere insulation to ductwork with adhesive. In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on 12 inch centers to prevent sagging of insulation.

D. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.

3.4 OUTDOOR DUCTWORK COVERING

A. Cover all supply and return ductwork outdoors:
   1. 1-1/2" thick, rigid closed cell insulation with reinforced foil facing.

B. Install a high point in center and slope in both directions so water will not stand on horizontal surfaces.

C. Impale the insulation over mechanical fasteners and washers.
   1. A minimum of 2 rows of fasteners per side on 12-inch centers.
   2. Seal all breaks, joints and punctures by applying a 1/8" thick vapor barrier mastic coating, embedded in open mesh reinforcing mesh.

D. Standing S, or flanged connections shall be covered with the same thickness of insulation overlapped a minimum of 4".

E. Apply a tack coat of Childers CP-10/11 or Foster 46-50 weather barrier mastic over the entire surface.

1. While this coat is still tacky, Childers #5 glass fiber reinforcing mesh shall be smoothly applied and pressed into the mastic. The cloth shall be taut with adjacent edges overlapped a minimum of 4".
2. After the first coat of mastic has taken its set, the second coat shall be applied over the cloth by palm, trowel, or spray to sufficient thickness that, when dried, the combined thickness of mastic and cloth is not less than 1/8".
3. Upon completion, the openings in the cloth shall be completely sealed and the yarn shall not be visible. The completed work shall be completely smooth and present a plane surface.
4. Aluminum gray or white finish as approved by the Architect.

F. Standing water on horizontal surfaces is not approved.

G. Apply outdoor duct laminated jacketing protection over entire insulation surface. Apply rubberized bitumen compound, applied to a cross-laminated high strength polyethylene film, laminated to aluminum foil.

3.5 KITCHEN GREASE EXHAUST DUCTWORK / KILN DUCTWORK / FUME HOOD DUCT

A. Secure fireboard insulation to duct with impaling pins and 3" square speed clips. In addition, provide a wire mesh support system and additional sealing or support as required by the code enforcing authority. The insulation support system shall include framed access to allow the insulation to be removed and replaced without damage at the access doors in the duct system for inspection and cleaning. Coordinate location of access openings to correspond accurately. Provide stainless steel banding on 12" centers.

3.6 GENERAL INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Apply insulation on clean, dry surfaces only.

C. Continue insulation with vapor barrier through penetrations.

D. Neatly finish insulation at supports, protrusions and interruptions.

E. Install insulation on clean, dry surfaces, and only after building is weatherproofed sufficiently to preclude any rainwater on insulation.

F. Apply mastic over the fiberglass reinforcing mesh to a thickness where fabric is not visible after completion.

G. Install fiberglass blanket duct insulation on top of supply air grilles not fire rated.

END OF SECTION

SECTION 23 07 16

VESSEL INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install insulation for both high and low temperature vessels.

B. Low temperature installations include expansion tanks, air eliminators, chiller nozzles, chiller heads and other vessels containing liquids 60°F and below.

C. High temperature installations include expansion tanks, air eliminators, domestic water storage tanks, boiler stack / transition and other vessels containing liquids above 60°F.

1.2 QUALITY ASSURANCE

A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.

B. An approved contractor for this work under this Division shall be:
   1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
   2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.

C. All vessel insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.

D. Condensation on any insulated vessel system is not acceptable.

E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation, also repair any damage caused by the condensation.

F. Where existing insulated vessel, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 APPROVALS

A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.

B. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

A. Division 9 Finishes. Painting and color-coding

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass fiber pipe & tank insulation:
   1. Schuller Type 817
   2. Owens-Corning Type 705
   3. Knauf 2.8 PCF

B. Closed cell, non-wicking pipe & tank insulation:
   1. Armaflex FS, 2" thickness

C. Aluminum Jacketing:
   1. Childers
   2. Pabco
   3. RPR

D. Monel Staples
   1. Bostich Monel
   2. Duo-Fast Monel
   3. Markwell Monel

E. Fiberglass reinforcing cloth mesh:
   1. Perma Glass Mesh
   2. Alpha Glass Mesh
   3. Childers Chil-Glas
   4. Foster Mast a Fab

F. Weather Resistant Coating:
   1. WB Armaflex Finish

2.2 CEMENT, MASTICS, SEALANTS, ADHESIVES AND COATINGS

A. Adhesive: Provide Childers CP-127 or Foster 85-60 fiberglass adhesive to seal insulation for low temperature vessels.

B. Adhesive / Joint Sealant: Provide Armaflex 520 adhesive to seal insulation for low and temperature vessels.

C. Lagging Adhesive / Coating: Furnish Childers CP50AHV2 or Foster 30-36 lagging adhesive / coating to provide a finish coat and to secure finish cloth for high temperature vessels.

D. Insulation Joint Sealant: Use Childers CP-76 or Foster 95-50 to seal the joints of insulation on low temperature vessels.

E. Metal Jacketing Sealant: Use Childers CP-76 or Foster 95-44 on all metal jacketing laps outdoors.

F. Vapor Barrier Coating: Indoors - Use Childers CP-38 or Foster 30-80 vapor barrier coating finish to coat the canvas finish on low temperature vessels. Permeance shall be 0.013 perms or less as tested by ASTM E96. Coating must comply with MIL-C-19565C, Type II and be QPL listed. Permeance shall be 0.03 perms or less at 30 mils, dry. Tested at 100°F and 90% RH per ASTM F 1249 and by Hypalon rubber based.

G. Weather Barrier Mastic: Furnish Childers CP-10/11 or Foster 46-50 weather barrier mastic and reinforcing mesh for outdoor finish.

H. Reinforcing Mesh: Furnish 10 X 10 white glass or polyester reinforcing mesh.

PART 3 - EXECUTION

3.1 VESSELS (CLOSED CELL)

A. Apply a layer of insulating board. Band the insulation on immediately after application, using bands on 12” centers, drawn tight and securely fastened.

B. To insulate removable heads, provide two equal sections of heavy-gauge, galvanized sheet metal covers, angle reinforced and lined with insulation board. Make covers easily removable to allow free access to the heads for inspection, cleaning and dismantling. Provide suitable flanges on the sections with neoprene gaskets between them, permitting a tight seal when the two sections are bolted together. Fill the voids with closed cell insulation.

C. Apply weather protective finish on closed cell insulation. Provide a minimum of three coats.

3.2 ALUMINUM JACKETING (Insulated vessels outdoors above grade)

A. Apply aluminum jacket on vessels according to manufacturer's recommendations using aluminum strapping and metal jacketing sealant to provide weather tight covering.

B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function.

C. Install straps on 12” centers.

3.3 VESSEL INSULATION REQUIREMENTS

A. Insulate all low and high temperature vessels located exterior (outside) of the building, including the following:
1. Air separators
2. Expansion Tanks
3. Chemical feeders
4. Chilled water system volume tanks
5. Insulation thickness shall match thickness of adjoining pipe insulation

B. Insulate all low temperature vessels located interior (inside of the building, including the following:
1. Air separators
2. Chemical feeders
3. Chilled water system volume tanks
4. Insulation thickness shall match thickness of adjoining pipe insulation

C. Insulate the following high temperature vessels located interior (inside the building).
1. Air Separators

2. Insulation thickness shall match thickness of adjoining pipe insulation

D. As indicated on the drawings

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including exterior condenser water piping, refrigerant lines, condensate piping and make-up water.

1.2 QUALITY ASSURANCE

A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.

B. An approved contractor for this work under this Division shall be:
   1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
   2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.

C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.

D. Condensation on any insulated piping system is not acceptable.

E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.

F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 SUBMITTALS

A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.

B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

A. Finishes. Painting and color-coding

B. Pipe Heat Tracing

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass fiber pipe insulation:
1. Johns-Manville Micro-Lok AP-T
2. Owens-Corning ASJ/SSL
3. Knauf ASJ/SSL

B. Cellular Glass Insulation (Foamglass):
1. Pittsburg Corning
2. Cell-U-Foam

C. Rigid Foam Insulation:
1. Kingsapan Tarec
2. Dow Trymer
3. Tarec Ecophen – Phenolic Foam

D. Aluminum Jacketing:
1. ITW Lock-on (Childers)
2. ITW Z-lock (Pabco)

E. Fiberglass reinforcing cloth mesh:
1. Perma Glass Mesh
2. Alpha Glass Mesh
3. Childers Chil-Glas
4 Foster Mast a Fab
5. Vimasco

F. Mastics, Sealants, Coatings and Adhesives
1. Childers
2. Foster
3. Vimasco
4. Armacell 520 Adhesive

G. Elastomeric Insulation
1. Armacell

H. Weather Resistant Coating
1. WB Armaflex Finish
2 Foster 30-64

I. Glass fiber blanket insulation
1. Manville R-series Microlite FSKL
2. Owens-Corning eD75 or ED100 RKF
3. Knauf 0.75 PCF FSK

2.2 RIGID FOAM PIPE INSULATION

A. Polyisocyanurate pipe insulation or phenolic foam pipe insulation, with all service reinforced vapor barrier jacket having integral laminated vapor barrier.

1. Polyisocyanurate: Thermal conductivity 0.14 @ 75°F mean (ASTM C518).
2. Phenolic Foam: Thermal conductivity 0.13 @ 75°F mean (ASTM C 518); minimum 2.5# density.
3. Polyisocyanurate is not to be used inside of buildings without 25/50 rating.

2.3 FIBERGLASS PIPE INSULATION

A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.4 ELASTOMERIC INSULATION

A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than ¾" shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test.
1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.5 CELLULAR GLASS INSULATION

A. ASTM C552:
1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
2. 8.0 lb/cu.ft. (128 kg/cu.m.) density

2.6 INSULATION/SHIELD AT HANGERS

A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½" aluminum bands (2) per shield.
1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
2. Minimum thickness of foam glass insulation shall not be less than 1" thick.

B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22". Provide 18 gauge through 4" pipe and 16-gauge 5" pipe and above.

2.7 SEALANT, ADHESIVE AND FINISH

A. Lap Adhesive. Provide Childers CP-82 or Foster 85-20 adhesive.

B. Vapor Barrier Finish:
1. Indoors: Provide as insulation coating Childers CP-38 or Foster 30-80, white. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100ºF and 90% RH per ASTM E96.

2. Outdoors: Provide as insulation coating Childers Encacel X or Foster 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100ºF and 90% RH per ASTM F 1249 and must be Hypalon rubber based.
3. Underground: Provide Childers CP-22/24 or Foster 60-25/26 for fittings and areas. Pittwrap cannot be used.

C. Insulation Joint Sealant. Provide Childers CP-76 or Foster 95-50 vapor barrier sealant.

D. Metal Jacketing Sealant. Provide Childers CP-76 or Foster 95-44 metal jacketing sealant for all outdoor metal jacketing laps.

E. Lagging Adhesive. Provide Childers CP-50AMV1 or Foster 30-36.

F. Other products of equal quality will be acceptable only upon approval.

2.8 ALUMINUM JACKETING

A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier.

B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.

C. Straps and Seals. Provide ½" x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.9 GLASS FIBER BLANKET INSULATION

A. Minimum density of 1.0 PCF, 2" thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

PART 3 - EXECUTION

3.1 INTERIOR PIPING

A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3" wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-38 or Foster 30-80 vapor barrier coating for chilled water piping applications.

B. Install hanger with protective shield, on the outside of all insulation.

C. Where domestic water pipes (1/2" & ¾" pipe sizes) are installed on trapeze type hangers, provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.

D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4" pipe and 16-gauge for 5" pipe and above.

E. Seal ends of pipe for chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.

F. Apply a smooth flood coat of white lagging adhesive Foster 30-35 or Childers CP-35 over all exposed insulation within mechanical rooms.

G. Piping to be insulated as specified above:
1. Chilled water and heating water
2. Domestic hot and cold water
3. Make-up water
4. Horizontal sanitary drain piping that receives condensate
5. Exposed to view storm drainage system including roof and overflow drain bodies, vertical piping from drain body to elbow, all horizontal rain leaders, and first elbow turning down
6. Condenser water

3.2 REFRIGERANT AND CONDENSATE PIPING

A. Cover all pipe with elastomeric insulation by slitting tubular sections or sliding unslit sections over the open ends of piping or tubing. Seams and butt joints shall be adhered and sealed using Foster 85-75, Childers CP-82 or Armstrong 520 Adhesive.

B. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Foster 85-75, Childers CP-82 or 520 Adhesive.

C. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter.

D. Outdoor exposed piping shall be painted with two coats of either WB or SB Armaflex finish or Foster 30-64 elastomer foam coating. All seams shall be located on the lower half of the pipe.

E. Outdoor exposed piping after being sealed as noted above apply aluminum jacketing to protect piping insulation exposed to weather, from damage from sunlight, moisture, equipment maintenance, wind, and shall provide shielding from solar radiation. Adhesive Tape shall not be permitted.

3.3 PIPING OUTDOORS ABOVE GRADE

A. Insulate all water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.

B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.

C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using Childers CP-82 or Foster 85-20 adhesive. Secure fitting insulation covers and segments in place with ½” wide glass filament tape.

D. Apply a tack coat of fitting vapor barrier coating over the insulation and tape.

E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.

F. Apply coating over the fiberglass cloth to a thickness where the mesh is not visible after completion.

G. Seal ends of pipe insulation with vapor barrier coating at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.

H. Finish with aluminum jacketing as specified.

I. Piping to be insulated as specified above:
   1. Heating water
   2. Make-up water
   3. Condenser water

3.4 UNDERGROUND PIPE COVERING

A. Cover chilled and hot water piping underground with cellular glass insulation.

B. Butter insulation joints with Childers CP-76 or Foster 95-50 vapor barrier sealant. Secure with stainless steel bands or ½" fiberglass reinforced tape on 9" centers.

C. Cover valves and flanges with fabricated fittings of thickness and material equal to the adjoining insulation. Fasten fittings in place with stainless steel bands or ½" fiberglass reinforced tape.

D. Apply a tack coat of fitting mastic Childers CP-22/24 or Foster 60-25/26 over the insulation and bands.

E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.

F. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.

G. Seal ends of pipe insulation with vapor barrier mastic at all valves, fittings, flanges and every 21' on straight run piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe, making a complete seal.

H. Finish with 125 mil thickness Pittwrap jacket applied in accordance with manufacturer's instructions. At contractor's option, cover insulation with Servi-Wrap P-500 installed in accordance with manufacturer's instructions.

3.5 FLANGE, VALVE AND FITTING INSULATION

A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
   1. Apply a tack coat of insulating coating/mastic to the insulated fitting to produce a smooth surface.
   2. After mastic is dry, apply a second coat of vapor barrier coating/mastic. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
   3. Overlap coating/mastic and fiberglass/polyester reinforcing mesh by 2" on adjoining sections of pipe insulation.
   4. Apply a second coat of coating/mastic over the fiberglass/polyester reinforcing mesh to present a smooth surface.
   5. Apply coating/mastic to a wet film thickness of 3/64".
   6. Fabric shall not be visible after completion.
   7. Vapor seal flanges, valves and fittings with Childers CP-38 or Foster 30-80. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100ºF and 90% RH per ASTM E96.

B. PVC fitting covers are not acceptable.

3.6 ALUMINUM JACKETING (Insulated Piping Outdoors Above Grade)

A. Apply smooth aluminum jacket on piping, valves, fittings and flange covers according to manufacturer's recommendations, using stainless steel strapping and seals, to provide weather tight covering and to shed water.

B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function. Lap each adjoining jacket section a minimum of 3" to make a weather tight seal with the application of 1/8" bead of Childers CP-76 or Foster 95-44 metal jacketing sealant.

C. Install straps on 9" centers and at each circumferential lap joint.

D. Cover and seal all exposed surfaces.

E. The use of screws and rivets is not approved.

F. Provide isolation (30# felt) between the aluminum jacket and the sheetmetal protection shield at each pipe support point.

3.7 MISCELLANEOUS

A. Insulate pumps.

B. Install materials after piping has been tested and approved.

C. Apply insulation on clean, dry surfaces only.

D. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.8 INSULATION THICKNESS

INSULATED UNIT	THICKNESS (Inches)
Refrigerant Piping	1-1/2
Condensate Drains	1
Exterior Condenser Water Piping	2
Heating Water Piping 2" Pipe and Larger	2
Heating Water Piping 1-1/2" Pipe and Smaller	1-1/2

END OF SECTION

SECTION 23 09 33

BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. The existing campuses included in this project are receiving HVAC equipment replacements and are controlled by Automated Logic Control systems installed by UES Houston. All new equipment shall be fully integrated into the existing control system including a completely new graphics package for all new equipment. Upon competition of this projects the resulting control system shall have all current version controllers for the systems being replaced including sensors, valves, dampers, valve and damper operators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. Integrate all components to provide a complete and functioning system.

B. Temperature Control System components:
   1. Electronic instruments as specified
   2. Electric instruments as specified
   3. Microcomputer instruments as specified

C. All control devices of the same type product shall be of a single manufacturer.

D. Control, power and interlock wiring necessary to accomplish sequences specified in this Section shall be provided and installed by the Control Subcontractor. Materials and methods of execution as specified in Division 26, Electrical.
   1. Coordinate current characteristics of all electrical instruments and equipment with Division 26 of the specifications and related electrical drawings.

E. The entire Building Management and Control System (BMCS) shall be installed by the Automation System Manufacturer or Authorized Distributor.
   1. All components and elements
   2. The testing and acceptance procedure

F. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

G. The entire Building Management and Control System (BMCS) shall be installed, Commissioned, and tested; all performed by the Automation System Manufacturer or Authorized Distributor if approved by engineer.
   1. All components and elements.
   2. Start-up and point verification.
   3. The testing and acceptance procedure.

1.2 RELATED WORK

A. Division 23, Mechanical

B. Division 26, Electrical

1.3 SUBMITTALS

A. Submit items of the Building Management and Control System (BMCS).
   1. Temperature control equipment & Field devices.
   2. Wiring & Flow diagrams.
   3. Sequence of operation.
   4. Complete, detailed, control and interlock-wiring diagram.
   5. Indicate mechanical and electrical equipment furnished and electrical interlocks, indicating terminal designation of equipment. Respective equipment manufacturers shall furnish through the Mechanical Contractor, approved drawings of equipment to be incorporated in this diagram.
   6. Submit Input / Output summary of all points.
   7. Submit an outline of testing procedures from section Testing and Acceptance.
   8. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: “Comply, “Do Not Comply”, or “Not Applicable”. Explain all “Do Not Comply” statements.
   9. Submit sample of space temperature sensor and guards for review prior to purchase or installation.

1.4 COOPERATION WITH OTHER TRADES

A. Furnish control valves, temperature sensing element wells, flow and pressure sensing devices, dampers and other similar devices to the Mechanical Contractor in a timely manner for installation under the Building Management and Control System (BMCS), Subcontractor's supervision.

1.5 WARRANTY

A. Provide with a manufacturer’s parts and labor warranty for a period of two years from substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Automated Logic Branch Office - WebCTRL

2.2 SYSTEM ARCHITECTURE

A. The Building Management and Control System (BMCS) shall consist of an information-sharing network of stand-alone Direct Digital Control Panels (DDCP) to monitor and control equipment as specified of the control sequence and input/output summary.

B. "Information sharing" shall be defined as: The function of each DDCP to exchange data on the network trunk with other DDCP's without the need for additional devices such as network managers, gateways or central computers.

C. "Stand-alone" shall be defined as: The function of each DDCP to independently monitor and control connected equipment through its own microcomputer.

2.3 COMMUNICATIONS PROCESSING

A. The BMCS shall operate as a true token-pass peer-to-peer communication network. Resident processors in each DDCP shall provide for full exchange of system data between other DDCP's on the network trunk. Systems that limit data exchange to a defined number of system points are not acceptable.

B. Systems that operate via polled response or other types of protocols that rely on a central processor or similar device to manage DDCP to DDCP communications may be considered only if a similar

device is provided as a stand-by. Upon a failure of malfunction of the primary device, the stand-by shall automatically, without any operator intervention, assume all BMCS network management activities.

C. The failure of any DDCP on the network shall not affect the operation of other DDCP's. All DDCP failure shall be annunciated at the specified alarm printers and terminals.

D. Network shall support a minimum communications speed of 115.2 Kbps.

E. The network shall support a minimum of 100 DDC controllers and PC workstations.

F. Each PC workstation shall support a minimum of 4 peer-to-peer networks, either by hardwired connection or dial up.

G. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein for hardwired points. Provide examples of 5 reference projects utilizing gateways required for this project.

2.4 DDCP HARDWARE

A. Each DDCP shall consist of a 32-bit microprocessor and controller, power supply, input / output boards and communication board. All program and point databases shall be stored in battery-backed RAM. Provide a minimum of 1.2 MEG RAM in each DDCP to allow for point expansion and trend data storage.

B. Each DDCP shall incorporate a real-time clock.

C. Each DDCP shall be provided with two RS232 communications port. Connecting an operator terminal, whether portable or stationery, shall allow the user to communicate with the entire network.

D. Each DDCP shall provide for input / output connections to field equipment. The following point types shall be supported:
1. Analog inputs - for measuring sensed variables. Inputs shall be capable of accepting voltage, resistance, current or pressure signals.
2. Analog outputs - for controlling end devices. Outputs shall be capable of producing voltage, resistance, current or pressure signals. Pneumatic outputs shall be provided with a manual override for adjusting outputs in the event of a power loss at the DDCP.
3. Digital inputs - for monitoring dry contacts such as relays, switches, pulses, etc.
4. Digital outputs - to control two position devices such as starters, actuators, relays, etc.

E. Each DDCP shall be listed under UL916 (Energy Management Systems), and shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.

F. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:
1. Control processes
2. Energy management applications
3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
4. Historical/trend data for points specified
5. Maintenance support applications
6. Custom processes

7. Operator I/O
8. Dial-up communications
9. Manual override monitoring

G. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
   1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
   2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.

H. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.

I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
   1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
   2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.
   3. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2.5 PROGRAMMING FUNCTIONS

A. Resident software in each DDCP shall provide custom programming of control strategies.
   1. Point database
   2. Operator interface
   3. Network communications
   4. Facilities and energy management functions

B. Programming of control and energy management strategies shall be accomplished via a high-level computer language such as BASIC, JC BASIC, C, or Powers Process Control Language. A standard math processor shall be part of the programming language. All analog loops shall be capable of proportional, integral and derivative control.

C. Each DDCP shall incorporate an operator interface program (OIP) that provides an English language user interface. The OIP shall allow the user to program, interrogate, command and edit the BMCS via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access the entire network from any DDCP. Access shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

2.6 FACILITY MANAGEMENT SOFTWARE

A. The BMCS shall be provided with standard and custom report generation functions that include:
   1. Alarm summaries
   2. Motor status summaries

3. Point displays by type, system, status, overrides, failures, location, equipment and enabled/disabled.
4. Program listings

B. All reports shall be either displayed or printed by:
1. Operator request.
2. Time of day.
3. Event conditions (such as in response to an alarm, interlock, etc.).

C. All reports shall be time and date stamped.

D. An alarm-processing program shall be provided to annunciate those points designated as alarmable. Alarm points shall, upon alarm occurrence, be displayed or printed at designated terminals.

E. Historical trend data shall be collected and stored at each DDCP for later retrieval. Retrieval shall be manual or automatic. Any point, physical or calculated, may be designated for trending. The system shall allow for two methods of trend collection: Either by a pre-defined time interval sample or upon a pre-defined change of value. Trend data shall be presented in a columnar format. Each sample shall be timed stamped. Trend reports may be a single point or may be a group of points, up to a maximum of (8) points in any single group. Any point, regardless of physical location in the system may become part of a multiple point group.

F. Each BMCS network shall provide a point-monitoring function that can display single or multiple points in a continuous updated fashion for dynamic displays of point values.

G. A database and configuration report program shall be provided that allows the user to interrogate BMCS status. As a minimum, the user shall be able to: Verify available RAM at each DDCP, verify DDCP status (on-line, off-line, and failed) and set the system clock.

H. Any invalid operator entry shall result in an error message.

I. DDCP's shall contain a password access routine that will assign an operator to one of three level of access. Level 1 shall permit display function only, level 2 shall additionally permit commanding of system points and level 3 shall additionally permit full program and database editing.

J. DDCP's shall provide for the accumulation of totalized values for the purposes of run-time or energy totalization. Totalized values may be displayed or printed automatically or by operator request.

2.7 ENERGY MANAGEMENT SOFTWARE

A. The BMCS shall be provided with an optimal start program such that the building may be divided into ten zones for optimum start. Warm-up and cool-down shall occur in sequence with succeeding zones starting only after the preceding zone has completed its warm-up or cool-down.
1. The optimum start-up time of assigned equipment shall be determined based on a software calculation that takes into consideration outdoor air conditions, space conditions, and building thermal characteristics ("U" factor).
2. The optimum start program shall control start-up of the cooling and heating equipment to achieve the target occupancy space temperature at the precise time of building occupancy.
3. A built-In "learning" technique shall cause the BMCS to automatically adjust itself to the most affective time to start equipment based on historical data.

B. The BMCS shall be provided with an operator interactive time of day (TOD) program. TOD programming and modifying shall be accomplished in a calendar-like format that prompts the user

in English language to specify month, year, day and time and associated point commands. It shall be possible to assign single points or groups of points to any on or off time. Appropriate time

delays shall be provided to "stagger" on times.

1. TOD shall incorporate a holiday and special day schedule capability, which will automatically bring up a pre-defined holiday or special day schedule of operation. Holidays or special days can be scheduled up to one year in advance.
2. In addition to the time dependent two-state control, TOD also provides time dependent setpoint control. This control provides the capability to output assignable, proportional setpoint values in accordance with the time of day and day of week. This program shall be used to accomplish night setback, morning warm-up and normal daily operating setpoints of all control system loops controlled by the BMCS. As with the two-state control, time dependent setpoint control shall be subject to the holiday schedule. The setpoints desired shall be user definable at any operator terminal.
3. The operator shall be capable of reading and/or altering all sorted data pertaining to time of day, day of week, on/off times, setpoint values, and holiday designation.
4. The TOD program shall also provide an override function that allows the user to conveniently change a start or stop time for any point up to one week in advance. The override command shall be temporary. Once executed the TOD program shall revert to its original schedule.
5. The TOD program shall interface with the optimal start program (OSP) such that stop times may be assigned by OSP.

C. Additional Program functions required are to be installed and programmed as requested by end user at no additional cost:

1. Enthalpy optimization.
2. Supply air reset.
3. Hot water reset.
4. Chilled water reset.
5. Volumetric control.
6. Dead band control. Install dual set points as requested by user.
7. All specified energy management programs, whether or not applicable to this project shall be provided such that the owner may enable the program at a future date without the need to purchase additional software or modify existing software.

2.8 WEB SERVER ACCESSIBILITY

A. Industry leading encryption technology to provide accessibility through a web browser.

B. Building Manager’s ability to access, view and command critical building information in real time over the intranet or internet.

1. Alarm Display
2. Point Commanding
3. Graphic Display
4. Scheduling
5. Running Reports
6. Point Details

2.9 REMOTE NOTIFICATION

A. Remote notification sends Alarm and System Event information to various notification devices as indicated below but not limited to. Operators can receive their building automation system alarms without restricting them to dedicated workstations.

1. Alphanumeric pagers
2. Numeric pagers
3. Email
4. Phones via voice or short message service (SMS)

2.10 POINT EXPANSION MODULES

A. Capable of extending its input/output capabilities via special purpose modules.
   1. Modules may be mounted remote from the DDCP.
   2. Shall communicate with the DDCP over a pair of twisted cables.

2.11 TERMINAL EQUIPMENT CONTROLLERS

A. Provide for control of each piece of equipment, including, but not limited to, the following:
   1. Variable Air Volume (VAV) boxes
   2. Constant Air Volume (CAV) boxes
   3. Dual Duct Terminal Boxes
   4. Unit Conditioners
   5. Heat Pumps
   6. Unit Ventilators
   7. Room Pressurization
   8. Fan Coil Units

B. Include the following items:
   1. All input and outputs necessary to perform the specified control sequences.
      a. Analog outputs shall be industry standard signals such as 24V floating control.
   2. Sufficient memory to accommodate point database, operating programs, local alarming and local trending.
   3. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 100-hour battery backup shall be provided.
   4. Return to full normal operation without user intervention after a power outage of unlimited duration.
   5. Operation programs shall be field selectable for specific applications.
   6. Specific control strategy requirements, allowing for additional system flexibility.
   7. Controllers that require factory changes of all applications are not acceptable.

2.12 ELECTRONIC DAMPER ACTUATORS

A. Two position damper operators:
   1. Spring return to full travel position.
   2. Built in auxiliary switches (motor end switches)
      a. Switch shall be fully adjustable so that cut-in/cut-out points may be preset at any point within angular travel of the motor.
   3. Minimum torque 60-in-lb

B. Modulating damper operators:
   1. Sized with sufficient reserve power to provide smooth modulating action and tight close off against the system pressure
   2. Select the operator with available torque to exceed the maximum required operating torque by not less than 100%
   3. Minimum torque 100 in-lb

2.13 ETHERNET CARD

A. Ethernet Card:
   1. Local area network connection interface card.

2.14 CONTROL CABINETS

A. Fully enclosed NEMA 1 for indoors, NEMA 4 for outdoors.

1. Powder coat painted on all sides
2. Cabinet with continuously piano type hinged door
3. Locking latch
4. All locks shall use a common key
5. Devices on the panel face must be identified with engraved nameplates.
6. Panels or termination panels must be identified with engraved nameplates.
7. Provide enamel beige finish and extruded aluminum alloy frame UL 50 certified.

2.15 AUTOMATIC CONTROL VALVES

A. Pressure ratings: Minimum 125 psig or 1.25 times maximum system operating pressure.

B. Construction:
   1. 2" and smaller:
      a. Screwed.
      b. Bodies and internal parts: Bronze, stainless steel or other approved corrosion-resistant metal.
   2. 2-1/2" and larger:
      a. Flanged.
      b. Bodies: Cast iron or cast steel.
      c. Seats and parts exposed to fluid: Bronze, stainless steel or other approved corrosion-resistant metal.
   3. Characterized port ball valves are acceptable for VAV terminal units only.

C. Modulating straight through water valves: Equal percentage contoured throttling plugs.

D. Three Way Mixing Valves: Linear throttling plugs allowing total flow through valve to remain constant regardless of position.

E. Sizes: By Automatic Control System Manufacturer for fully modulating operation.
   1. Minimum pressure drop: Equal to pressure drop of coil or exchanger.
   2. Maximum pressure drop: 5.5 psi.
   3. Relief and bypass valves: Sized according to pressure available.
   4. 2-position valves: Line size.
   5. Manual by-pass operator.

F. Electronic Actuator:
   1. Direct coupled installation
   2. Visual and electronic stroke indicator
   3. Die-cast aluminum housing
   4. Manual override
   5. Self-lubricating bearing and gear train
   6. Automatic calibration
   7. Automatic duty cycle protection
   8. Overload and stall protection
   9. Non-spring return
   10. Floating /0-10 VAC / 4-20mA operation
   11. UL approved
   12. Provide smooth modulating action and tight close off against the system pressure.
   13. Torque to exceed the maximum required operating torque by not less than 150%.
   14. Actuator input signal shall be compatible with output DDC controller.
   15. Provide weatherproof enclosure (exterior use).
   16. Damper actuators not acceptable for valves.

2.16 FLOW DETECTION SWITCHES

A. Remote Flow Solid-State Flow Detection:
   1. Extended length flow probe
   2. Cabinet-mounted control monitor
   3. Wetted parts, 316 stainless steel probe
   4. Optional temperature and wire-break outputs
   5. Flow and temperature switch points
   6. LED bar graph display for status indication

B. Approved Manufacturer:
   1. IFM Effector

2.17 DIFFERENTIAL PRESSURE SWITCHES

A. Wet/wet differential pressure switch
   1. Integral Mounting Frame
   2. Watertight, dust-tight, and corrosion resistant enclosure.
   3. Wetted materials of brass and flouroelastomer.
   4. Externally adjustable set point

B. Approved manufacturer:
   1. Square D #9012GGW4
   2. Dwyer #DXW-11-153-1
   3. Carrier #HK06ZC033

2.18 TEMPERATURE LOW LIMIT SWITCH

A. Responsive to the coldest 1' section of its length.
   1. Double pole single throw switch
   2. 20' capillary
   3. Line voltage with bellows actuated switch
   4. Auto reset for outdoor installation
   5. Manual reset for indoor installation

2.19 TEMPERATURE AND HUMIDITY SENSORS

A. Space Temperature Sensors
   1. Thermister with resistance of 10,000 ohms at 77°F.
   2. Accuracy shall be +/-1/2°F.
   3. Range of 55° to 95° F.
   4. Flush mounted
      a. Stainless steel flush mount sensor, submit sample for review.
   6. Location and height to be approved by Architect/Engineer prior to installation.

B. Space / Duct Humidity Sensor
   1. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
   2. Capacitance element shall be field replaceable and not require calibration.
   3. Accuracy shall be +/-2% in the range from 20 to 95% RH.
   4. Relative humidity sensors shall have the sensing element of inorganic resistance media.
   5. Provide impact resistant Polycarbonate equal to BAPI-Guard covers suitable for institutional use. Submit sample for review.
   6. Provide manufacturers calibration certificate.
   7. Provide impact resistant Polycarbonate equal to BAPI-Guard guards in the following locations:

a. Corridors
b. Cafeteria
c. Kitchen.
d. Gymnasium.
e. Dressing Rooms.
f. Industrial Labs.

C. Duct Temperature Sensors
1. Range of 20° to 120°F.
2. Single point sensing of temperature.
3. Averaging elements of sufficient length to sense temperature across 2/3 duct width.
4. Averaging elements of sufficient length to provide accurate, representative indication and control.
5. Averaging elements of sufficient length to prevent variances in temperature or stratification.

D. Liquid Immersion Temperature Sensors
1. Platinum type resistance temperature detector (RTD).
2. Match sensor range to medium being monitored.
a. Hot water range 30° to 250°F.
b. Chilled Water 20° to 70°F.
3. Furnish stainless steel wells for installation by Mechanical Contractor.
4. Locate all sensors in field with Owner/Engineer present.
5. System accuracy for liquid temperature sensing shall be +/-1/2°.
6. Sensors must be removable from wells.

E. Outside Air / Freezer / Cooler Sensors
1. Range of –58° to 122°F.
2. Weatherproof sun shield.
3. External trim material corrosion resistant with all parts assembled into water tight, vibration-proof, heat resistant assembly.
4. Minimum of 8' long leads.
5. Encapsulated into Type 304 stainless steel tubes with low conductivity moisture proofing material and lag extension for thickness of insulation.

2.20 CURRENT SENSITIVE RELAYS

A. Ensure compatibility with VFD applications for variable speed motor status.
1. Provide with adjustable set point.
2. Relays must be mounted and not hung by power wires thru CT.
3. Provide split-core type current sensors.
4. Loop powered.
5. LED Status.
6. Acceptable Manufacturer: Veris Industries / Hawkeye
7. Relays shall close status contacts in response to current flow in power leads to the equipment being monitored.

2.21 DIFFERENTIAL PRESSURE TRANSDUCER

A. Transducers to convert differential pressures to 4-20 MA analog outputs.
1. Solid state pressure sensor with accuracy of +/- 1% of calibration range.
2. Factory calibrated and have zero and span trimmers for field calibration.
3. Range shall be selected to match the medium being monitored.
4. Pressure snubbers to protect from pressure pulses and a 3-way bypass / valve assembly to protect the transducer from overpressure damage during start-up.

5. LCD Display
6. Acceptable Manufacturer: Rosemount 1151 or 3051 Pressure Transmitter

2.22 FLOW DIFFERENTIAL PRESSURE SWITCH

A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system differential pressure.
   1. Select the pressure range based on the sensed differential pressure.
   2. The unit shall be protected against overpressure to the full static pressure rating.
   3. Accuracy: +/- 2% of full scale.

B. Switch assembly.
   1. Reed switch.
   2. NEMA-4 enclosure.
   3. Threaded boss conduit entrance.
   4. SPST action.
   5. Voltage and rating as required for the control circuit.

C. Wetted parts shall be made of type 303 stainless steel.

D. Install an isolation valve in each sensing pipe leg to permit servicing without shutting the system down.

2.23 ELECTRIC REMOTE BULB THERMOSTAT

A. Two position remote bulb thermostat:
   1. Bimetal controlled.
   2. Sealed mercury switches.
   3. Provide specified control action.
   4. Adjustment can be made by removing unit cover.
   5. Element with capillary length as required for the location.

2.24 ELECTRIC SPACE THERMOSTAT

A. Two position space thermostat.
   1. Single Pole switch actuated by bi-metal sensing element.
   2. Range shall be 60°F to 90°F.
   3. Removable external knob adjustment means.

2.25 HIGH STATIC PRESSURE SWITCH

A. With manual reset switch
   1. Approved manufacturer: Cleveland AFS-460.

2.26 INSERTION FLOW SENSORS

A. Turbine Flow Meter
   1. Retractable hot tap flow sensor
   2. Accuracy: +/- 1% of full scale
   3. Dual Turbine
   4. Custom thread-o-let 400 psi / 250°F rated
   5. Line size from 2-1/2 to 72 inch
   6. Metering range from 0.3 to 15 f/sec.
   7. Remote NEMA 4 wall mounted LCD display
   8. Field Pro Software & Communicator

9. Warranty two years
10. Approved Manufacturer: Onicon Flow Meter F1200 Series

B. Electromagnetic Flow Meter
1. Retractable hot tap flow sensor
2. Accuracy: +/- 1% of full scale
3. Electromagnetic
4. Custom thread-o-let 400 psi / 250 degree F rated.
5. Line size from 1-1/4 to 72 inch
6. Metering range from 0.3 to 15 f/sec.
7. Remote NEMA 4 wall mounted LCD display
8. Field Pro Software & Communicator
9. Warranty two years
10. Approved Manufacturer Onicon Flow Meter F3500

2.27 CONTROL DAMPERS

A. Opposed blade dampers.
1. Frames of 13-gauge galvanized sheet metal.
2. Provisions for duct mounting.
3. Damper blades not exceeding 8" in width.
4. Blades of two sheets of 16-gauge galvanized sheet metal.
5. Blades suitable for high velocity performance.
6. Bearings of nylon or oil-impregnated, sinthered bronze.
7. Shafts of 1/2" zinc-plated steel
8. Leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure.
9. Replaceable resilient seals along top, bottom and sides of frame and blade edge.
10. Submit leakage and flow characteristics data with shop drawings.
11. Linkage shall be concealed out of the air stream within damper frame.
12. Acceptable Model is Ruskin Model CD60.

2.28 PHOTO CELL CONTROL

A. Light Sensitive Resistor.
1. 4-20 output or switch.
2. On = 3.0 / fc. Off 10.0 / fc.
3. UL Approved.

2.29 DRAIN PAN FLOAT SWITCH

A. Rated at 10 Amps.
1. Shuts off equipment if water level becomes too high.
2. DPDT Contacts.

2.30 BY-PASS AUTOMATIC SHUT-OFF TIMERS

A. Rated at 10 Amps, 125 VAC
1. Shuts off equipment with timed switch
2. White decorated timer
3. Without hold feature
4. Time Cycle 60 minutes

Valves and Actuators

PART 3 - EXECUTION

3.1 INSTALLATION

A. The control system shall be installed and final adjustments made by full-time employees of the factory-approved BMCS Building Management Control Subcontractor.

B. The contractor shall collaborate through Architect / Engineer and Owner to determine the Owner's

preference for naming conventions, etc. before entering the data in to the system.

C. Due to actual operational or space conditions, it may be necessary for the Contractor to make sequence of operation modifications and/or controller adjustments, change the location or type of sensor to obtain proper operation and coverage of the system in each room or space. These change, if requested by the Owner or Engineer, shall be performed at no additional cost to the Owner. Therefore labor allowances should be made for such changes and adjustments if requested.

D. Points listed within this section are to be connected to the BMCS system as hard-wired points to cards and not connected through BacNet integration. The BacNet interface is for read only points not included within sequences of this specification.

3.2 INTERLOCK AND SAFETY CIRCUITS

A. Close the outdoor air dampers when the related HVAC unit supply or exhaust fan is de-energized:
   1. The damper and actuators are specified in this section.
   2. Outdoor air damper shall be fully opened before related air handling unit fan is energized for 100% outside air use.
   3. Provide motorized outside air dampers for the following:
      a. Supply fans
      b. AHUs
      c. Exhaust fans (except kitchen exhaust)

B. Close the chilled and hot water valves to the coil when the related unit is de-energized.

C. Interlock each chiller to start its dedicated chilled and condenser water pumps.
   1. On shutdown provide a circuit to permit the chilled water pumps and condenser water pumps to run while the chillers pump down as required by the manufacturer.
   2. As per manufacturer's recommendations

D. Primary chilled water control:
   1. Operating and safety controls are furnished as an integral part of the water-chilling unit and not specified in this section.
   2. Provide a high limit temperature sensor in each primary chilled water pump loop.

E. Exhaust/Supply Fans:
   1. Interlock the related exhaust and supply fans and the related outside air damper.
   2. Interlock the exhaust fans with the related air-handling unit through software.
   3. Interlock related exhaust fan for dishwasher with time delay off relay.
   4. Interlock related exhaust fan for kiln with time delay off relay
   5. Interlock kitchen hood related supply and exhaust fans.
   6. Provide additional interlocks as indicated on fan schedule and on drawings.
   7. Interlock electrical and mechanical room exhaust fans with thermostat.
   8. Interlock refrigerant monitor with mechanical room purge system.
   9. Interlock science room related supply and exhaust fans.
   10. Interlock outside air supply fans for VAV air-handling unit with air-handling unit status point.

F. Freeze Protection:
   1. Provide a freeze protection sequence to ensure proper operation of equipment during a freeze condition not limited to the following:
      a. Outside Air Handling Units & Supply Fans with heating and cooling coils: If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper,

open both heating and cooling valves to enable full flow condition. If heating

coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition, disable unit, close outside air damper, and open both heating and cooling valves to enable full flow condition. Ensure HW & CHW pumps are operational.

b. Boilers - Enable during a freeze condition.

c. Chillers – Open isolation valves then command by-pass valve to dump water into basin or by-pass tower. Enable condenser water pumps during a freeze condition.

d. Air Cooled Chillers – Open isolation valves, then enable pumps, run cycle for 15 minutes per hour, open all chilled water valves.

e. Protect coils downstream of DX cooling coil with freeze protection. If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, disable the DX cooling coil. If coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition.

2. Temperature low limit switch wired with double pole single throw switch with one switch leg hard-wired to de-energize fan and one switch leg to signal BMCS.

G. Drain Pan Float Protection:

1. Interlock to shut down unit and close valves.
2. Cooling Coils mounted above ceiling and in roof mounted units.
3. Provide for each cooling coil location.
4. Signal BMCS alarm point

H. Copper Tube Boiler:

1. Interlock each boiler to start its dedicated primary circulating pump. Interlock flow switch and pump to boiler safety terminal strip.
2. On startup enable boiler and primary pump prior to starting secondary system pump until primary loop temperature reaches 105 degrees as per manufacturer’s recommendations.
3. Disable secondary pump if boiler goes into alarm or fails to produce heating water within 30 minutes.

3.3 GRAPHICS

A. Furnish as-built drawings indicating finally corrected "as installed" diagram(s) of the complete Building Management Control System.

1. Modification of existing control systems shall be included.
2. These must be as-built and any changes during the warranty period drawings must be revised and updated.
3. Provide final sequence of operation in written format.

B. Provide a set of the "as installed" diagram(s) of the complete control system laminated in plastic and hung in the main mechanical room or as directed by Owner.

C. Provide a color-coded floor plan of the building showing the location of each system, and the area served by each AHU or related zone. These must be of professional quality. Floor plan is to hang in main mechanical room near central control panel.

D. Provide computer graphics for each system.

E. Provide final graphic room numbers as selected by Owner / Architect.. Obtain a graphic submittal package for review. Construction Drawing room numbers are not to be used unless approved in writing.

3.4 IDENTIFICATION

A. Provide a laminated engraved nameplate on all control panels and devices shown on the "as installed" control diagrams. Coordinate engraving with nomenclature used on the diagrams.

B. A black-white-black laminated plastic engraved identifying nameplate shall be secured to each terminal cabinet, and control panels. Identifying nameplates shall have ½ inch high, engraved letters.

3.5 WIRING FOR BUILDING MANAGEMENT AND CONTROL SYSTEMS

A. Furnish and install all wire, conduit, raceways and cable systems required for the complete operation of the Building Management and Control System.

B. All wiring for the Building Management and Control System is specified in this section and includes, but is not limited to:
1. Wiring of interlock system.
2. Wiring of control instruments.
3. Wiring of control panels.
4. Wiring of related power supplies, i.e. transformers.
5. Wiring of 120 VAC power circuits for control panels and devices.

C. All materials and methods specified in this section shall comply with the requirements specified in Division 26 of this specification.

D. All power supply requirements shall be connected to the building electrical distribution system in an approved manner. Do not connect control equipment of circuits common with other building loads or devices.

E. Temperature control wiring shall be jacketed cables installed with or without conduit as specified below or single conductors installed in conduit. Control wiring shall have minimum 300V insulation for low voltage wiring and 600V insulation for line voltage wiring.

F. All line voltage control wiring, all low voltage control wiring which is exposed in the central plant, penthouse, and other similar spaces; all low voltage control wiring which is routed through concealed inaccessible locations shall be installed in conduit.

G. All low voltage control wiring which is routed through concealed accessible locations may be run without conduit provided that the wiring run without conduit is properly supported from the building structure on maximum 5' centers and does not depend upon the ceiling grid or the ceiling support system for support. Wiring run in plenum spaces shall be plenum rated. Support all plenum wiring in accessible locations in bridle rings, J-hooks, D rings. Plenum wiring is not to be supported within building structure or attached to conduit raceways. All low voltage wiring must be installed through supports. Wires shall be supported on 5’ centers and identified at each termination point and at 50’ centers minimum. Install wire parallel or perpendicular to the structural features of the building.

H. Line and low voltage control wiring shall not be installed in the same conduit with control wiring and shall not be installed in the same conduit with power wiring.

I. All wiring associated with building management and control system cover shall be as follows:
1. Sensor jacket color, Green
2. LAN communications, Yellow
3. All THHN wiring shall comply with Division 26 insulation color identification

3.7 MISCELLANEOUS

A. At the existing 10 classroom building (Fibrebond Building) the existing ground mounted packaged DX outside air ERV unit, multizone dx air handling units with electric duct heat are being removed and replaced with a new ground mounted packaged DX outside air unit, ground mounted exhaust fan and a Variable Refrigerant Flow system with multiple indoor vertical air handling units. The existing BMCS shall be modified, expanded to remove the existing systems and incorporate the new systems. The BMCS expansion shall include providing all new current version controllers and updating all BMCS graphics to remove old systems and to add new systems for this building. In addition this contractor shall be responsible for removal of all existing end devices and installation of new to facilitate a complete and functional control system.

3.8 VARIABLE FREQUENCY DRIVE INTERFACE

A. Interface to the VFD directly

B. Interface may be hardwired or via RS-485

C. The following points shall be available at a minimum:

Point Name	Type
Start-stop	DO
Drive alarm	DI
Last fault	AI
Reset drive	DO
Percent output	AI
Frequency output	AI
Speed	AI
Current	AI
Power	AI
Drive temperature	AI
KWH	AI
Run time	AI

3.9 EXHAUST FANS

A. The existing general building exhaust system which was integral to the ERV system is being removed. A new ground mounted exhaust fan is being installed to meet the needs of the general exhaust.

B. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.

C. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.10 PACKAGED DX OUTSIDE AIR UNITS

A. These units are furnished with a direct expansion coil, hot gas reheat coil and gas heater in the reheat position. Control shall be as follows:
   1. Start/Stop shall be by BMCS. Internal unit controls shall control operation.
   2. The unit shall operate through its internal unit controls. The unit shall maintain a constant leaving air temperature off the cooling coil as scheduled and the hot gas reheat shall modulate to deliver neutral temperature air to the space at all times. The BMCS shall send an alarm if the leaving cooling coil leaving air temperature is above setpoint by more than 5 degrees (adjustable) singling unit operational issues.
   2. The outside air unit is provided with an outside air damper. The BMCS shall signal the unit controller for damper operation. The outside air damper shall be normally open.
   3. The BMCS shall monitor the temperature and humidity level within this building.
   4. Fully integrate all available BACNET points into the graphics page associated with this unit.

B. Provide and install all low voltage control wiring associated with the DX Outside Air system. This includes but not limited to installing and wiring to manufacturer provided space sensors. Installation shall be in accordance with this specification section and with manufacturer's installation requirements.

C. All points listed below shall be provided by the BMCS contractor as hardwired points and independent of the outside air unit BacNet points. The points listed below are to be used as verification of unit operation.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Cooling Discharge Air Temperature	AI	RTD
Hot Gas Reheat Coil Discharge Temperature	AI	RTD
Unit Discharge Air Temperature	AI	RTD
Status	DI	Air Flow Switch
Space Humidity	AI	Humidity Sensor

3.11 VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS

A. This system consists of outdoor packaged condensing units and interior ducted vertical fan coil units with FCU integration kits. The variable refrigerant flow system is provided with internal and a centralized BACnet controller. Refer to Section 23 81 26 for additional information and requirements.
   1. The BMCS shall start and stop the system, provide operation scheduling, and provide the ability to modify individual space setpoints.
   2. The BMCS shall integrate with the VRF control system completely including the ability to view all available points provided by the VRF equipment.
   3. The BMCS system shall have a dedicated graphics page that shows the VRF system in the Administration area. This graphics page shall allow view/edit of space temperatures and schedules.
   4. It is the VRF manufacturer's responsibility to provide a BACnet capable gateway and

assist with the integration into the BAS. The VRF manufacturer will provide dedicated

time for the integration process and the BMCS contractor shall coordinate when the VRF manufacturer shall have a certified technician onsite for integration assistance.

B. System Off - When the system is off:
1. The condensing unit and indoor units shall be off.

C. Initiation of System Start-Up - System start-up shall be initiated:
1. Scheduled by the BMCS.
2. Activation of override signaled through the VRF system from a local zone controller.

D. Variable Frequency Drive is being provided for soft start and balancing only.

E. Provide and install all low voltage control wiring associated with the VRF system. This includes but not limited to installing and wiring to manufacturer provided temperature sensors in each space, installation and wiring between indoor and outdoor units, installation and wiring between each indoor unit and installation and wiring of all VRF system control end devices. Installation shall be in accordance with this specification section and with manufacturer's installation requirements.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop (Each Zone)	DO	
Zone Unit Status (Each Zone)	DI	
Zone Space Temp. (Each Zone)	AI	
Zone Space Humidity (Each Zone)	AI	
Zone Fan Coil Unit Speed Control	AO	Variable Frequency Drive
Enable/Disable "Lock" of Wall Control On/Off (Each Zone)	DO	
Enable/Disable "Lock" of Wall Control Mode (Each Zone)	DO	
Enable/Disable "Lock" of Wall Control Temp. Adjustment (Each Zone)	DO	
Lock Status (Each Zone)	DI	
Operation Mode Setting (Each Zone)	DO	
Operation Mode Status (Each Zone)	DI	
Fan Speed Setting (Each Zone)	DO	
Fan Speed Status (Each Zone)	DI	
Set Temperature (Each Zone)	AO	
Alarm Flag	DI	

POINT DESCRIPTION	TYPES	DEVICE
Alarm Code	AI	
Compressor Status	DO	

3.12 HYDRONIC HEATING SYSTEM

A. The existing exterior boiler and dedicated boiler pump associated with the two-pipe system is being replaced. The BMCS system shall be modified and expanded to incorporate the new equipment. The existing two pipe control sequence shall remain, but the BMCS graphics shall be updated to include new equipment. In addition, the existing abandoned interior heating boiler is being removed. This contractor shall remove all controls associated with this abandoned boiler.

B. The system consists of one heating water boiler, dedicated boiler pump and an existing building CHW/HW pump.
1. Energize the hot water heating system whenever the system calls for the two-pipe system to provide heating in the building.
2. Interlock the boiler circulating pump with the related boiler. Provide a time delay relay off to disperse the heat in the boiler as required by manufacturer. Disable the related pump if boiler fails to produce heating water or boiler goes into alarm.
3. Enable the boilers throughout the year with an override option to disable the boilers, as Owner requires.
4. Provide the following new points as a minimum for the new hot water heating system.

POINT DESCRIPTION	TYPES	DEVICE
Boiler Enable/Disable	DO	Control Relay
Boiler Alarm Status	DI	Safety Relay
Primary Boiler Pump Start/Stop	DO	Control Relay
Primary Boiler Pump Status	DI	Current Sensitive Relay
Boiler discharge water Temperature	AI	Pipe RTD
Ambient Temperature	AI	Thermistor

MARSHALL MIDDLE SCHOOL

3.13 VARIABLE FREQUENCY DRIVE INTERFACE

A. Interface to the VFD directly

B. Interface may be hardwired or via RS-485

C. The following points shall be available at a minimum:

Point Name	Type
Start-stop	DO
Drive alarm	DI
Last fault	AI

Reset drive	DO
Percent output	AI
Frequency output	AI
Speed	AI
Current	AI
Power	AI
Drive temperature	AI
KWH	AI
Run time	AI

3.14 EXHAUST FANS

A. The existing general building exhaust system which was integral to the ERV system is being removed. A new ground mounted exhaust fan is being installed to meet the needs of the general exhaust.

B. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.

C. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.15 PACKAGED DX OUTSIDE AIR UNITS

A. These units are furnished with a direct expansion coil, hot gas reheat coil and gas heater in the reheat position. Control shall be as follows:
   1. Start/Stop shall be by BMCS. Internal unit controls shall control operation.
   2. The unit shall operate through its internal unit controls. The unit shall maintain a constant leaving air temperature off the cooling coil as scheduled and the hot gas reheat shall modulate to deliver neutral temperature air to the space at all times. The BMCS shall send an alarm if the leaving cooling coil leaving air temperature is above setpoint by more than 5 degrees (adjustable) singling unit operational issues.
   2. The outside air unit is provided with an outside air damper. The BMCS shall signal the unit controller for damper operation. The outside air damper shall be normally open.
   3. The BMCS shall monitor the temperature and humidity level within this building.
   4. Fully integrate all available BACNET points into the graphics page associated with this unit.

B. Provide and install all low voltage control wiring associated with the DX Outside Air system. This includes but not limited to installing and wiring to manufacturer provided space sensors. Installation shall be in accordance with this specification section and with manufacturer's installation requirements.

C. All points listed below shall be provided by the BMCS contractor as hardwired points and independent of the outside air unit BacNet points. The points listed below are to be used as verification of unit operation.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Cooling Discharge Air Temperature	AI	RTD
Hot Gas Reheat Coil Discharge Temperature	AI	RTD
Unit Discharge Air Temperature	AI	RTD
Status	DI	Air Flow Switch
Space Humidity	AI	Humidity Sensor

3.16 VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS

A. This system consists of outdoor packaged condensing units and interior ducted vertical fan coil units with FCU integration kits. The variable refrigerant flow system is provided with internal and a centralized BACnet controller. Refer to Section 23 81 26 for additional information and requirements.
   1. The BMCS shall start and stop the system, provide operation scheduling, and provide the ability to modify individual space setpoints.
   2. The BMCS shall integrate with the VRF control system completely including the ability to view all available points provided by the VRF equipment.
   3. The BMCS system shall have a dedicated graphics page that shows the VRF system in the Administration area. This graphics page shall allow view/edit of space temperatures and schedules.
   4. It is the VRF manufacturer's responsibility to provide a BACnet capable gateway and assist with the integration into the BAS. The VRF manufacturer will provide dedicated time for the integration process and the BMCS contractor shall coordinate when the VRF manufacturer shall have a certified technician onsite for integration assistance.

B. System Off - When the system is off:
   1. The condensing unit and indoor units shall be off.

C. Initiation of System Start-Up - System start-up shall be initiated:
   1. Scheduled by the BMCS.
   2. Activation of override signaled through the VRF system from a local zone controller.

D. Variable Frequency Drive is being provided for soft start and balancing only.

E. Provide and install all low voltage control wiring associated with the VRF system. This includes but not limited to installing and wiring to manufacturer provided temperature sensors in each space, installation and wiring between indoor and outdoor units, installation and wiring between each indoor unit and installation and wiring of all VRF system control end devices. Installation shall be in accordance with this specification section and with manufacturer's installation requirements.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop (Each Zone)	DO	

POINT DESCRIPTION	TYPES	DEVICE
Zone Unit Status (Each Zone)	DI	
Zone Space Temp. (Each Zone)	AI	
Zone Space Humidity (Each Zone)	AI	
Zone Fan Coil Unit Speed Control	AO	Variable Frequency Drive
Enable/Disable “Lock” of Wall Control On/Off (Each Zone)	DO	
Enable/Disable “Lock” of Wall Control Mode (Each Zone)	DO	
Enable/Disable “Lock” of Wall Control Temp. Adjustment (Each Zone)	DO	
Lock Status (Each Zone)	DI	
Operation Mode Setting (Each Zone)	DO	
Operation Mode Status (Each Zone)	DI	
Fan Speed Setting (Each Zone)	DO	
Fan Speed Status (Each Zone)	DI	
Set Temperature (Each Zone)	AO	
Alarm Flag	DI	
Alarm Code	AI	
Compressor Status	DO	

VINCENT MIDDLE SCHOOL

3.17 MISCELLANEOUS

A. At the existing 9 classroom building (Fibrebond Building) the existing ground mounted packaged DX outside air ERV unit, multizone dx air handling units with electric duct heat are being removed and replaced with a new ground mounted packaged DX outside air unit, ground mounted exhaust fan and a Variable Refrigerant Flow system with multiple indoor vertical air handling units. The existing BMCS shall be modified, expanded to remove the existing systems and incorporate the new systems. The BMCS expansion shall include providing all new current version controllers and updating all BMCS graphics to remove old systems and to add new systems for this building. In addition this contractor shall be responsible for removal of all existing end devices and installation of new to facilitate a complete and functional control system.

3.18 VARIABLE FREQUENCY DRIVE INTERFACE

A. Interface to the VFD directly

B. Interface may be hardwired or via RS-485

C. The following points shall be available at a minimum:

Point Name	Type
Start-stop	DO
Drive alarm	DI
Last fault	AI
Reset drive	DO
Percent output	AI
Frequency output	AI
Speed	AI
Current	AI
Power	AI
Drive temperature	AI
KWH	AI
Run time	AI

3.19 EXHAUST FANS

A. The existing general building exhaust system which was integral to the ERV system is being removed. A new ground mounted exhaust fan is being installed to meet the needs of the general exhaust.

B. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.

C. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.20 PACKAGED DX OUTSIDE AIR UNITS

A. These units are furnished with a direct expansion coil, hot gas reheat coil and gas heater in the reheat position. Control shall be as follows:
   1. Start/Stop shall be by BMCS. Internal unit controls shall control operation.
   2. The unit shall operate through its internal unit controls. The unit shall maintain a constant leaving air temperature off the cooling coil as scheduled and the hot gas reheat shall modulate to deliver neutral temperature air to the space at all times. The BMCS shall send an alarm if the leaving cooling coil leaving air temperature is above setpoint by more than 5 degrees (adjustable) singling unit operational issues.
   2. The outside air unit is provided with an outside air damper. The BMCS shall signal the unit controller for damper operation. The outside air damper shall be normally open.
   3. The BMCS shall monitor the temperature and humidity level within this building.
   4. Fully integrate all available BACNET points into the graphics page associated with this unit.

B. Provide and install all low voltage control wiring associated with the DX Outside Air system. This includes but not limited to installing and wiring to manufacturer provided space sensors. Installation shall be in accordance with this specification section and with manufacturer's installation requirements.

C. All points listed below shall be provided by the BMCS contractor as hardwired points and independent of the outside air unit BacNet points. The points listed below are to be used as verification of unit operation.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Cooling Discharge Air Temperature	AI	RTD
Hot Gas Reheat Coil Discharge Temperature	AI	RTD
Unit Discharge Air Temperature	AI	RTD
Status	DI	Air Flow Switch
Space Humidity	AI	Humidity Sensor

3.21 VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS

A. This system consists of outdoor packaged condensing units and interior ducted vertical fan coil units with FCU integration kits. The variable refrigerant flow system is provided with internal and a centralized BACnet controller. Refer to Section 23 81 26 for additional information and requirements.
   1. The BMCS shall start and stop the system, provide operation scheduling, and provide the ability to modify individual space setpoints.
   2. The BMCS shall integrate with the VRF control system completely including the ability to view all available points provided by the VRF equipment.
   3. The BMCS system shall have a dedicated graphics page that shows the VRF system in the Administration area. This graphics page shall allow view/edit of space temperatures and schedules.
   4. It is the VRF manufacturer's responsibility to provide a BACnet capable gateway and assist with the integration into the BAS. The VRF manufacturer will provide dedicated time for the integration process and the BMCS contractor shall coordinate when the VRF manufacturer shall have a certified technician onsite for integration assistance.

B. System Off - When the system is off:
   1. The condensing unit and indoor units shall be off.

C. Initiation of System Start-Up - System start-up shall be initiated:
   1. Scheduled by the BMCS.
   2. Activation of override signaled through the VRF system from a local zone controller.

D. Variable Frequency Drive is being provided for soft start and balancing only.

E. Provide and install all low voltage control wiring associated with the VRF system. This includes but not limited to installing and wiring to manufacturer provided temperature sensors in each space, installation and wiring between indoor and outdoor units, installation and wiring between

each indoor unit and installation and wiring of all VRF system control end devices. Installation shall be in accordance with this specification section and with manufacturer's installation requirements.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop (Each Zone)	DO	
Zone Unit Status (Each Zone)	DI	
Zone Space Temp. (Each Zone)	AI	
Zone Space Humidity (Each Zone)	AI	
Zone Fan Coil Unit Speed Control	AO	Variable Frequency Drive
Enable/Disable "Lock" of Wall Control On/Off (Each Zone)	DO	
Enable/Disable "Lock" of Wall Control Mode (Each Zone)	DO	
Enable/Disable "Lock" of Wall Control Temp. Adjustment (Each Zone)	DO	
Lock Status (Each Zone)	DI	
Operation Mode Setting (Each Zone)	DO	
Operation Mode Status (Each Zone)	DI	
Fan Speed Setting (Each Zone)	DO	
Fan Speed Status (Each Zone)	DI	
Set Temperature (Each Zone)	AO	
Alarm Flag	DI	
Alarm Code	AI	
Compressor Status	DO	

HOMER ELEMENTARY SCHOOL

3.22 MISCELLANEOUS

A. At the existing 10 classroom building (Fibrebond Building) the existing ground mounted packaged DX outside air ERV unit, multizone dx air handling units with electric duct heat are being removed and replaced with a new ground mounted packaged DX outside air unit, ground mounted exhaust fan and a Variable Refrigerant Flow system with multiple indoor vertical air handling units. The existing BMCS shall be modified, expanded to remove the existing systems and incorporate the new systems. The BMCS expansion shall include providing all new current version controllers and updating all BMCS graphics to remove old systems and to add new

systems for this building. In addition this contractor shall be responsible for removal of all existing end devices and installation of new to facilitate a complete and functional control system.

3.23 VARIABLE FREQUENCY DRIVE INTERFACE

A. Interface to the VFD directly

B. Interface may be hardwired or via RS-485

C. The following points shall be available at a minimum:

Point Name	Type
Start-stop	DO
Drive alarm	DI
Last fault	AI
Reset drive	DO
Percent output	AI
Frequency output	AI
Speed	AI
Current	AI
Power	AI
Drive temperature	AI
KWH	AI
Run time	AI

3.24 EXHAUST FANS

A. The existing general building exhaust system which was integral to the ERV system is being removed. A new ground mounted exhaust fan is being installed to meet the needs of the general exhaust.

B. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.

C. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.25 PACKAGED DX OUTSIDE AIR UNITS

A. These units are furnished with a direct expansion coil, hot gas reheat coil and gas heater in the reheat position. Control shall be as follows:
   1. Start/Stop shall be by BMCS. Internal unit controls shall control operation.
   2. The unit shall operate through its internal unit controls. The unit shall maintain a constant leaving air temperature off the cooling coil as scheduled and the hot gas reheat shall modulate to deliver neutral temperature air to the space at all times. The BMCS shall send an alarm if the leaving cooling coil leaving air temperature is above setpoint by

more than 5 degrees (adjustable) singling unit operational issues.

2. The outside air unit is provided with an outside air damper. The BMCS shall signal the unit controller for damper operation. The outside air damper shall be normally open.
3. The BMCS shall monitor the temperature and humidity level within this building.
4. Fully integrate all available BACNET points into the graphics page associated with this unit.

B. Provide and install all low voltage control wiring associated with the DX Outside Air system. This includes but not limited to installing and wiring to manufacturer provided space sensors. Installation shall be in accordance with this specification section and with manufacturer's installation requirements.

C. All points listed below shall be provided by the BMCS contractor as hardwired points and independent of the outside air unit BacNet points. The points listed below are to be used as verification of unit operation.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Cooling Discharge Air Temperature	AI	RTD
Hot Gas Reheat Coil Discharge Temperature	AI	RTD
Unit Discharge Air Temperature	AI	RTD
Status	DI	Air Flow Switch
Space Humidity	AI	Humidity Sensor

3.26 VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS

A. This system consists of outdoor packaged condensing units and interior ducted vertical fan coil units with FCU integration kits. The variable refrigerant flow system is provided with internal and a centralized BACnet controller. Refer to Section 23 81 26 for additional information and requirements.

1. The BMCS shall start and stop the system, provide operation scheduling, and provide the ability to modify individual space setpoints.
2. The BMCS shall integrate with the VRF control system completely including the ability to view all available points provided by the VRF equipment.
3. The BMCS system shall have a dedicated graphics page that shows the VRF system in the Administration area. This graphics page shall allow view/edit of space temperatures and schedules.
4. It is the VRF manufacturer's responsibility to provide a BACnet capable gateway and assist with the integration into the BAS. The VRF manufacturer will provide dedicated time for the integration process and the BMCS contractor shall coordinate when the VRF manufacturer shall have a certified technician onsite for integration assistance.

B. System Off - When the system is off:

1. The condensing unit and indoor units shall be off.

C. Initiation of System Start-Up - System start-up shall be initiated:

1. Scheduled by the BMCS.
2. Activation of override signaled through the VRF system from a local zone controller.

D. Variable Frequency Drive is being provided for soft start and balancing only.

E. Provide and install all low voltage control wiring associated with the VRF system. This includes but not limited to installing and wiring to manufacturer provided temperature sensors in each space, installation and wiring between indoor and outdoor units, installation and wiring between each indoor unit and installation and wiring of all VRF system control end devices. Installation shall be in accordance with this specification section and with manufacturer's installation requirements.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop (Each Zone)	DO	
Zone Unit Status (Each Zone)	DI	
Zone Space Temp. (Each Zone)	AI	
Zone Space Humidity (Each Zone)	AI	
Zone Fan Coil Unit Speed Control	AO	Variable Frequency Drive
Enable/Disable "Lock" of Wall Control On/Off (Each Zone)	DO	
Enable/Disable "Lock" of Wall Control Mode (Each Zone)	DO	
Enable/Disable "Lock" of Wall Control Temp. Adjustment (Each Zone)	DO	
Lock Status (Each Zone)	DI	
Operation Mode Setting (Each Zone)	DO	
Operation Mode Status (Each Zone)	DI	
Fan Speed Setting (Each Zone)	DO	
Fan Speed Status (Each Zone)	DI	
Set Temperature (Each Zone)	AO	
Alarm Flag	DI	
Alarm Code	AI	
Compressor Status	DO	

TAYLOR CAREER AND TECHNICAL EDUCATION CENTER

3.27 MISCELLANEOUS

A. The buildings HVAC equipment is being replaced. The existing BMCS shall be modified,

expanded to remove the existing systems and incorporate the new systems. The BMCS expansion shall include updating all BMCS graphics to remove old systems and to add new systems for this building. In addition, this contractor shall be responsible for removal of all existing end devices and installation of new to facilitate a complete and functional control system.

B. The BMCS expansion shall include removing all obsolete controllers and installing new current version controllers.

3.28 EXHAUST FANS

A. The existing general building exhaust fans are being replaced with new fans.

B. Existing motorized exhaust dampers and motorized exhaust damper actuators shall be replaced on all exhaust fans being replaced.

C. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.

D. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.29 CONDENSER WATER SYSTEM CONTROL

A. The Existing Condenser Water System equipment is being replaced. Refer to mechanical drawings for additional information.

B. The Condenser Water system consists of a Closed Condenser Water Loop (CCWL), Condenser Water Boiler, Condenser Water Boiler Pump, (2) Condenser Water Pumps, Open Condenser Water Loop (OCWL), Fluid Cooler (FC), and Open Condenser Water Fluid Cooler Pump.
1. The BMCS shall enable and disable the Condenser Water System control.

B. The CCWL consists of two main building condenser water pumps control shall be as follows:
1. Upon startup of building, the lead CCWL pump shall be energized. The BMCS shall monitor the CCWL temperature.
2. Provide a 15-minute delay (adjustable) to allow the CCWL system temperatures to stabilize.
3. Alternate the lead/lag CCWL pumps on a daily basis. If one pump fails to start energize the lag pump.
4. If the CCWL temperature is within the range specified by the water source heat pump equipment manufacturer, all WSHPs shall be enabled. Minimum 55°F (Adjustable) and Maximum 90°F (Adjustable)
5. If the CCWL temperature does not come into range or goes out of range during system operation, disable the system and send an alarm through the BMCS.
6. A temperature sensor in the main return CCWL piping shall in sequence :
   a. On a drop of the CCWL temperature, activate the Condenser Water Boiler Loop.
   b. On a rise of the CCWL temperature, activate the Open Condenser Water Loop pump.

c. Provide adjustable dead band temperatures on each loop to ensure CCWL

temperature is maintained.

C. The CCWL also contains a high efficiency gas fired boiler, a boiler circulation pump, and a system motorized changeover isolation valve.
1. Upon activation of the CCWL Boiler sequence, the system motorized changeover isolation valve shall close to restrict flow to the Fluid Cooler, and the CCWL Boiler Pump shall be energized.
2. The Boiler and the BMCS shall monitor the Condenser Water Boiler loop leaving water temperature. The boiler controller shall modulate the boiler to maintain a 60°F (Adjustable) Condenser Water Boiler loop leaving water temperature.

D. The OCWL consists of a Fluid Cooler, Open Condenser Water Fluid Cooler Pump condenser water pump, Fluid Cooler Coil, and a system motorized changeover isolation valve.
1. Upon activation of the OCWL sequence, the system motorized isolation valve shall open fully to allow water to flow to the Fluid Cooler Coil, and the OCWL Fluid Cooler Pump shall be energized.
2. The Fluid Cooler fan shall be energized and cycled to maintain cooling tower leaving water temperature of 90°F (Adjustable).

E. Provide interface to boiler through the chiller BacNet interface card. Provide a graphic page for the interface card that displays all values available.

POINT DESCRIPTION	TYP	DEVICE
CCWL Pump Start/Stop (2)	DO	Control Relay
CCWL Pump Status (2)	DI	Current Sensitive Relay
CCWL Building Water Supply Temp.	AI	Pipe Thermistor
CCWL Building Return Supply Temp.	AI	Pipe Thermistor
OCWL Pump Start/Stop	DO	Control Relay
OCWL Pump Status	DI	Current Sensitive Relay
OCWL Water Supply Temp.	AI	Pipe Thermistor
OCWL Water Return Temp.	AI	Pipe Thermistor
System Changeover Valve	AO	Electronic Operator
FC Start/Stop	DO	Control Relay
FC Status (CT Fan)	DI	Current Switch
FC Vibration Alarm	DI	Vibration Switch
CCWL FC Water Supply Temp.	AI	Pipe Thermistor
CCWL FC Return Supply Temp.	AI	Pipe Thermistor

POINT DESCRIPTION	TYP	DEVICE
FC Pump Start/Stop	DO	Control Relay
FC Pump Status	DI	Current Sensitive Relay
Boiler Controller	DO	Control Relay
Boiler Alarm Status	DI	Safety Relay (Each Boiler)
Boiler Pump Start/Stop	DO	Control Relay
Boiler Pump Status	DI	Current Sensitive Relay
Boiler Return Water Temp.	AI	Pipe Thermistor
Boiler Supply Water Temp.	AI	Pipe Thermistor
Inlet Temperature (Read Only)		Bacnet Card (Each Boiler)
Outlet Temperature (Read Only)		Bacnet Card (Each Boiler)
Header Temperature (Read Only)		Bacnet Card (Each Boiler
Boiler State (Read Only)		Bacnet Card (Each Boiler)
Error Code (Read Only)		Bacnet Card (Each Boiler)

3.30 WATER SOURCE HEAT PUMP UNIT

A. Each water source heat pump unit is furnished with water to refrigerant heat exchanger, compressor/s, refrigerant reversing valve, fan and on-board unit controls. Control shall be local via a programmable thermostat provided with each Water Source Heat Pump Unit. This contractor shall wire and install thermostats.

1. Start/stop of water source coil unit shall be by terminal equipment controller via a local space programmable thermostat.
2. The outside air damper shall be open when the water source heat pump units are operating during the occupied periods.
3. A float sensor provided with WSHP mounted in the primary pan shall disable unit at a high-water level condition. The BMCS shall send an alarm upon activation of the condensate Drain Overflow Sensor.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Status	DI	Current Relay
Unit Alarm	DI	Current Relay
Discharge Air Temperature	AI	Duct Thermistor

POINT DESCRIPTION	TYPES	DEVICE
Condensate Overflow Alarm	AI	Condensate Drain Overflow Sensor
Outside Air Damper	DO	Electronic Operator

WESTBROOK HIGH SCHOOL

3.31 AIR ROTATION UNIT

A. An Air Rotation Unit is being installed at the existing ROTC room. This unit shall not be added to the existing control system. However, this contractor shall wire, install and configure the programmable thermostat provided by the mechanical contractor. Refer to 23 81 27 for additional information. Programming shall be as specified by owner.

3.32 START-UP AND POINT VERIFICATION

A. Final startup and point verification shall include the following information.
   1. Field panel checkout:
      a. Verify enclosure is not mounted on vibrating surface.
      b. Verify class I and class II wiring is separated within enclosure.
      c. Check for shorts/grounds/induced voltages/proper voltages.
      d. Verify proper point terminations in accordance with as-builts.
      e. Verify that all modules are in proper place and addressed.
      f. Verify proper power voltage.
      g. Load database and programming.
      h. Startup the panel.
      i. Point and device checkout.
   2. Analog input point checkout:
      a. Verify the correct wiring terminations per the design documentation package, at the field panel. Verify that all wiring and terminations are neat and dressed.
      b. Verify the point address by checking that the analog input instrument is wired to the correct piece of field equipment. Do this by altering the environment at the sensing element or by disconnecting one of the wires at the sensor, and verifying that the reading at the field panel has reacted to this change.
      c. Verify the point database to be correct, (i.e., alarmability, alarm limits, slope/intercept, engineering units, etc.). Verify that the correct change of value (COV) limit has been defined.
      d. Verify the sensor has the correct range and input signal. (i.e., 20-120°F, 4 - 20 ma). Verify that the device is mounted in the correct location and is wired and installed correctly per the design documentation package.
      e. Set-up and/or calibrate any associated equipment (i.e., panel LCD meters, loop isolators, etc.). Verify that these auxiliary devices are mounted in the correct location and are wired and installed correctly per the design documentation package.
      f. Verify the correct reading at the field panel using appropriate MMI devices. Verify that any associated LCD panel meters indicate the correct measured value.
   3. Digital input point checkout:
      a. Verify the device is correctly wired and terminated as shown in the design documentation package. Verify that all wiring and terminations are neat and properly secured.
      b. Verify the point address by verifying that the digital input is correctly terminated at the controlled piece of equipment.

c. Verify the point database is correct (i.e., point name, address, alarmability, etc.).
d. Set-up and/or calibrate the associated equipment, i.e. smoke detector, high/low temp detector, high/low static switch, end switch, current relay, pressure switch,

etc. is mounted in the correct location, and is wired and installed correctly per the control system installation drawings.

e. With the controlled equipment running or energized as described in the digital output checkout procedures, verify the correct operation of the digital input point and associated equipment by putting the digital input monitored equipment into its two states. Verify that the proof or status point indicates the correct value at the operator's terminal and that the status led is giving the proper indication in each mode of operation (on/off).

4. Digital output point checkout:
   a. Verify that device is correctly wired and terminated as shown in the design documentation package.
   b. Verify that the correct voltage is utilized in the circuit.
   c. Verify the point database to be correct (i.e. point name, address, etc.).
   d. Check and verify that the end device responds appropriately to the digital output(s).
   e. After verifying the set-up and operation of any associated digital input/proof points, check and verify correct operation of the logical point and associated equipment by commanding the point to all possible states (i.e. off, on, fast, slow, auto, etc.). Verify that the defined proof delay is adequate for all modes of operation.
   f. If any interlocked equipment exists that has independent hand-off-auto or auxiliary control wiring, verify correct operation of same. Also check that any interlocked equipment such as EP switches for damper operation or exhaust and return fans are wired correctly and operate correctly.
   g. Verify that the controlled piece or pieces of equipment cannot be caused to change state via the digital output if an associated hand-off-auto switch is in the hand/on or hand/off mode of operation, unless specified as a fireman's override point etc.
5. Analog output point checkout:
   a. Verify the correct wiring or piping terminations per the design documentation package, at the field panel. Verify that all wiring and piping terminations are neat and dressed.
   b. Insure that the correct output device(s) are installed per the Control System Installation Drawings. (i.e., I/P or P/I transducers, transformers, power supply, etc.). Verify that these devices are installed, wired and piped correctly. Verify that any configuration jumpers are in the proper settings for the required application. Verify related transformers are fused in accordance with installation drawings.
   c. Verify the point database to be correct. Verify that the correct COV limit has been defined.
   d. Verify the point address by checking that the analog output is wired and/or piped to the correct output transducer and/or equipment.
   e. Verify that the controlled device is calibrated (i.e., 3-8PSI valve, 8-13 PSI damper motor, 4-20 ma variable frequency drive, etc.) and is in the correct location, and is wired or piped and installed correctly per the design documentation package. If the controlled device is not calibrated, then a three-point (high, low and mid-point) calibration procedure must take place. Verify proper operation of the end device. When calibration has been verified, ensure that installation drawings, point database, and PPCL have been updated.
   f. Set-up and or calibrate any associated equipment, (i.e., panel LCD meters, loop isolators, pneumatic gauges, etc.). Also verify that these auxiliary devices are mounted in the correct location, and are wired or piped and installed correctly per the design documentation package.
   g. After verifying the set-up and operation of any associated equipment check for the correct operation of the logical point and associated equipment by

commanding the analog output to the top and bottom of its range. Verify that the

control device(s) responded appropriately as indicated by the design documentation package. Check to insure that all network terminals, host console devices, etc. can also command these outputs.

h. Check that all pneumatic gauges, pilot positioners and LCD panel meters indicate the correct values.

6. Terminal equipment controller checkout:
   a. Load program database
   b. Enable programs
   c. Verify sequence of operations
7. Programming checkout:
   a. Provide checkout for each system and sequence of operation.
   b. The following are sample sequence of operations tests. The intent of these procedures is to provide a plan of action to verify system operations via block checks of the project specific sequence of operations. The procedures may be used in this format, or one procedure to a page should more detail be required. The procedures outlined below should be verified for accuracy, and may be modified to meet your specific requirements.
   c. Description of Test: AHU Alarm Checkout. Verify AHU-1 discharge air temperature alarming is operational and is received at the designated terminal.
   d. Input to Trigger Test: Change discharge temperature high alarm limit through software to a value below the current discharge temperature (discharge temperature - 10°F).
   e. Expected Outcome: A high temperature alarm will be received per the Alarm Definition Report at its designated terminal.
   f. Provide signoff sheet with indication for test Pass, Fail, Date of test and Initials for signoff.
8. Workstation checkout:
   a. Verify the operation of all trunk interface equipment.
   b. Verify all workstation software, including options, based upon the installation instructions for the PC.
   c. Perform software backup (site, options, etc.)
   d. Complete workstation configuration report for owner signoff.
   e. Provide verification that all graphics have been created, as required by project bid documents.

3.33 TESTING AND ACCEPTANCE

A. General:
   1. After completion of installation and start-up procedures, commence the specified 3-phase verification and testing sequence leading to final acceptance.
      a. Follow in the order specified.
      b. Each testing phase shall be satisfactorily completed before entering the next phase.
   2. Prior to entering each phase of the sequence, submit for approval, a written agenda describing in detail the procedure to be followed to meet the requirements for each specified verification, test or demonstration.
   3. Submit for approval, a sample of the form on which the test will be reported.
      a. Identify project.
      b. Provide a list of all points, arrange in numerical order of point addresses.
         1) Show point descriptor and location of each.
         2) Indicate DDC panel that processes each point.
         3) Use the list as a basis for the specified report form.
      c. Signatures of participants and observers.
      d. Results.
      e. Description of adjustment or corrections of points in error.

f. Date.

4. Provide schedule of tests. Estimate dates of significant events.
5. Test, calibrate and adjust each point in the system as specified.
6. Provide documentation of all tests and verifications as specified.
7. Provide trend reports indicating proper control of all points for an extended period of time.

B. Phase 1 - Testing, Calibrating, and Adjusting:
1. Operate each analog point in the entire system.
   a. At a point in the upper quarter of its range.
   b. At a point in the lower quarter of its range.
   c. At its operating point.
2. Provide personnel and diagnostic instruments at both the central and remote locations.
3. Provide testing stimulants for alarms.
4. Use digital meters of double the accuracy of the instruments being calibrated.
5. Provide an approved test device for simulating high and low temperatures.
6. When the function is performed, read values at the central control and observe the actual function at the field instrument.
7. Exercise each binary point and observe indication at console and simultaneously observe operation in the field.
8. Submit an operation report for each point in the system, in approved format, and describe any corrective or adjusting action taken.
9. Test all power transducers with a Dranetz Power Analyzer.

C. Phase 2 - Equipment and Point Verification:
1. Verify calibration or function of each point.
   a. Verify analog points at operating value.
   b. Record on specified form.
   c. Make approved adjustments to out of tolerance points.
      1) Identify these points for ready reference.
2. After verification procedure in completed:
   a. Verify corrected points.
   b. Record on specified form.
   c. Points requiring correction.
      1) Replace sensor or actuator if electrical measurements indicated components are out of specified tolerance.

D. Phase 3 - Software Verification:
1. Submit agenda and report format for software demonstrations.
2. Demonstrate to the Owner and the Engineer that all software programs and automatic control sequences function as specified.
3. Demonstrate compliance with response time specifications.
   a. Simulate normal heavy load conditions.
   b. Initiate at least ten successive occurrences on normal heavy load conditions as specified, and measure response time of typical alarms and status changes.

04. Provide written documentation of demonstration, signed by representatives of the Contractor and Engineer.

E. Provide the following reports to Engineer at final completion of all Testing:
1. List of all points.
2. List of all points currently in alarm.
3. List of all disabled points.
4. List of all points in over-ride status.
5. List of all points currently locked out.
6. List of user accounts and access levels.

7. List all weekly schedules.
8. List of holiday programming schedules.
9. List of limits and deadbands.
10. System diagnostics reports including, list of DDC panels on line and communicating, status of all DDC terminal units device points.
11. List of programs.
12. Provide trend data reports to ensure proper operation and sequence control of BMCS.

F. Substantial Completion of the BMCS will not occur until completion and acceptance of all testing and acceptance procedures.

3.34 TRAINING

A. The contractor shall provide factory-trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.

B. Provide 40 hours of training for Owner's designated operating personnel. Training shall include:

Explanation of drawings, operations and maintenance manuals
Walk-through of the job to locate control components
Operator workstation and peripherals
DDC controller and ASC operation/function
Operator control functions including graphic generation and field panel programming
Operation of portable operator's terminal
Explanation of adjustment, calibration and replacement procedures
Student binder with training modules

C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor.

3.35 PROJECT MANAGEMENT

A. Provide a designated project manager who will be responsible for the following:
1. Construct and maintain project schedule.
2. Authorized to accept and execute orders or instructions from General Contractor, Owner / Architect & Engineer.
3. Attend project meetings as necessary to avoid conflict and delays.
4. Make necessary field decisions relating to this section.
5. Coordination / Single point contact.
6. Have Internet access for project management.

END OF SECTION

SECTION 23 20 00

HVAC PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install pipe and pipe fittings for piping systems specified in Division 23 - Mechanical.

1.2 RELATED WORK

A. Division 23 Mechanical:
1. Earthwork.
2. Valves, Strainers and Vents.
3. Vibration Isolation.
4. Insulation.
5. Other Piping Sections

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.

B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.

C. Solder joints.
1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
3. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping. Use lead free solder on all other copper piping.

D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.

E. Flanged.
1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.

3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.

F. Mechanical Joints: Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.

2.3 UNIONS

A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe material of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

A. Pipe 2" and Smaller: For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.

B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

A. High Temperature Piping: Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.

B. Other Piping: Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.7 DOMESTIC MANUFACTURE

A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufactured, for maintenance.

B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.

C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.

D. Install piping without tapping out of the bottom of pipe.

3.2 WELD

A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.

B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.

F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.

B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be

supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging. Review structural drawings for additional information.

B. Provide supports both sides and within 12” of each horizontal elbow for pipe 6" and larger.

C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On chilled water pipe supports shall be outside the insulation.

D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.

E. Install trapeze hangers, properly sized, to support the intended load without distortion. Use hangers with 1-1/2” minimum vertical adjustment.

F. Use electro-galvanized or zinc plated beam clamps if acceptable to the structural engineer, threaded rods, nuts, washers and hangers. All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. Use only on beams as directed by the Structural Engineer.

G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.

H. Provide hangers within 3' of pipe length from all coil connections.

I. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Ft.	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.5 PIPE SUPPORTS

A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanized members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.

B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.

C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

A. Support condensate drain pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact

polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 ANCHORS

A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.8 FLOOR PENETRATIONS

A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.9 PIPE SLEEVES

A. Sleeves through masonry and concrete construction:
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
   2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.

B. Sleeves through gypsum wall construction.
   1. Fabricate sleeves of 16 gauge galvanized sheet metal.

C. Sleeves through elevated slab construction.
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.

D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2” above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.

E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.

F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.

G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.

H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate. Flush the chilled and hot water systems utilizing the filter feeders.

B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.

C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until “potable water clear” and particles larger than 5 microns are removed.

D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.

E. Dispose of water in approved manner.

F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be equal to Nalco 2578 prepping compound. Insert anti-foam compound as necessary. Circulate for 48 hours or as recommended by the manufacture. Dispose of water in approved manner. Flush system and replace with clean water. Verify compatibility of chemicals used with existing chemical treatment program on remodel projects.

G. Phase Three: Final flushing and rinsing: Flush and rinse until “potable water clear” and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.

H. Submit status reports upon completion of each phase of work on each system.

I. Special requirements, if any, are specified in the sections on each type of piping or in the section on Water Treatment Systems.

3.13 TESTING

A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.

B. Do not insulate or conceal piping systems until tests are satisfactorily complete.

C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.

D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate

proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

C. Install identification in the following locations:
   1. both sides of penetrations through walls, floors and ceilings.
   2. Close to valves or flanges.
   3. Intervals on straight pipe runs not to exceed 50 feet
   4. Apply marker where view is obstructed.

D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 “Scheme for Identification of Piping Systems”.

END OF SECTION

SECTION 23 21 13

PIPING APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install heating water and chilled water piping, valves and appurtenances, including fittings and strainers. Domestic hot water piping is specified in the Domestic Water Piping and Appurtenances section.

1.2 RELATED WORK

A. Division 23 Mechanical:
1. Pipe and Pipe Fittings - General
2. Valves, Strainers and Vents
3. Vibration Isolation
4. Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. For pipe 2" and less in diameter, provide pipe conforming to ASTM A 53, Grade A or B, or ASTM A106 standard weight seamless, or electric-resistance welded black steel pipe. Furnish 150 lb. screwed malleable iron fittings conforming to ANSI B 16.3 for chilled water. Provide fittings conforming to ANSI B 16.4 for hot water.

B. For pipe 2-1/2" in diameter and larger, provide pipe meeting the requirements of ASTM A 53, Grade A or B, or ASTM A 106 standard weight seamless, or electric-resistance welded black steel pipe with standard weight seamless steel welded fittings, satisfying ASTM A 234, Grade WPA or WPB, ANSI B16.9.

2.2 VALVES

A. Refer to Section 23 05 23.

B. Refer to Building Management and Control System.

2.3 WATER SPECIALTIES

A. Automatic Air vents shall be float actuated high capacity air vent designed to purge free air from the system and provide shutoff at pressures up to 150 psig at a maximum temperature of 250 degrees F. The design of the high capacity air vent shall prevent air from entering the system if system pressure should drop below atmospheric pressure. The high capacity air vent shall purge free air at pressures up to 150 psig during normal system operation. The high capacity air vent shall be constructed of cast iron and fitted with components of stainless steel, brass, and EPDM.
1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.

B. Air and Dirt Separators shall be a full flow coalescing type combination air eliminator and dirt separator. The separator shall be designed for full flow high volume systems. The inlet and outlet connections shall be the same as adjoining pipe. Vessel shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet and outlet nozzles. The vessel shall include copper or stainless steel coalescing medium to aid in the separation of air and dirt in the system entrained water. Air elimination efficiency shall be 100% free air, 100% entrained air, and a minimum of 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100

passes. Unit shall be provided with a separate venting chamber to prevent system contaminants from harming the float and venting valve operation.

1. Acceptable manufacturer shall be Spirovent Series HV by Spirotherm, TACO High Velocity 4900, Thrush

C. Pressure Reducing Valves shall be diaphragm operated with brass body, low inlet pressure check valve and inlet strainer. The strainer shall be easily removed without system shutdown. The valve seat, strainer, and stem must be removable and of non-corrosive material.

1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.

PART 3 - EXECUTION

3.1 TESTING

A. Test all piping systems to assure they are absolutely leak free.

B. Apply a hydraulic pressure 1-1/2 times the operating pressure, 150 psig minimum, and check for leaks. Maintain test for a minimum of 24 hours. The piping system must remain absolutely tight during this period. The satisfactory completion of any test or series of tests will not relieve the contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories. The test should be observed by the Architect / Engineer before pressure is removed and water drained.

END OF SECTION

SECTION 23 21 23

HVAC PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. General characteristics for pumps specified in Division 23 - Mechanical.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 23 - Mechanical, including the following:

A. Division 23 Mechanical - Electrical Provisions of Mechanical Work.

1.3 PUMP SELECTION

A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.

B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.

C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.

D. The pump curve shall rise continuously from maximum flow to cut-off.

E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.

F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.

G. Select the pump for operation at or near peak efficiency.

H. Cavitation-free at all points on the curve.

I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.

J. Pumps shall be suitable for parallel operation. Where pumps are operated in parallel, individual pumps shall be capable of stable operation with only one pump operating in the system. Submit pump curves with single and multiple pumps operating on system curve for approval.

1.4 PUMP SIZE AND TYPE

A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.

B. The head capacities indicated in the schedules are listed for bidding purposes only. Calculate the operating head at each pump; take 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.

1.5 CERTIFIED DATA

A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. When multiple pumps are operating in parallel, show pump curves for one pump running, two pumps running, and so on. Show pump curves with system curve plotted.

PART 2 - PRODUCTS

2.1 HORIZONTAL PUMPS

A. Pump Construction:
1. Cast iron, designed for 175 psi working pressure
2. Bronze case wear rings
3. Grease lubricated ball bearings selected for an average life of 200,000 hours; pressure grease fittings
4. Flexible coupled
5. Hot Dipped galvanized drip-rim structural steel base extending past the pump flanges allowing all condensation to be accumulated. Galvanized integral drain pan.
6. Falk all-metal center dropout spacer coupling
7. Totally enclosed metal or high-impact polyethylene plastic (Orange Peel) coupling guard per ANSI B15.1, Section 8 and OSHA 1910.219
8. Suction and discharge flange gauge ports
9. Fully enclosed bronze impeller keyed to the shaft
10. 304 Stainless steel shaft minimum

B. End suction pump volute with integrally cast pedestal support foot for back pullout to allow pump to be serviced without disturbing the system piping. Pumps utilizing pedestal mounted bearing frames in lieu of volute will not be accepted.

C. Bearings:
1. Conform to Anti-Friction Bearing Manufacturers Association (AFBMA) Standards
2. Ball or roller bearing pillow block type
3. Self-aligning
4. AFBMA L50 rating of 200,000 hours

D. Horizontal or vertical split case pumps: Double row grease lubricated ball bearing each side.

E. Provide each pump with an internally flushed mechanical seal. If external flush line is required, provide sediment filter for each line.
1. Use seal materials suitable for the pumped liquid
2. Renewable bronze or stainless shaft sleeve

F. Provide each pump with a stuffing box with packing:
1. Hardened 440C stainless steel renewable shaft sleeve
2. Bronze gland and stainless steel gland bolts
3. Oil graphite packing

G. Paint entire unit with two coats of machinery enamel after completion of installation.

H. Pump Motor:
1. Premium efficiency
2. Totally enclosed fan cooled
3. Cast iron frame and end plate
4. Forge steel lifting eye
5. Over sized conduit box with ground lug
6. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve
7. Designed for Variable Frequency Drive Application
8. Provide with factory installed shaft grounding rings by AEGIS.
9. Minimum Efficiency

3 hp	1800 rpm	89.5%
5 hp	1800 rpm	90.2%
7.5 hp	1800 rpm	91.7%
10 hp	1800 rpm	91.7%
15 hp	1800 rpm	92.4%
20 hp	1800 rpm	93%
25 hp	1800 rpm	93.6%
30 hp	1800 rpm	94.1%
40 hp	1800 rpm	94.5%
50 hp	1800 rpm	94.5%
60 hp	1800 rpm	95%
75 hp+	1800 rpm	95.4%

I. Data plates:
1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
2. Locate the nameplate for easy visibility.
3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
   a. Manufacturer, address, telephone number
   b. Pump model number
   c. Pump serial number
   d. Size (including impeller diameter scheduled in inches)
   e. Type
   f. Equipment designation as listed on the pump schedule.
   g. Flow scheduled (gallons per minute)
   h. Dynamic head scheduled (feet of water)
   i. Efficiency (percent)
   j. Shut-off head (feet of water)
   k. Speed (rpm)
   l. Brake horsepower
   m. Maximum brake horsepower with rated impeller
   n. Rotation
   o. Maximum allowable pressure (psig)

J. The schedule on the drawing sets forth the type of pump and GPM required.
1. The head capacities and horsepower are for bidding purposes only.
2. Make pump selection based on actual system calculations.

K. Acceptable manufacturers:
1. Bell & Gossett
2. TACO

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
   1. Provide access space around pumps for service.
   2. Install pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Install stainless steel drain pan with trough under chilled water pumps only.
   3. Provide air cock and drain connection piped to floor drain.
   4. Lubricate pumps prior to start-up.
   5. Install condenser water pumps to ensure a full flooded suction.
   6. Paint entire unit with two coats of machinery enamel after completion of installation.
   7. Provide a spool piece between the suction diffuser and the suction side of the pump minimum length 8" face to face.
   8. Provide pressure taps with valves on each side of the pump.
   9. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60” above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.

B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge. Provide an automatic air vent off the pump casing. For base mounted pumps, provide a drain line the full size of the base connection and extend it to and terminate it over the nearest floor drain.

C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.

D. Ensure pumps:
   1. Operate at specified system fluid temperatures without vapor binding and cavitation.
   2. Are non-overloading in parallel and individual operation.
   3. Operate within 25 percent of midpoint of published maximum efficiency curve.

E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.2 ALIGNMENT FOR BASE MOUNTED PUMPS

A. Set the pump on a concrete inertia base or concrete housekeeping pad as specified; anchor, level and grout.

B. Align the pump and driver in accordance with Hydraulic Institute Standards for centrifugal, rotary and reciprocating pumps.

C. Realign the pump and driver after initial leveling of pump base before placing the grout and again after the grout has set and the foundation bolts are tightened. Recheck the alignment after the piping has been connected.

3.3 MANUFACTURER START-UP SERVICE ALIGNMENT

A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
   1. Technicians, as required, shall be trained and experienced in the work they perform (contractor start-up / alignment is unacceptable).

B. Before starting pumps, but after connecting piping:
   1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
   2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
   3. Submit readings for approval.
   4. Include the approved readings in the Owner's Maintenance Manual.

3.4 FINAL PUMP FLOW CALIBRATION

A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
   1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
   2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.

B. Enter the information on the final configuration of the pump in the Owner's Manual.
   1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.5 SPARE PARTS

A. Provide the following spare parts and material to the Owner for his use after the warranty period.
   1. A mechanical seal for each pump
   2. A set of bearings for each pump

END OF SECTION

SECTION 23 21 24

CONDENSER WATER PIPING, VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED WORK

A. Division 23 Mechanical
1. Pipe and Pipe Fittings - General
2. Valves, Strainer and Vents
3. Vibration Isolation
4. Painting

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Aboveground.
1. 2" or smaller diameter pipe: Provide ASTM A #53 Grade A or B or ASTM A 120, Sch. 40 seamless or electric-resistance welded black steel pipe with 150 lb. screwed malleable iron fittings, ANSI B16.3.
2. 2-1/2" through 6" pipe: Provide ASTM A #53 Grade A or B or ASTM A 120, Sch. 40 seamless or electric-resistance welded black steel pipe with standard weight seamless steel welding fittings, ASTM A 234, Grade WPA or WPB, ANSI B16.9.
3. 8" through 20" pipe: Furnish ASTM A 53, Grade A or B, Sch. 20, seamless or electric-resistance welded black steel pipe with standard weight seamless steel welding fittings, ASTM A 234, Grade WPA or WPB, ANSI B16.9.
4. 24" and larger diameter pipe: ASTM A 53, Grade A or B, 0.375" wall seamless or electric-resistance welded black steel pipe with seamless steel welding fittings, 0.375" wall, ASTM A 234, Grade WPA or WPB, ANSI B16.9. At Contractor's option, pipe sizes over 24" outside diameter can be ASTM A 134 with mitered fittings using ASTM A 285, Grade B or C steel plate.

C. Underground: Same as above except provide corrosion protection as specified in Section 23 20 02.

2.2 VALVES

A. Refer to Section 23 05 23.

B. Refer to Building Management and Control System.

PART 3 - EXECUTION

3.1 TESTING

A. Apply a hydraulic pressure of 1-1/2 times operating pressure, 150 psig minimum, and check for leaks. Maintain test for a minimum of 24 hours. The piping system must remain absolutely tight during this period. The satisfactory completion of any test or series of tests will not relieve the contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories. The test should be observed by the Architect / Engineer before pressure is removed and the water drained.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install copper tubing, valves, strainers and sight glass for refrigerant piping.

1.2 RELATED WORK

A. Division 23 Mechanical.
   1. Pipe and Pipe Fittings
   2. Piping Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Furnish refrigerant piping of Type K hard-drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

2.2 SERVICE VALVES

A. Provide angle or globe service valves, with sweat connections. Use packed-type, wrench operated, valves with gasketed seal cap and back seat feature. Furnish valves designed for refrigerant service, in conformance with the ARI code.

B. Place service valves at the inlet and outlet of each compressor, on both sides of each strainer and solenoid valve, and as otherwise shown and specified.

2.3 SOLENOID VALVES

A. Furnish pilot-operated, floating-piston solenoid valves suitable for operation with refrigerant.

B. Use valves with a bronze body and sweat-type connections.

C. Provide stainless steel stem and plunger assembly and a stainless steel piston.

D. Furnish sealed and moisture proof solenoid coils.

E. Use electrical characteristics of 115 volt, 60 Hertz.

2.4 SIGHT GLASSES

A. Provide suitable moisture and liquid sight glass in the liquid line leaving the condenser or receiver.

2.5 FILTER DRYER

A. Furnish replaceable core liquid line filter dryer.

B. Provide filter dryer constructed to permit the removal of the core element without removing the filter dryer from the line.

PART 3 - EXECUTION

3.1 BRAZING

A. During the brazing process, dry nitrogen shall be purged through the tubing to prevent oxides from forming.

3.2 PRESSURE TEST

A. After refrigeration and piping system items are installed, charge the system with dry nitrogen and test to 450 psig.
   1. Test joints with a Halide torch or an electronic leak detector.
   2. Repair leaks and retest each system until proved tight.

3.3 EVACUATION AND DRYING

A. After refrigerant system has been pressure-tested, connect a suitable vacuum pump and evacuate piping system, including lines and equipment.
   1. Maintain a vacuum as high as practicable for long enough to evaporate the moisture in the system (at least 48 hours).
   2. Check the humidity within the system with a wet bulb indicator, and maintain the vacuum until the wet bulb temperature is reduced to -40°F. After the system has been evacuated and dried, break the vacuum by charging proper refrigerant into the system.

3.4 PIPE SIZE

A. Pipe shall be routed and sized per condensing unit manufacturer’s instructions.

END OF SECTION

SECTION 23 25 12

FLUSHING AND CLEANING OF STEEL PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01, apply to this Section.

B. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

A. Flushing and cleaning of the complete closed loop condenser water system including the hot water portion of system. This work shall be performed prior to replacing the air separator with new air dirt separator.

1.3 SERVICE AND SUPPLIES

A. All work shall be performed by a qualified, full-time, Flushing Contractor.
1. Specialist in the field of industrial system flushing and cleaning.

B. After the mechanical contractor has tested the piping, it shall be flushed and cleaned for service. Provide a complete water flushing and cleaning of the closed loop chilled and hot water systems as specified herein. Systems must be commissioned as clean and meet water treatment specifications.

C. All closed loop condenser water, and hot water piping and related equipment shall be thoroughly flushed out with precleaning chemicals designed to remove deposits such as pipe dope, oils, loose rust, mill scale and other extraneous materials. Recommended dosages of pre-cleaner chemical products shall be furnished by water treatment supplier, added and circulated throughout the water systems. The water system shall then be diluted and final flushed thoroughly until no foreign matter is observed and total alkalinity of the water is equal to or better that that of the make-up water.

D. All temporary connections required for flushing, cleaning, purging, and circulating shall be provided by mechanical contractor. Provide suitable pipe bypasses at each coil and heat exchanger during the flushing and cleaning operation.

E. Self-contained flush unit requirements shall contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve shall be submitted along with other important documentation for the related equipment on the unit. This will include, at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators shall comply with all safety regulations of the project site. The flushing operation shall be manned continuously during the flushing process.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. PurgeRite

B. Owner or Engineer approved equivalent. Substitution request must be received as outlined

elsewhere in specifications.

PART 3 - EXECUTION

3.1 FLUSHING PROCEDURE

A. PRE-FLUSH

1. Bypass loops should be installed in front of any strainers and control valves at all equipment components. Coordinate with flushing and cleaning contractor for proper sizing and placement of bypasses and flush ports.
2. Install temporary strainer elements in front of pumps, tanks, solenoid valves, control valves, and other equipment where permanent strainers are not indicated that are not bypassed. Keep these strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow-off valve. Strainers should be removed when a self-contained flush unit is used in conjunction with on board filtration.
3. Flush ports should be identified along with the type of high pressure hose or piping that will be used to connect to the system.
4. The water source shall be provided and identified to the flushing and cleaning contractor by the mechanical contractor and must be adequate to fill and make up water in a timely manner to the system during the flush process.
5. A water dump location source shall be provided and identified to the flushing and cleaning contractor by the mechanical contractor which is usually the sanitary.

B. CLEAR WATER FLUSH

1. Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 -7 ft./sec throughout. Filtration should be at minimum, 50 microns. This flush shall continue until the system water is comparable to the make-up water. Iron content should be under 2.0 ppm.

C. CLEANING AND PASSIVATION

1. The second flush cycle is a combined flushing cycle where cleaning and passivation chemicals are introduced into the system to clean the oils and treat the inside wall of the piping system. This process will be monitored by the chemical treatment company to meet the chemical specifications of the water. The cleaning velocity should be between 3 to 5 ft./sec throughout, and the circulation time will be based on the chemical testing, but will be at minimum, 24 hours.

D. FINAL CLEAR WATER FLUSH

1. The system will be continuously flushed while discharging chemicals into the sanitary system as approved locally. As the existing treated water is being discharged, a fresh water make-up source will be utilized to ensure air is not introduced into the system. Continue to drain the system while adding domestic water to dilute the treated water. The chemical treatment company will monitor the outgoing water composition and compare the composition with the incoming water. Flush with fresh water until the conductivity is reduced to that of the make-up water and iron meets specifications. The final system water should be approved by the chemical treatment company. Filtration should be 5 microns.

E. FINAL CHEMICAL FILL

1. Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system. Once the system is filled with the final chemicals it is important the water not be left stagnant.
2. Verify satisfactory completion of clean piping and a final flushing and chemical treatment report should be submitted by field personnel. The report should include at

minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.

3. Cleaning chemicals, procedure, water testing, reporting, and consultation must be provided by a qualified water treatment company specializing in this type of work.

END OF SECTION

SECTION 23 25 13

CIRCULATING WATER SYSTEM CHEMICAL TREATMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide equipment, chemicals and treatment materials for the complete water treatment system.

B. Determine which chemicals to use from the results of a water sample analysis taken from the building domestic water supply.

C. Provide water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to achieve the required water quality for each system specified.
   1. Closed chilled and hot water systems
   2. The cooling tower condenser water system
   3. Closed condenser water system

1.2 SERVICE AND SUPPLIES

A. All work shall be performed by a qualified, full-time, Water Program Manager.
   1. Specialist in the field of industrial water treatment.
   2. Facilities include water analysis laboratory, development facilities and service department.

B. Provide a water treatment test set for each system (pH, alkalinity, hardness, chloride) for field use including test equipment and reagents as required for specific use with the treatment products employed.

C. Where specialized supplementary testing or control equipment is required, provide appropriate items.

D. Provide a water management and service program for a period of one year beginning at substantial completion. Make routine visits bi-weekly during first two months of operation and monthly during the remainder of the specified period.

E. Routing Services
   1. Check and adjust water treatment system operation.
   2. Instruct, train and advise operating personnel.
   3. Check efficiency of chemicals and chemical applications.
   4. Replenish chemicals and replace expendables.
   5. Clean or replace filter in feeder.

F. Chemically clean the piping system.

G. Provide a complete laboratory analysis of water samples. Insert in the Owner's manuals.

H. Provide review of report figures in the field water testing.

1.3 QUALITY ASSURANCE

A. Acceptable program manager shall have:
   1. Research and development facilities.
   2. Regional laboratories capable of making water analysis.
   3. A service department and qualified technical service representatives located within a

reasonable distance of the project site.

4. Service representatives who are registered Engineers or factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.

B. Ensure that all products, packaging, blow-down or other effluents do not violate local, state, or federal laws or regulations. Use only chemicals that are registered, when required, with the U.S. Department of Agriculture or the U.S. Environmental Protection Agency and that are labeled as required by law.

C. Provide electrical products that have been tested, listed and labeled by Underwriters Laboratories and comply with the National Electrical Manufacturers Association Standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Chem-Aqua

2.2 CLOSED CONDENSER WATER SYSTEM

A. By-pass filter feeders in the hot water and chilled water systems:
   1. Rated at 40-gpm capacity.
   2. Operating conditions: 150 psig and 250°F.
   3. Quick opening cap with a Buna N-O ring seal; or 1-1/2" valve and funnel.
   4. 5 micron polypropylene filter bag mounted in a perforated stainless steel holder. Filter bag shall be supported from top of feeder.
      a. Filter bag and holder shall extend full length of feeder tank.
      b. Bottom feed tanks are not acceptable.
   5. Fabricated hot dipped galvanized steel support legs and frame. Refer to detail drawing for requirements.
   6. Provide sufficient quantity of filter bags for warranty period. Minimum of six additional bags provided to owner.

B. Acceptable Manufacturers
   1. Neptune Model FTS-5
   2. Efficiency Dynamics FF-100.
   3. J.L. Wingert Model FHC-5HD.
   4. Hydro-systems HS-800
   5. Vector Industries, Inc. FA-900

C. Treatment chemicals:
   1. Furnished as a concentrated liquid in 5 gallon pails
   2. A corrosion inhibitor of the nitrite-borate type.
   3. Maintained at a nitrite residual of 600 – 800 ppm in chilled loops and 1000-1500 in hot loops.
   4. With effective copper, black iron, stainless steel and aluminum corrosion inhibitors.
   5. Form a protective film to prevent corrosion and scale formation.
   6. Have colored dye to indicate presence.

D. Multiple chemicals used in a common system shall be compatible.

E. Flow Indicator:
   1. Bronze Construction
   2. Rotating Wheel

3. Line Size
4. Double Window
5. Ernst Flow Industries Model EFIE-57-3

PART 3 - EXECUTION

3.1 INSTALLATION/START-UP

A. In accordance with manufacturer's recommendations.

B. Anchor the chemical filter feeder to a concrete housekeeping pad using wedge type expansion anchors.

D. Clean and flush closed loops systems.
1. Clear water flush systems before introducing chemical cleaners.
2. Chemical cleaner shall be introduced into the systems to remove construction related oils, greases, threading compounds, and silt.
3. Chemical Cleaner shall passivate and pre-film pipe system.

3.2 WATER ANALYSIS

A. The chemical treatment agency shall provide the services of a testing laboratory to perform a site water analysis. As a minimum, conduct the following tests in accordance with ASTM standards and to the satisfaction of the Owner/Architect/Engineer.
1. Silica in water and wastewater.
2. Acidity or alkalinity of water.
3. Iron in water.
4. Hardness of water.
5. Ph of water.
6. Particulate and Dissolved Matter, Solids or Residue in Water.
7. Turbidity in water.
8. Corrosivity of water in absence of heat transfer.
9. Standard practices for sampling water.

B. Take water samples in accordance with ASTM.

C. Prepare a test report in accordance with ASTM for each of the tests conducted.

D. Submit the test reports to the Architect/Engineer.

3.3 CHEMICAL TREATMENT

A. The chemical treatment agency shall provide complete services necessary for chemically cleaning and treatment the following systems:
1. Chilled water.
2. Hot water.
3. Condenser water.

B. The chemical treatment agency shall provide, but not be limited to the following:
1. Equipment and installation.
2. Chemicals.
3. Analytical and testing work.
4. Inspection.
5. Calculations.
6. Assistance to the trade installing the piping.
7. Instruction to Owner.

C. Determine which chemicals to use from the results of site water analysis. Provide the chemical necessary to achieve the desired water condition.

D. Examine and supervise flushing and pipe cleaning operations and verify that the systems are clean, free of debris and rust and other construction materials before starting water treatment.

E. After the piping has been flushed, cleaned, rinsed and charged with chemicals, then start-up and operate the chemical treatment equipment to provide steady, stable characteristics for the systems treated.

F. During construction, instruct the Contractor in the field piping and wiring of chemical feeding equipment. If such piping and wiring details are not shown on the Contract Drawings, then provide all equipment, piping, wiring, instrumentation and chemicals to provide a complete and operating system without additional cost.

G. After the chemical treatment is functioning as intended, the chemical treatment agency shall demonstrate to the Architect/Engineer the chemical treatment operation.

3.4 OWNER TRAINING

A. A chemical treatment agency, in conjunction with the chemical treatment equipment manufacturer's factory representative, shall train the Owner to operate and maintain the chemical treatment system as a whole and in part for each piece of equipment.

B. Furnish to the Owner a chemical treatment administration manual covering the chemical treatment program for each of the systems treated. The manual shall include, but not be limited to:
   1. Name, address and telephone number of the chemical treatment agency and each of the equipment manufacturers.
   2. Operation and maintenance manuals.
   3. Test reports.
   4. Chemical data sheets.
   5. A narrative describing the chemical treatment program for each of the systems being treated.

3.5 TESTING AND INSPECTION

A. After the systems have been accepted, the chemical treatment agency shall visit the site every month during the warranty period.

B. During each visit:
   1. Check and adjust the chemical treatment equipment.
   2. Check the chemistry of the treated system to confirm the chemicals are maintaining the system as intended.
   3. Advise and instruct the Owner on operational changes made to the chemical treatment program.
   4. Take a water sample of each system being chemically treated and have the samples tested by a testing laboratory. Prepare a report for each water sample and submit it to the Owner. Include in the test report the changes that need to be made to the chemical treatment program.
   5. Maintain complete records of the treatment program for each system at the project site. Keep the records in a hardbound manual with the building manager. A second copy shall be maintained by the agency for the agency's records.

C. Routine visits must be coordinated with the Owner.

D. Send copy of monthly report to Engineer for Verification.

END OF SECTION

SECTION 23 31 13

DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct construction, support and accessories. Dimensions shown on the drawings are free area dimensions.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Air Devices
   2. Variable Refrigerant Flow Units
   3. Insulation
   4. Terminal Units
   5 Fan Coil Units
   6. Fans
   7. Water Source Heat Pumps
   8. Testing, Balancing and Adjusting (TAB) of Environmental Systems

B. Division 9 – Finishes, Painting and Color Coding

1.3 QUALITY ASSURANCE

A. The intent of ductwork specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide ductwork in accordance with the specifications for each type of service.

B. An approved contractor for this work under this division shall be:
   1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
   2. Able to furnish evidence of having contracted for and installed not less than 5 systems of comparable size and type that have served their owners satisfactorily for not less than 5 years.

1.4 GUARANTEE

A. Guarantee ductwork for 1 year from the date of substantial completion. The guarantee covers workmanship, noise, chatter, whistling, or vibration. Ductwork shall be free from pulsation under conditions of operation.

1.5 CONTRACTOR COORDINATION

A. Erect ducts in the general locations shown, but conform to structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.

B. Coordinate location of ductwork with structural members and Architectural drawings and requirements.

1.6 SHOP DRAWINGS AND SAMPLES

A. Submit shop drawings of all ductwork layouts, including enlarged plans and elevations of all air

handling equipment, and summit details of duct fittings, including particulars such as gauge sizes, welds, and configurations prior to starting work.

B. Submit product data and sealing materials to be used.

C. Submit sound attenuation data.

D. Submit shop drawings in plan, elevation and sections, and three-dimensional view showing equipment in mechanical equipment areas.

PART 2 - PRODUCTS

2.1 STANDARDS AND CODES

A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards. Air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and NFPA 90A.

2.2 DUCT MATERIAL AND CONSTRUCTION

A. Except for the special ducts specified below use lock forming quality prime galvanized steel sheets or coils up to 60" wide. Stencil each sheet with gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10' centers with gauge and manufacturer's name. Provide certification of duct gauge and manufacturer for each size duct.

B. Rectangular low and medium pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.

C. Medium pressure oval and round ductwork shall be spiral seam. Spiral lock-seam SMACNA Type RL-1. Fittings shall be welded construction.
1. Galvanized

D. Low pressure round ducts shall be shop fabricated with snap lock longitudinal seams. Ducts shall be constructed for a minimum of 2" w.g. static pressure.

E. Dishwasher Hood Exhaust System: Welded 304 Stainless steel.

F. Shower Area Exhaust Systems: Welded 304 Stainless steel.

G. Kitchen exhaust duct: Welded Black steel, minimum 16 gauge

H. Natatorium Ductwork: 304 Stainless Steel

2.3 ACOUSTICAL DUCT

A. Duct and fittings:
1. Double wall acoustically treated.
2. Annular space packed with fiberglass insulation.
3. Perforated metal liner to provide specific acoustic impedance
4. Insulation 1.0 pcf. 1 inch thick
5. United McGill Acousti-K27 spiral lockseam or approved equal
6. Material as indicated below:
a. Paintable Galvanized Steel

B. Pressure rating and tests as specified for single wall ductwork.

2.4 DUCT SEALING OF SEAMS AND JOINTS

A. Follow seal classification as indicated in Table 1-2 of SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL". Use seal class A for 4" w.g. static. All longitudinal and transverse joints and seams shall be sealed by use of a fireproof, non-hardening, and non-migrating elastomeric sealant. With the exception of continuously welded joints and machine made spiral lock seams, joints and seams made air tight with duct sealer.
   1. Indoor applications – Foster 32-14
   2. Outdoor applications – Foster 32-17

2.5 FLEXIBLE DUCT LOW PRESSURE

A. Construction:
   1. Continuous galvanized spring steel wire helix, with reinforced metalized cover
      a. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
   2. UL 181 Class I air duct label
   3. Reinforced vapor barrier jacket
   4. Rated for use at system pressure (6" wc minimum)
   5. Flexible duct connections from lateral taps to variable volume boxes or terminal boxes shall be rated at twice the maximum pressure rating of the medium pressure system.

B. Fire hazard classification:
   1. Flame spread rating 25 maximum.
   2. Smoke developed rating 50 maximum.

C. Thermal characteristics:
   1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
   2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
   3. 2" minimum wall thickness insulation with 1" overlap

D. Acceptable manufacturers:
   1. Flexmaster
   2. Hart & Cooley
   3. Omniair
   4. Peppertree Air Solutions

2.6 FLEXIBLE DUCT MEDIUM/HIGH PRESSURE

A. The duct shall be constructed of a heavy coated fiberglass cloth fabric supported by helical wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.

B. The internal working pressure rating shall be at least as follows with a bursting pressure of at least two times the working pressure:
Positive: 12" w.g.
Negative: 5" w.g.

C. The duct shall be rated for a velocity of at least 5500 fpm.

D. Suitable for operating temperature range of -20°F to +250°F.

E. Factory insulate the flexible duct with fiberglass insulation.
   1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
   2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
   3. 2" minimum wall thickness insulation with 1" overlap

F. Cover the insulation with a fire retarding polyethylene vapor barrier jacket having a permeance of not greater than 0.10 perms when tested in accordance with ASTM E96, Procedure A.

G. Acceptable manufacturers:
1. Flexmaster
2. Omniair
3. Peppertree Air Solutions

2.7 FIRE DAMPERS

A. Fire dampers for required wall ratings that are 95% minimum free area. Provide Type B or Type C UL dampers for low, medium and high-pressure rectangular, square or round ducts. Dampers shall be activated by a fusible link designed to react at 165°F. Install per manufactures recommendations to provide a UL assembly. Provide sealed sleeve to meet desired leakage performance.

B. Acceptable Manufacturers:
1. Ruskin
2. Prefco Products
3. Air Balance
4. Greenheck, Inc.
5. Nailor Industries
6. Pottoroff

2.8 CEILING RADIATION DAMPERS

A. Ceiling Radiation Dampers at location shown on plans constructed and tested in accordance with the current edition of UL555C of a minimum 22 gauge (0.8) blades, hinged in the center and held open with a 165° fusible link. Maximum blade height in the open position shall be 10" overall regardless of damper area. Maximum distance between blades held in the open position shall be 1-1/4" for units not requiring blade insulation and 1/4" for units with sheetrock blade insulation. Blades requiring radiation protection insulation shall utilize sheetrock. Refractory Ceramic or Mineral Wool Fiber is not allowed in the air stream. Radiation insulation outside of the air stream shall be Mineral Wool Fiber only. Ceramic Fiber Material is not approved for use. Units shall be constructed of a minimum 20-gauge (0.9) frame welded at all seams.

B. Acceptable Manufactures
1. Ruskin
2. Prefco
3. Air Balance
4. Phillips
5. Safe-Air
6. Nailor Industries

2.9 WALL LOUVERS

A. Refer to schedule on drawings. Coordinate with Architectural Drawings.

B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.

C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.

D. Louvers shall be AMCA-550 tested and approved.

E. Acceptable manufacturers:
1. American Warming and Ventilation
2. Arrow
3. Greenheck
4. NCA
5. Pottorff
6. Ruskin

2.10 FLUES FOR POWER EXHAUST AND HIGH EFFICIENCY BOILERS AND WATER HEATERS

A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 550°F maximum flue gas temperature and with a UL tested pressure rating of 40 inches w.c. The interior pipe shall be constructed of AL 29-4C stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one inch air gap between inner liner and outer cover. Chimney shall be constructed and installed per UL-1738 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.11 FLUES FOR FAN POWERED FIRETUBE BOILERS AND WATER HEATERS

A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 1400°F continuous operation, 1800°F intermittent operation and for positive pressures up to 60 inches w.c. The interior pipe shall be constructed of 304 stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one-inch air gap between inner liner and outer cover. Chimney shall be constructed and installed per UL-103 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.12 FLUE CAPS

A. Stainless steel flue caps of a design so that wind action from any direction will create a vacuum in the flue. Caps as manufactured by Breidert or equal are acceptable. Refer to installation details on drawings.

2.13 DUCT LINING

A. Duct lining shall be 1" thick, 1-1/2 lb. density, flexible lining coated on the air stream side to reduce attrition. Liner shall be Schuler Lina-Coustic, Certain-Teed Ultralite, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

2.14 VOLUME DAMPERS

A. Manual balancing dampers that meet or exceed the following minimum construction standards:
1. Frame 16-gauge
2. Blades 16-gauge
3. Bearings corrosion resistant
4. Concealed linkage
5. Opposed blade dampers

B. Acceptable manufacturer:
1. Ruskin Model MD-35 or approved equal, by
2. Arrow
3. American Warming and Ventilating
4. Nailor Industries
5. Pottoroff

2.15 ACCESS DOORS

A. Round spin-in door of galvanized steel.
   1. Fire proof sealing gaskets and quick fastening locking devices
   2. Insulated door
   3. Conform to the requirements of the NFPA
   4. Identification and use of each access door
   5. UL label to match the construction in which it is installed
   6. Cable attached to door and outer frame
   7. Low leakage Access Door

B. Acceptable Manufacturer
   1. Flex master, Inspector Series
   2. Approved Equal

2.16 COMBINATION FIRE/SMOKE DAMPERS

A. Combination fire/smoke dampers meeting the following requirements:
   1. Each combination fire/smoke damper shall be 1-1/2 hour fire rated under UL Standard 555, 4th Edition, and shall be further classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
   2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16-gauge galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
   3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
   4. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. After exposure to high temperature of fire, the damper must be inspected prior to reset to ensure proper operation. Release temperature is 165°F.
   5. Provide UL555S qualified electric actuator at 120 VAC.
   6. Provide air-foil type blades.

B. Provide integral sleeves

C. Acceptable Manufacturers:
   1. Ruskin
   2. Air Balance, Inc.
   3. Greenheck, Inc.
   4. Nailor Industries

5. Pottoroff

2.17 SMOKE DAMPERS

A. Smoke dampers meeting the following requirements.
   1. Each smoke damper shall be classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
   2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16 gauge, galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
   3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
   4. Provide UL555S qualified electric actuator at 120 VAC.
   5. Provide air-foil type blades.

B. Provide integral sleeves.

C. Acceptable Manufacturers:
   1. Ruskin
   2. Air Balance, Inc.
   3. Greenheck, Inc.
   4. Nailor Industries
   5. Pottoroff

2.18 DIFFUSER FITTINGS LOW PRESSURE TAPS

A. Fitting shall meet or exceed the following minimum construction standards:
   1. Conical with a base diameter two inches larger than the tap diameter.
   2. Construct fitting and damper of galvanized steel in accordance with ASTM A 527, G90 finish.
      a. Fitting with a 3/16-inch high stop bead approximately 2-1/2-inches from the discharge end of the fitting
      b. Provide the fitting with a butterfly damper, damper rod, end bearings and heavy duty locking quadrant.
      c. Size the length of the straight section of the fitting to match the damper blade diameter. Center the damper blade in the straight section.
   3. Match the fitting body gauge to the SMACNA duct gauge, but not less than:
      a. Through 8 inches: 26 gauge; Damper blade 22 gauge
      b. 10 inches and 12 inches: 24 gauge; Damper blade 22 gauge
      c. 14 inches and 16 inches: 22 gauge; Damper blade 22 gauge
      d. 18 inches and 20 inches: 20 gauge; Damper blade 20 gauge
   4. Fasten damper blade to a 3/8 X 3/8 continuous square rod with minimum (2) galvanized U-bolts.
   5. Support the damper rod to the fitting with airtight nylon end bushings / bearings.
   6. Provide the damper with a self-locking regulator and handle.

7. Provide a 2” sheet metal stand-off to extend the regulator.
8. Flex duct grip area – 2 inches behind retaining bead
9. Flex duct retaining bead – 1 inch from end
10. Conical length of at least 3 inches
11. Barrel length of at least 9 inches

2.19 AUXILIARY DRAIN PANS

A. Galvanized steel, same gauge and same bracing or cross breaks as a duct with same dimensions. Sides of pan turned up to 1-1/2”, all joints soldered watertight. Pan is to be large enough to complete cover drip lines of unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use construction methods and requirements as outlined in SMACNA HVAC Duct Construction Standards as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in the specifications. Refer to details on the drawings for additional information.

B. Reinforce ducts in accordance with recommended construction practice of SMACNA. Provide additional reinforcement of large plenums as required to prevent excessive flexing and or vibration.

C. Cross break or bead sheet metal for rigidity, except ducts that are 12" or less in the longest dimension.

D. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers.

E. At locations where ductwork passes through floors, provide watertight concrete curb around penetration.

F. Support ducts where passing through floors with galvanized steel structural angles of adequate bearing surface.

G. Metal or lined ductwork exposed to view through grilles, registers, and other openings shall be painted flat black. Do not install grilles, registers, or similar items until painting is complete.

H. Fire Dampers shall be installed per manufacturer’s recommendations to create a UL rated assembly.

I. Install end bearing at all location where damper shaft penetrates duct wall.

J. Clean duct to remove accumulated dust. Ducts shall be closed on ends between phases of fabrication to assure that no foreign material enters the ducts.

3.2 DUCTWORK

A. Construct rectangular ducts and round ducts in accordance with the latest SMACNA HVAC Duct Construction Standards. Use the static pressure specified on the air handling unit schedule or fan schedules as a minimum for duct construction. All ductwork between the variable volume air handling units and the terminal units shall be constructed to the medium pressure ductwork specification.

B. Provide adjustable, galvanized splitter-dampers, pivoted at the downstream end with appropriate control device at each supply duct split.

C. For branch ducts wider than 18", and when shown on drawings provide extractors with an appropriate control device at each rectangular zone or branch supply duct connection. Provide controllers for extractors. Branch ducts shall have a 45° angle in the direction of flow. Do not provide extractor at branch ducts to sidewall registers where the registers are within 10 feet of the main duct.

D. Shop manufactured curved blade scoops may be used for branch duct takeoffs up to 18" wide. Taper scoop blade to the end, to prevent any sagging that may cut into, or damage duct liner if specified during operation.
   1. Construct shop manufactured scoops and splitter blades of galvanized sheet metal 2 full gauges heavier than equivalent sheet metal gauge of branch duct (up to 16 gauge).
   2. Check extractors, scoops and splitter blades thoroughly for freedom of operation. Oil bearing points before installing.

E. Use pushrod operator with locking nut and butt hinges assembly.

F. Provide opposed-blade volume dampers with an appropriate control device in each of the following locations:
   1. Return air ductwork
   2. Outside air branch duct
   3. Exhaust branch duct
   4. Exhaust connections to hoods except kitchen grease hoods or equipment
   5. In each zone at multi-zone unit discharge installed downstream of duct mounted re-heat coils
   6. At each outside air and return air duct connection to plenum of constant volume units
   7. At discharge side of constant volume boxes
   8. Where otherwise indicated or required for balancing coordinate location of additional dampers required by TAB Contractor.
   9. Provide multi-blade dampers when blade width exceeds 12". Provide end bearing where damper shaft penetrates duct wall.

G. Elbows:
   1. Rectangular: Where square elbows are shown, or are required for good airflow, provide and install single-wall or airfoil turning vanes. Job-fabricated turning vanes, if used, shall be single-thickness vanes of galvanized steel sheets of the same gauge metal as the duct in which they are installed. Furnish vanes fabricated for the same angle as the duct offset. The use of radius elbows with a centerline radius of not less than 1-1/2 times the duct width may be provided in lieu of vaned elbows where space and air flow requirements permit.
   2. Round Oval Duct. Provide elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5 piece, 90° elbows and 3 piece, 45° elbows.

H. For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed-type Young regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. Provide with chrome plated cover plates. Use only one mitered gear set for each control device.

I. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.

J. Insulated Flexible Duct:
   1. Install in accordance with manufacturer's instructions, and the terms of its UL listing. Duct shall not exceed 6' in length. Make connections by use of sheet metal collars and

stainless steel circular screw clamps. Clamps shall encircle the duct completely and be tightened with a worm gear operator to the point that will provide an airtight connection without unnecessary deformation of the duct. Provide one clamp on flexible duct and one clamp on external insulation. Vapor barrier jacket shall be tucked inside to conceal insulation material.

2. Construct bends over 45° with sheet metal elbows.

K. Duct Supports:

1. Horizontal ducts up to 40". Support horizontal ducts up to and including 40" in their greater dimension by means of #18 U.S. gauge galvanized iron strap hangers attached to the ducts by a minimum of two locations per side by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on at least 8' centers. Use clamps to fasten hangers to reinforcing on sealed ducts.
2. Horizontal ducts larger than 40". Support horizontal ducts larger than 40" in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on at least 8' centers in accordance with SMACNA Standards.
3. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles shall be increased in strength and sized on an individual basis considering space requirements.
4. Supports shall be suspended from structural or by independent support. Do not support from structural bridging. Upper attachments should be selected with a safety factor of 4 or 5 times actual load conditions and subject to Engineers approval. Double wrap straps over open web of joist.

L. Branch connections for medium pressure ductwork shall be made with a conical lateral. Field installed conical branch ducts shall be minimum 20-gauge galvanized sheet metal, “Everdur” welded and coated with “Galvabar”.

3.3 PLENUMS

A. Return air plenums shall be rectangular galvanized sheet metal ductwork.

B. Fabricate plenums upstream of fan of 16-gauge material.

C. Fabricate plenums upstream of filters minimum 18-gauge material.

3.4 FLEXIBLE CONNECTIONS

A. Where ducts connect to fans or air handling units that are not internally isolated, make flexible airtight connections using "Ventglas" fabric. The fabric shall be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Provide a minimum of 1/2" slack in the connections, and a minimum of 2-1/2" distance between the edges of the ducts. Also, provide a minimum of 1" slack for each inch of static pressure on the fan system. Fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands. Where connections are made in outdoor locations, seal fabric to metal with mastic.

3.5 ACCESS DOORS

A. Install ductwork access doors as noted below, arranged for convenient access. Stencil each door for specific use. Install access doors in each of the following locations:

1. Fire Dampers
2. Smoke Dampers
3. Smoke/fire Dampers
4. Outside Air Dampers
5. Duct Mounted Coils (up-stream)

6. Control Dampers

B. Size access door 1" smaller than ductwork.
1. Available Sizes: 8”, 10”, 12”, 18”, 24”

C. Construct access door air tight, and conform to recommendations of NFPA and SMACNA.

D. Demonstrate suitability of access for the intended purpose. Install multiple access doors as required.

3.6 DUCT LINING

A. Install glass fiber acoustical lining where shown on drawings. Secure to duct surfaces with Foster 85-62 / 85-60 or Childers CP-125-1 / CP-127 adhesive and sheet metal fasteners on 12" centers. Coat exposed edges and leading edges of cross-joints with adhesive.

B. Provide metal nosing that is either channeled or "Z" profiled or are integrally-formed from the duct wall securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.

C. Refer to Insulation & Liner Detail on drawings for locations requiring liner to be installed.

D. Do not install liner in multi-zone unit ductwork.

3.7 SEALING OF SEAMS AND JOINTS

A. Seal supply, return, exhaust and outside air duct systems.

3.8 FLUES

A. Provide and install flues for all gas fired equipment.

B. Refer to plans for all related locations.

C. Contractor is responsible for coordinating stack sizing, stack drains, stack test ports, stack termination fittings and all other required fittings with the selected equipment manufacturers.

D. All fittings and accessories shall be manufactured by the flue manufacturer. The flue shall be installed per manufacturer's instruction.

E. Terminate flues at height above roof to prevent flue gas from entering the building.

3.9 ACOUSTICAL DUCT

A. Install in the following locations:
1. Where indicated on the drawings

3.10 SCREENS

A. Furnish and install screens on all duct, fan, etc., openings furnished by the Contractor that lead to, or are, outdoors; screens shall be No. 16 gauge, one-half inch (1/2”) mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

3.11 CONNECTIONS TO LOUVERS

A. Make watertight connections to all louvers. Ductwork behind louver shall have watertight soldered

joints for a minimum of three feet and be sloped to bottom of louver. Lap duct to be over bottom louver blade where possible.

B. Where plenums are installed on inside of louver, construct such that bottom of plenum will lap over bottom blade of louver to drain any water that may enter.

3.12 PLENUMS

A. Construct plenums with galvanized steel framing members and galvanized sheet steel, cross broken and rigidly braced with galvanized angles. Gauges and bracing shall conform to SMACNA recommendations for ductwork of like sizes. Openings for fans, access doors, etc., shall be framed with galvanized steel angles.

B. Provide access doors.

3.13 AUXILIARY DRAIN PANS

A. Where coils that have a condensate drain are located above ceiling.

3.14 TESTING OF LOW PRESSURE DUCTWORK

A. Test ductwork for leaks before concealing. Maximum allowable leakage is 5% of total airflow.

B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers and pressure vs CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.

C. Mains: Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Provide pressure in mains at 1-1/2 times design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.

D. Ductwork down stream of terminal boxes, return, exhaust, and outside air ducts are to be visually inspected.

3.15 TESTING OF MEDIUM AND HIGH PRESSURE DUCT

A. As the project progresses, test the ductwork in sections.

B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers, and pressure vs. CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.

C. Finally as a complete system, test ductwork at a minimum of 2.5” with a maximum allowable leakage of 1% of the total design supply airflow.

D. Test method as set forth in SMACNA "HVAC Duct Construction Standards".

END OF SECTION

SECTION 23 34 16

FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install fans, including centrifugal, axial and propeller types, with supplemental equipment.

1.2 RELATED WORK

A. Division 23 Mechanical:
   1. Ductwork
   2. Vibration Isolation
   3. Air Balance
   4. Electrical Provisions of Mechanical Work

1.3 PERFORMANCE

A. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings. Provide fans capable of accommodating static pressure variations of +10% of scheduled design at the design air flow.

B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA Standards. All fans provided must be licensed to bear the Certified Ratings Seal.

C. Statically and dynamically balance all fans.

D. Motors shall be sized so that they do not operate within the motor service factor.

E. Fans shall be capable of 120% of the scheduled air capacities.

F. All static pressures shown on schedules are external to fans. Manufacturer shall add damper and accessory losses to scheduled value before selecting fan.

1.4 SUBMITTALS

A. Submit fan performance curves with system operating point plotted on curves.

B. Submit manufacturer’s printed installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cook

B. Greenheck

C. Penn Barry Ventilator

D. Twin City Fans

2.2 PROTECTIVE COATINGS

A. Manufacturer's Standard. Apply to fans, motors and accessories, the manufacturer's standard prime coat and finish, except on aluminum surfaces or where special coatings are required.

B. Galvanizing. After fabrication of the parts, hot-dip coat surfaces that require galvanizing. Where galvanizing is specified, a zinc coating may be used. After fabrication, apply the zinc coating and air-dry the coating to 95% pure zinc. Acceptable zinc coatings include Zincilate, Sealube, Amercoat, Diametcoat, or an approved equal.

2.3 SUPPLEMENTAL EQUIPMENT

A. Motor Covers. Provide weatherproof motor covers for installations out of doors. Apply the same finish as used on the fan.

B. Belt Drives:
1. Unless otherwise specified for belt-driven fans, equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20% speed variation from full open to full closed. Size drives for 150% of rated horsepower. Key the fan sheave to the fan shaft.
2. Nonadjustable motor sheaves may be used for motor sizes over 15 horsepower, at the Contractor's option. However, if changing a nonadjustable sheave becomes necessary to produce the specified capacity, the change must be made at no additional cost.
3. Provide belt guards and apply the same finish as used on the fan.
4. Oil and heat resistant, nonstatic type belts.
5. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty, regreasable, ball type, in a pillow block, cast iron housing, selected for a minimum L50 life in excess of 200,000 hours at maximum catalog operating speed.

C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.

D. Relief Vents and Air Inlets: Provide vents and inlets with aluminum frames and 1/2" mesh, galvanized bird screens. Include dampers where shown.

E. Prefabricated Roof Curbs: Furnish prefabricated roof curbs as detailed. The minimum height is 14". Include a resilient pad on each roof curb so the equipment can be mounted on the top flange for proper seal. Coordinate roof slope and curb to ensure equipment is installed in level position. Provide double shell to protect insulation from damage.

F. All fans are to be provided with a durable, deep etched, .025" thick, factory installed aluminum identification plate with the following information. Plates are to be furnished with four mounting holes.
1. Fan mark as indicated on the Contract Drawings.
2. Serial number
3. Model number
4. Capacity (CFM) and static pressure.
5. Motor HP
6. Motor Amps
7. Manufacturer
8. Motor phase
9. Number of Belts/Make/Size
10. Motor volts

G. Utility Vent Set Fans, provide minimum ¾ inch threaded coupling drain connection at lowest point of housing.

2.4 VENTILATION AND EXHAUST FANS

A. Provide the ventilation and exhaust fans shown on the drawings.

B. Provide each motor with internal overload protection.

C. Provide each belt driven fan with approved, totally enclosed belt guard.

D. Provide approved safety screen where inlet or outlet is exposed.

E. Provide duct flanges where required for connections.

F. Furnish kitchen hood exhaust fans with vented curb extension that meets NFPA 96, cleanout port, grease tap, curb seal, drain connection and hinge kit.

G. Furnish supply fans with 1" aluminum, washable filter section.

2.5 ROOFTOP VENTILATION AND EXHAUST SYSTEMS

A. Provide the rooftop ventilation and exhaust systems shown on the drawings.

B. Provide each motor with internal overload protection.

C. Components:
1. Aluminum, stainless steel or plastic coated bird guard.
2. Screws and fasteners of stainless steel or nonferrous material.
3. All aluminum construction unless indicated otherwise on fan schedule.

D. Welded construction, corrosion resistant fasteners, minimum 16 gauge marine allow aluminum.

E. Aluminum base shall be continuously welded curb cap corners.

2.6 GRAVITY ROOF-TOP INTAKE AND RELIEF VENTS

A. Provide the rooftop intake and relief vent systems shown on the drawings.

B. Provide with aluminum, stainless steel or plastic coated bird guard.
1. Screws and fasteners of stainless steel or nonferrous material
2. All aluminum construction

C. Welded construction, corrosion resistant fasteners, minimum 16-gauge marine alloy aluminum.

D. Aluminum base shall be continuously welded curb cap corners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings. Ensure fan location is installed at minimum distance from roof edge to meet code requirements.

B. Do not operate fans or fan powered devices for any purpose until ductwork is clean, filters in place, bearings lubricated and the fan has been run under observation.

C. Roof mounted fans and gravity roof-top intake and relief vents shall be secured to the curb with

stainless steel lag screws at a minimum of 6-inches on center. Follow manufacturer's installation instructions if they are more stringent. Install roof mounted equipment in a level position. Units shall be seated on properly sized curb. Gap between base of the fan and top of the curb shall be sealed with neoprene 1" x ¼" gasket. Gasket shall be glued or attached with pressure sensitive adhesive.

D. Install curbs and equipment in level position.

E. Ceiling mounted in-line centrifugal blowers
   1. Shall be suspended from structure with 1/2-inch zinc plated all-thread rods secured to structure.
   2. Provide sub-structure where required.
   3. Mount bottom of fan no more than 18-inches above the finished ceiling height.

3.2 EXTRA MATERIALS

A. Provide two sets of belts for each fan, not including the set installed on the fans. Tag set to identify fan.

END OF SECTION

SECTION 23 37 13

AIR DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install air distribution devices, including grilles, diffusers, registers, dampers, and extractors.

1.2 RELATED WORK

A. Division 23 Mechanical.
   1. Ductwork.
   2. Air Balance.
   3. Electrical Requirements for Mechanical Work.

1.3 COOPERATION WITH OTHER TRADES

A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.4 SUBMITTALS

A. Submit product data for outlets, grilles, registers, control devices, and similar equipment for review prior to placement of purchase order.

B. Submittal shall include performance sheet for each air device type. Performance sheet shall include NC levels, throw, and total pressure loss at various air flows.

1.5 FINISHES

A. Paint exposed devices with factory standard prime coat, or factory finish coat, as specified.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES AND REGISTERS - Refer to Drawing Schedule.

2.2 ACCEPTABLE MANUFACTURERS

A. Titus.

B. Krueger.

C. Nailor Industries.

D. Price

E. Metal-Aire

2.3 ACCESSORIES

A. Supply Grille Extractors. Provide supply grilles with an air control device capable of positively regulating the volume of air extracted from the supply duct.

Select extractors similar to Titus Model AG25, tight-closing in the minimum position. Include a

key-operated or worm-gear adjusting mechanism to facilitate positioning from the grille opening. Where adjustment is not accessible at the grille opening, provide a square control rod equipped with a locking quadrant.

B. Mounting Frames. Provide each grille or register not equipped with a removable core with a companion, all-purpose mounting frame constructed like grille frame to facilitate installation and removal of the grille or register without marring adjacent mounting surfaces.
   1. Furnish frames with 1/2" thick sponge rubber gasket to prevent air leakage.
   2. Provide a frame that neatly fits the grille. Mounting frames will not be required for grilles or registers mounted directly on exposed ductwork.

PART 3 - EXECUTION

3.1 INSPECTION

A. Do not install ceilings adjacent to fixtures until installation of fixtures, air supply assemblies, return-air blank-off strips and flexible duct have been approved. Remove and reinstall any part of the installation found incorrect.

3.2 INSTALLATION

A. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets to ductwork with sheet metal screws. For perforated diffusers, attach the frame assembly by a concealed hinge assembly to an outer frame compatible with the type of ceiling on which the diffuser is installed.

END OF SECTION

SECTION 23 41 00

AIR FILTRATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install air filters and air filter gauges.

1.2 RELATED WORK

A. Division 23 Mechanical.

1.3 SUBMITTALS

A. Submit manufacturer's product data sheets and capacity information as specified.

B. Submit recommended Dirty Filter pressure drop.

PART 2 - PRODUCTS

2.1 MEDIUM EFFICIENCY AIR FILTERS

A. The filter cells:
   1. Pleated media.
   2. Disposable type.
   3. Contain not less than 4.6 sq. ft. of filtering media per square foot of face area.
   4. 18 pleats per linear foot of filter.
   5. 2" thick.

B. Media of reinforced nonwoven cotton fabric treated with adhesive and continuously laminated to a supporting steel wire grid conforming to the configuration of the pleats.
   1. Seal the media pack in a water resistant cardboard frame.

C. Rated average dust spot efficiency of not less than 80%.
   1. Average synthetic arrestance in excess of 98% when tested in accordance with the ASHRAE 52-68 test standard.

D. Filter capable of operating with variable face velocities up to 500 fpm without impairing efficiency.

E. Initial resistance to air flow:
   1. 500 fpm - 0.41" WG.

F. UL listed with Class II rating.

G. MERV 13 minimum

H. Provide one spare set for a complete change, in original cartons, for Owner's use during the warranty period.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the filters and filter gauges in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 23 52 33

COPPER TUBE BOILER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a copper tube hot water boiler complete with all controls and trim for an outdoor installation.

1.2 RELATED WORK

A. Division 23 - Mechanical
1. Hot water piping.
2. Gas piping.
3. Ductwork

1.3 PERFORMANCE

A. Provide performance as scheduled on drawings; rate boiler in accordance with test standards of American Gas Association.

1.4 WARRANTIES

A. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of twelve (12) months from date of substantial completion. Heat exchanger and fuel burner shall be warranted for a period of ten (10) years from date of substantial completion. Boiler shall be provided with a twenty (20) year thermal shock warranty from date of substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Lochinvar Powerfin

B. Laars Pennant

2.2 PERFORMANCE CRITERIA

A. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 84 %.

B. The boiler(s) shall be ASME inspected and stamped and National Board registered for 160 PSIG working pressure, complete with a Manufacturer's Data Report.

C. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5 inch WC to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 inch WC.

D. Boilers shall be certified for low NOx by the TCEQ. NOx emissions shall not exceed 30 PPM when referenced at 3% O2 at all firing rates.

2.3 HEAT EXCHANGER

A. Heat exchanger shall be of a single-bank, horizontal bank, horizontal-grid with integral cupro nickel copper finned tubes, each of which is rolled into an ASME boiler quality steel tube sheet.

B. The heat exchanger shall be sealed to 160 PSIG rated Cast Iron headers with silicone "O" rings, having a temperature rating over 500°F.

C. The low water volume heat exchanger shall be explosion-proof on the water side and shall carry a twenty-year warranty against thermal shock.

D. The headers shall be secured to the tube sheet by stud bolts with flange nuts to permit inspection and maintenance without removal of external piping connections.

E. The boiler(s) shall be capable of operating at inlet water temperatures as low as 105°F without condensation.

F. The boiler(s) shall be designed to accommodate field changes of either left or right hand plumbing and electrical while leaving the tube bundle in place.

2.4 BURNERS

A. The tubular burners shall have multiport radial gas orifices, punched ports and slots, be capable of quiet ignition and extinction without flashback at the orifice, and be manufactured from corrosion resistant titanium-stabilized stainless steel with low expansion coefficient.

B. The burners will be supplied with a fan-assisted, clean burning, and highly efficient fuel-air mixture.

2.5 PILOT CONTROL SYSTEM

A. The boiler(s) shall be equipped with a 100 percent safety shutdown system.

B. The ignition shall be Hot Surface Ignition type with full flame rectification by remote sensing separate from the ignition source, with a three-try-for-ignition sequence, to ensure consistent operation.

C. The igniter will be located away from the water inlet to protect the device from condensation during startup.

D. The ignition control module shall include an LED that indicates six (6) individual diagnostic flash codes.

E. Two external viewing ports shall be provided, permitting visual observation of burner operation.

2.6 GAS TRAIN

A. The boiler(s) shall have a firing/leak test valve and pressure test valve as required by CSD-1.

B. The boiler(s) shall have dual-seated main gas valve(s).

C. Gas control trains shall have a redundant safety shut-off feature, main gas regulator, shut-off cock and plugged pressure tapping to meet the requirements of ANSI Z21.13/CSA 4.9.

2.7 BOILER CONTROL

A. The following safety controls shall be provided:
   1. High limit control
   2. Flow switch, mounted and wired
   3. 60 PSIG ASME pressure relief valve, piped by the installer to an approved drain
   4. Temperature and pressure gauge

B. The boiler(s) shall be equipped with a fixed five-minute energy-saving pump control relay, mounted and wired, which automatically shuts off the boiler pump at a set period after boiler shut-down to avoid standby losses associated with constant pump operation.

2.8 FIRING MODE

A. Provide two-stage firing control of the gas input to the boiler.

2.9 BOILER DIAGNOSTICS

A. Provide external LED panel displaying the following boiler status/faults:
   1 Power on - Green
   2. Call for heat – Amber
   3. Burner on – Blue
   4. Safety fault – Red

B. A Central Point Wiring board with diagnostic LED's indicating the status of each relay.

C. Provide ignition module indicating the following flash codes by LED signal:
   1. 1 flash – low air pressure
   2. 2 flashes – flame in the combustion chamber w/o CFH
   3. 3 flashes – ignition lock-out (flame failure)
   4. 4 flashes – low hot surface igniter current
   5. 5 flashes – low 24VAC
   6. 6 flashes – internal fault

2.10 COMBUSTION CHAMBER

A. The lightweight, high temperature, multi-piece, interlocking ceramic fiber combustion chamber liner shall be sealed to reduce standby radiation losses, reducing jacket losses and increasing unit efficiency.

2.11 VENTING

A. When routed vertically, the boiler's flue material and size shall be in accordance with the National Fuel Gas Code, ANSI Z223.1/NFPA54 latest edition (Category I).
B. When routed horizontally, the boiler(s) flue material and size shall meet or exceed the requirements as specified for Category III in the National Fuel Gas Code, ANSI Z223.1/NFPA 54 latest edition.
C. The boiler(s) shall be ducted combustion air ready.

2.12 CABINET

A. The corrosion-resistant galvanized steel jackets shall be finished with a baked-on epoxy powder coat which is suitable for outdoor installation, applied prior to assembly for complete coverage, and shall incorporate louvers in the outer panels to divert air past heated surfaces.

B. The boiler shall have the option of venting the flue products either through the top or the back of the unit.

C. Combustion air intake shall be on the left side of the cabinet.

D. Boiler controls shall be installed in an enclosed weatherproof enclosure.

E. Boiler will be installed outdoors and shall be provided with all options for an exterior boiler installation. At minimum this shall include combustion air intake weather shield, boiler controls cabinet rated for exterior environment, pump cover, and combustion air cover.

2.13 OPERATING CONTROLS

A. The boiler(s) shall feature an optional multi-stage digital controller with adjustable outdoor reset, mounted and wired.

B. Water and air temperature sensors shall be shipped loose for field installation by installing contractor.

2.14 CIRCULATION PUMP

A. Boiler shall be equipped with a circulation system piped across the boiler vessel. System shall include a pump, two isolation valves, check valve, piping, starter and disconnect, all factory piped, mounted and wired. Pump shall be wired to boiler's control panel such that only one power source is required for blower motor, boiler controls and pump. Pump GPM and Head shall be designed to provide at least the minimum flow required by the boiler manufacturer. Pump GPM shall not exceed the maximum flow required by the boiler manufacturer.

2.15 SOURCE QUALITY CONTROL

A. The boiler(s) shall be completely assembled, wired, and fire-tested prior to shipment from the factory.

B. The boiler(s) shall be furnished with the sales order, ASME Manufacturer's Data Report, inspection sheet, wiring diagram, rating plate and Installation and Operating Manual.

2.16 CARBON MONOXIDE MONITORING SYSTEM

A. Provide and install a manual reset Carbon Monoxide Detector located within the the adjacent mechanical room. The Carbon Monoxide Detector and the boiler shall be interlocked so that the burners will not operate when the level of CO in the room rises above 100ppm. The Carbon Monoxide detector shall disable the boiler's burner upon loss of power to the detector.

B. Carbon Monoxide Sensor with two year warranty by U.S. Draft Co. Model CGM-505 with model XB expansion module.
   1. Provided with pre-programmed dry contacts to shut down equipment during unsafe operation.
   2. NEMA 1 Enclosure
   3. Complies with Texas State Boiler Code 65.603-2015
   4. Additional features shall include 0-10 VDC control signal out, visual alarm and audible alarm.
   5. Provide expansion board for additional equipment interlocks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation as per manufacturer's recommendations.

B. Install isolation valves and unions on supply and return water lines to boiler.

C. Install strainer, drain lines with ball valve, pressure and temperature gauges on return and supply line to boiler.

D. Install main gas valve and cock, drip leg and union close to boiler.

E. Vent gas pressure regulator, N.O. vent valve, high and low gas pressure switches to above adjacent roof line. Support piping to exterior wall.

F. Install on 4" concrete pad and place into operation in accordance with manufacturer's instructions. Pipe as detailed on drawings.

C. Install per State Boiler Code.

D. Boiler flue shall be extended up to above adjacent roof line. Flue pipe shall be secured to exterior wall using stainless steel brackets that provide proper separation from wall surface.

3.2 BOILER MANUFACTURER START-UP SERVICE

A. Startup shall be performed by factory trained personnel to assure proper operation.

C. Test the following items at a minimum and adjust as necessary for proper boiler operation:
1. Boiler Safeties
2. Operating Controls
3. Static and full load gas supply pressure
4. Gas manifold and blower air pressure.

C. Perform a flue gas analysis at the boiler outlet. Record the following results of the analysis:
1. Carbon dioxide percent volume.
2. Oxygen percent volume.
3. Stack temperature.
4. Calculated combustion efficiency.

D. Do not operate the boiler for any reason until the factory start-up service has been completed.

E. Submit a copy of start-up report to Engineer.

3.3 TRAINING

A. Provide factory-authorized service representative to train maintenance personnel on procedures and schedules related to start-up, shut-down, trouble shooting, servicing, and preventive maintenance.

B. Schedule training at least seven days in advance.

END OF SECTION

SECTION 23 52 35

GAS-FIRED MODULATING HOT WATER BOILER (Condensing)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a packaged, gas-fired, power type condensing stainless steel boiler complete with all controls and trim for outdoor installation.

B. Each factory "packaged" boiler shall be complete with all components, accessories and appurtenances necessary for a complete and operable boiler as hereinafter specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.

C. Each factory "packaged" boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all be assembled and furnished by the boiler manufacturer. The boiler manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory "packaged" boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

1.2 RELATED WORK

A. Division 23 - Mechanical
   1. Hot Water Piping
   2. Gas Piping
   3. Ductwork

1.3 PERFORMANCE

A. Provide performance as scheduled on drawings. Boiler shall be certified for up to 99% efficiency.

1.4 WARRANTIES

A. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of five (5) years from date of substantial completion. Heat exchanger and fuel burner shall be warranted for a period of ten (10) years from date of substantial completion. Warranty shall cover both parts and labor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Lochinvar Crest Outdoor

B. Larrs MagnaTherm

2.2 PERFORMANCE CRITERIA

A. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 92 % on 500 MBH input boilers and less and not less than 95% on

larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68º F.

B. Boiler shall comply with ASME Section IV for 80 psig, max 200º F (100 psig on 1500 MBH and larger units).

C. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5 inch wc to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 in. WC.

D. Boilers shall be certified for low NOx by the TCEQ. NOx emissions shall not exceed 30 PPM when referenced at 3% O2 at all firing rates.

E. The burner, gas train and controls shall conform to the requirements of I.R.I./G.E. Gap.

2.3 BOILER DESIGN

A. Each hot water boiler shall consist of a horizontal, stainless steel or cast iron heat exchanger complete with trim, valve trains, burner, and boiler control system. The boiler manufacturer shall fully coordinate the boiler as to the interaction of its elements with the burner and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.

B. Each boiler heat exchanger shall be stainless steel or cast iron, counter-flow design for maximum heat transfer with the multiple sections arranged in a reverse return configuration to assure balanced flow through each section

C. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

D. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.

F. Boiler heat exchanger headers shall be fabricated steel and be completely removable for inspection. Seals shall be EPDM, rated for 400 deg F service. Push nipples or gaskets between the sections are not permitted.

G. Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from minimum 16 gauge carbon steel. The front and top wall shall be secured in place with ¼ -20 NC bolts (sheet metal screws are not acceptable).The complete outer casing shall be finished, inside and out, with a powder coat finish. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure an outer casing temperature of not more than 50ºF above ambient temperature when the boiler is operated at full rated load.

H. An observation port shall be located on the boiler to allow for observation of the burner flame.

2.4 BOILER TRIM

A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:
   1. Safety relief valve shall be provided in compliance with the ASME code. Contractor to pipe to acceptable drain.
   2. Water pressure-temperature gauge.
   3. Primary low water flow fuel cutoff (probe type with manual reset).
   4. Manual reset high limit water temperature controller.
   5. Operating temperature control to control the sequential operation of the burner.
   6. Separate inlet and outlet water temperature sensors capable of monitoring flow

7. Exhaust temperature sensor
8. Provide condensate neutralization kit (shipped loose).

B. The corrosion-resistant galvanized steel jackets shall be finished with a baked-on epoxy powder coat which is suitable for outdoor installation, applied prior to assembly for complete coverage, and shall incorporate louvers in the outer panels to divert air past heated surfaces.

C. Boiler will be installed outdoors and shall be provided with all options for an exterior boiler installation. At minimum this shall include combustion air intake weather shield, boiler controls cabinet rated for exterior environment, pump cover, and combustion air cover.

2.5 BOILER FUEL BURNING SYSTEM

A. The boiler manufacturer shall furnish each boiler with an integral, power type, straight gas, fully automatic fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements with the boiler heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.

B. Each burner shall be provided with an integral gas firing combustion head.

C. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gases.

D. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel within the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. Static and total pressure capability shall comply with the requirements of the boiler. The blower shall operate at 6000 RPM maximum without undue vibration and noise and shall be designed and constructed for exposure to temperatures normal to its location on the boiler. The operating fan speed will be tachometer sensed and be capable of being displayed at the LED display.

E. Each burner shall be of the radial-fired (down-fired) type and constructed of steel with a stainless steel inner and stainless steel mesh outer screen.

F. Each boiler shall be provided with a “Full Modulating” firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100% as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.

G. The Micro Processor shall use a Proportional Integral Algorithm to determine the firing rate. The control must have the following capabilities:
1. Maintain single set point
2. Reset the set point based on outdoor air temperature.
3. Boiler shutdown based on outdoor air temperature
4. Internal dual set point program with an external switchover. (e.g. - night setback w/external clock, supplied by others)
5. Alarm relay for any for any manual reset alarm function.
6. Programmable Low Fire Delay to prevent short cycling based on a time and temperature factor for release to modulation.
7. LED Display showing current supply and return temperatures, current set points as well as differential set points. It must also display any fault codes whether automatically reset or manually reset.
8. Local Manual Operation.

9. Remote Control System (Building Management / Sequencer Control) - The boiler control shall be capable of accepting a 0 -10vdc remote external analog signal to control the firing rate
10. Computer (PC) interface for programming and monitoring all functions

2.6 MAIN GAS VALVE TRAIN

A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:
1. Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.
2. Air – Gas ratio control (maximum inlet pressure 14 inch wc)
3. One (1) low gas pressure switch (manual reset).
4. One (1) high gas pressure switch (manual reset).
5. Two (2) pressure test ports

2.7 IGNITION SYSTEM

A. Each boiler shall be equipped for direct spark ignition

2.8 COMBUSTION AIR CONTROL SYSTEM

A. Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:
1. The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.
2. One (1) low airflow differential pressure switch to insure that combustion air is supplied.
3. High exhaust back pressure switch

2.9 BURNER CONTROL SYSTEM

A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The 120/1/60 power supply to each boiler shall be protected by a 15 Amp circuit breaker located in the MCC (supplied by contractor).

B. The boiler shall include an electric spark ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.

C. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

D. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.

2.10 BOILER CONTROL PANEL

A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:
1. One (1) burner "on-off" switch.
2. One (1) electronic combination temperature control, flame safeguard and system control.

3. Control circuit breaker, 5 amp
4. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.
5. LED Display Panel to adjust set points and control operating parameters. LED display to indicate burner sequence, all service codes (0-65), fan speed, boiler set point, sensor values such as inlet, outlet, flue gas and outdoor air.

2.11 FACTORY TESTING - HYDROSTATIC

A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME “H” stamp.

2.12 FACTORY TESTING - FIRE TESTING

A. Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.

2.13 HYBRID SEQUENCE CONTROLLER

A. Provide a stand alone boiler sequence controller that is capable of controlling a combination of condensing and non-condensing boilers. Sequence controller shall sequence the lead boiler based on its condensing capabilities to provide the most efficient operation. Controller shall operate based on outdoor reset, see specification Section 23 09 33 for reset schedule. Controller shall visually display relay status, firing rate of each boiler, header temperature, outdoor air temperature. Coordinate wiring of this controller with mechanical and controls contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install isolation valves and unions on supply and return water lines to boiler.

B. Install strainer, drain with valve, pressure and temperature gauge on return water line to boiler.

C. Install main gas cock, drip leg and union close to boiler.

D. Install on 4" concrete pad and place into operation in accordance with manufacturer's instructions. Pipe as detailed on drawings.

E. Provide Category IV vent stack material. Mechanical contractor shall coordinate draft requirements and other venting requirements between stack supplier and boiler supplier.

F. Install boilers, piping and accessories in accordance with the manufacturer's installation instructions and state boiler code.

G. Pipe each gas relief vent to the outdoors, in accordance with the manufacturer's recommendations and the local codes.

H. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

I. Contractor to route condensate connection off of boiler and stack to acid neutralization kit and then to appropriate drain. Trap as required by boiler manufacturer.

3.2 BOILER MANUFACTURER STARTUP SERVICE

A. Provide factory authorized startup services to assure its proper operation.

B. Set the boiler operating and safety controls.

C. Perform a flue gas analysis at the boiler outlet. Record the following results of the analysis:
   1. Carbon dioxide percent volume.
   2. Oxygen percent volume.
   3. Stack temperature.
   4. Calculated combustion efficiency.

D. Do not operate the boiler for any reason until the factory startup service has been completed.

E. Startup procedure shall include a functional test of Carbon Monoxide Detector. Simulate an alarm condition and demonstrate the functionality of the detector shutting down the appliances. Owner/Engineer shall be present to witness test.

F. Boiler shall not be operated without water treatment in the closed water loop.

END OF SECTION

SECTION 23 63 00

AIR-COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a wo speed air-cooled condensing units complete with casing, compressor, condenser coil, condenser fan and controls required for a split air conditioning system.

1.2 RELATED WORK

A. Refrigerant Piping.

B. Electrical Provisions of Mechanical Work.

1.3 PERFORMANCE

A. Provide performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. Daikin

C. Trane

2.2 COMPRESSOR

A. Provide a hermetic 2 speed compressor with crankcase heaters, inherently protected motors, spring mounts and capacity modulation. Provide each compressor with a 5-year warranty.

2.3 CONDENSER COILS

A. Provide copper tubes with mechanically bonded aluminum fins. Protect condenser coils with a heavy gauge, corrosion resistant wire guard.

B. Provide condenser coil coated with corrosion resistant epoxy utilizing a dip and bake process. Coating shall be flexible and uniformly bonded to all condenser coil surfaces.

2.4 FANS AND MOTORS

A. Provide propeller-type fans with direct drive or belt drive and vertical discharge. Protect fan with a heavy-gauge, corrosion resistant wire guard. Provide inherently protected, permanently lubricated, and weatherproof motors.

2.5 CASING

A. Furnish a unit designed for outdoor mounting. Fabricate the casing of heavy gauge steel, zinc coated and finished with enamel. Provide removable access panels.

2.6 CONTROLS

A. Provide safety and operating controls factory wired and mounted in a separate enclosure. Include

thermostatic expansion valve, high and low pressure switches and compressor motor overload devices. Furnish a time delay device to prevent short cycling. Employ a control transformer, a pressure relief device and suction and discharge valves with service connections.

2.7 THERMOSTAT

A. Low voltage, 7-day programmable thermostat is a component of the unit manufacturer unless specified in another Section.
   1. Individual Heating/Cooling setpoints.
   2. Automatic Heat/Cool change-over.
   3. Sub-Base On-Off-Auto fan selection.
   4. Sub-Base Heat-Off-Cool-Auto system selection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount condensing units on 4" foundation pads and pipe as shown on Drawings or as recommended by the equipment manufacturer. Install removable core refrigerant filter dryer and sight indicating glass.

3.2 CONTROL WIRING

A. Furnish and install control wiring as required. Install control wiring in conduit.

END OF SECTION

SECTION 23 76 13

EVAPORATIVE FLUID COOLER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide packaged industrial fluid cooler as shown.
   1. Designed for outdoor operation.

B. Equipment capacity as scheduled.
   1. Motors for mechanical equipment.

1.2 SUBMITTALS

A. Submit shop drawings and product data as specified.

B. Submit pressure drop through the closed circuit coils.

C. Submit foundation requirements and operating weight.

D. Submit manufacturer's certified capacity curve with selections plotted thereon.

E. Submit manufacturer's installation, start-up and service instructions.

F. Submit wiring diagram.

G. Mark-up a copy of the specifications, indicating in the margin of each paragraph, the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE

1.3 WARRANTY

A. The manufacturer shall provide a full machine parts and labor warranty for a period of one (1) year from substantial completion. Provide the fan motor/drive system with a five (5) year warranty from substantial completion.

PART 2 - PRODUCT

2.1 ACCEPTABLE MANUFACTURERS

A. Evapco.

2.2 INTERNATIONAL BUILDING CODE COMPLIANCE

A. The structure of this product shall be designed, analyzed, and constructed in accordance with the wind and seismic load requirements of the following: 2009 IBC, 2012 IBC, 2015 IBC, 2018 IBC, ASCE/SEI 7-05, ASCE/SEI 7-10, ASCE/SEI 7-16, NFPA 5000

2.2 COMPONENTS

A. Factory assembled and tested, induced draft counter flow closed circuit cooler complete with fan, coil, fill, louvers, accessories and rigging supports

B. Materials of Construction
   1. All cold water basin components including vertical supports, air inlet louver frames and panels up to rigging seam shall be constructed of Type 304 Stainless Steel. All factory cold water basin seams shall be welded for water tight construction.

2. Casing and fan section, including channels and angle supports, shall be constructed of Type 304 stainless steel. Fan cowl and guard shall be constructed of Type 304 Stainless Steel.

C. Fan(s):

1. Fan(s) shall be high efficiency axial propeller type with aluminum wide chord blade construction. Each fan shall be dynamically balanced and installed in a closely fitted cowl with venturi air inlet for maximum fan efficiency.

D. Drift Eliminators

1. Drift eliminators shall be constructed entirely of Polyvinyl Chloride (PVC) in easily handled sections. Design shall incorporate three changes in air direction and limit the water carryover to a maximum of 0.001% of the recirculating water rate. Drift eliminators shall be self-extinguishing, have a flame spread of less than 25 under ASTM E84, and shall be resistant to rot, decay and biological attack.

E. Water Distribution System

1. Spray nozzles shall be precision molded ABS, large orifice spray nozzles utilizing fluidic technology for superior water distribution over the fill media. Nozzles shall be designed to minimize water distribution system maintenance. Spray header, branches, and riser shall be Schedule 40 Polyvinyl Chloride (PVC) for corrosion resistance.

F. Heat Transfer Media

1. Heat transfer coil shall be elliptical tubes of prime surface steel, encased in steel framework with entire assembly hot-dip galvanized after fabrication. The coil assembly shall be designed with sloping tubes for liquid drainage. Coil shall have design pressure of 300 psi and shall be in compliance with ASME/ANSI B31.5, Refrigeration Piping and Heat Transfer Components. The coil assembly shall be strength tested in accordance with ASME/ANSI B31.5 and subsequently leak tested using air under water.
2. All evaporative cooling equipment utilizing galvanized construction require initial passivation to maximize the service life of the equipment. The site's water treatment vendor should be contacted several weeks prior to adding any water to the system to provide a passivation plan along with associated passivation plan costs.

G. Pump

1. Unit shall have EISA close-coupled centrifugal pump with mechanical seal. The pump shall be installed in a vertical position so that water will drain from the pump when the cold water basin is emptied. Pump motor shall be totally enclosed with protective canopy for outdoor operation.

F. Bleed-off

1. Unit shall have a waste water bleed line with a manual adjustable valve provided.

G. Air Inlet Louvers

1. The air inlet louvers shall be constructed from UV inhibited Polyvinyl Chloride (PVC) and incorporate a framed interlocking design that allows for easy removal of air inlet louvers for access to the entire basin area for maintenance. The air inlet louvers shall have a minimum of two changes in air direction and shall be of a non-planar design to prevent splash-out and block direct sunlight & debris from entering the basin. Air inlet louvers shall be self-extinguishing, have a flame spread of less than 25 under ASTM E84, and shall be resistant to rot, decay and biological attack.

H. Make up Float Valve Assembly

1. Make up float assembly shall be a mechanical brass valve with an adjustable plastic float.

I. Pan Strainer

1. Pan Strainer(s) shall be all Type 304 Stainless Steel construction with large area removable perforated screens.

J. Pipe Connection Type
   1. Any connections provided with a Groove (GVD) or Beveled for Welding/Grooved (BFW/GVD) shall conform to standard groove specification (SGS).

2.3 MOTOR AND DRIVES

A. Fan motor(s) shall be totally enclosed, ball bearing type electric motor(s) suitable for moist air service. Motor(s) are Premium Efficient, Class F insulated, 1.15 service factor design. Inverter rated per NEMA MG1 Part 31.4.4.2 and suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.

B. Fan motor(s) shall include strip-type space heaters with separate leads brought to the motor conduit box.

C. The fan drive shall be multigroove, solid back V-belt type with QD tapered bushings designed for 150% of the motor nameplate power. The belt material shall be neoprene reinforced with polyester cord and specifically designed for evaporative equipment service. Fan sheave shall be aluminum alloy construction. Belt adjustment shall be accomplished from the exterior of the unit.

D. Fan shaft shall be solid, ground and polished steel. Exposed surface shall be coated with rust preventative.

E. Fan Shaft Bearings shall be heavy-duty, self-aligning ball type bearings with extended lubrication lines to grease fittings located on access door frame. Bearings shall be designed for a minimum L-10 life of 100,000 hours.

F. Unit shall be provided with a Vibration Cutout Switch, operating on 120 VAC feed, to protect the fan and drive assembly from damage in the event of excess vibration. Vibration switch shall be DPDT.

2.4 MAINTENANCE ACCESS

A. Fan section shall be provided with hinged access doors and located in the fan section for fan drive and water distribution system access.

B. Basin and sump shall be accessible through the framed removable louver panels on all four sides on unit.

C. Provide with internal working platform to provide access to the fans, belts, motors, sheaves, bearings, all mechanical equipment and complete water distribution system. The fill shall be an acceptable means of accessing these components.

D. Provide with an external service platform compliant with OSHA shall be provided at the motor access door of the unit extending the full length of the access door. Each platform shall have at least a 36 in wide walking surface. The platforms shall have galvanized steel grating, supported by galvanized steel framework attached to the unit and surrounded by a handrail, knee rail and toe plate system that is compliant with OSHA. Mounting channels shall be the same material as the casing section (galvanized or stainless steel). A vertical ladder shall be provided from the base of the unit to the platform.

E. Louver Access Door shall be hinged.

2.5 BASIN HEATER

A. Cold water basin shall be fitted with Type 304 Stainless Steel element, electric immersion heater(s) with a separate thermostat and low water protection device. Heaters shall be selected to maintain +40° F pan water at 20° ambient temperature.

B. Electric immersion heater package shall include a factory-supplied NEMA 4x enclosure containing a magnetic contactor with 120 VAC control circuit, transformer, and main power disconnect. Control package wired by others.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install and start-up the system in accordance with the manufacturer's installation, start-up and service instructions.

END OF SECTION

SECTION 23 81 18

SINGLE PACKAGE ROOFTOP AIR CONDITIONERS (100% OUTSIDE AIR)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide and install a single-package, single-zone, electric air conditioner with gas-fired heat for 100% outside air a ground mounted application.

1.2 RELATED WORK

A. Division 15 Mechanical:
   1. Ductwork
   2. Air Balance
   3. Electrical provisions for mechanical work
   4. Air Filtration
   5. Vibration Isolation

1.3 PERFORMANCE

A. Provide performance as scheduled on drawings.

1.4 QUALITY ASSURANCE

A. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

B. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

C. System Seasonal Energy Efficiency Ratio/Energy Efficiency Ratio (SEER/EER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

D. Unit shall be safety certified by ETL and be ETL US listed.

1.5 SUBMITTALS

A. Manufacturer’s certified capacity data

B. Submit manufacturer’s installation, start-up and service instructions.

C. Submit recommended clearance dimensions for air flow and service.

D. Submit coordination drawings as specified. Consideration shall be given to adjacent structures and their effect on air flow patterns.

E. Submit internal wiring diagram of Control Center

F. Submit sequence of operation in narrative form.

G. Mark-up a copy of the specifications indicating in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be shipped with doors bolted shut to prevent damage during transport and thereafter while in storage awaiting installation.

B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation and Maintenance manual.

1.7 WARRANTY

A. Manufacturer shall provide a parts and labor warranty for a period of 5 years from the date of substantial completion.

B. Stainless steel heat exchanger shall be provided with a minimum of a 10 year non-prorated parts warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. Daikin

C. Trane

2.2 COMPRESSOR

A. Compressors shall be a fully modulating digital scroll or variable speed scroll type with thermal overload protection, independently circuited and shall be capable of modulation from 10-100% of its capacity and allow for airflow turn down to 30% of full flow.

B. Each compressor shall include a crankcase heater.

C. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged access doors shall provide access to the compressors.

D. Compressors shall be isolated from the base pan with the compressor manufacturer’s recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

E. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided. Finished field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line, insulated hot gas bypass line, insulated hot gas and suction lines.

F. Unit shall include a factory holding charge of R-410a refrigerant.

G Each compressor shall be equipped with a 5 minute off, delay timer to prevent compressor short cycling.

H. The unit shall be capable of stable cooling operation to a minimum of 35°F outdoor temperature.

I. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal.

J. Provide each compressor with a Removable Sound Cover that is constructed of a Silicone-fiberglass cloth outer jacket, a loaded vinyl barrier septum, fiberglass needle mat (11 lbs./ft.3 density), and a Silicone-fiberglass cloth inner jacket. The covers shall be connected together by means of a cloth straps with "D" rings and Velcro fasteners. The inner and outer jackets shall protect against UV rays, oil and water. Finished Surface Mass – 3 lbs. per sq. ft., to cover compressors and extended components for the specified equipment. Manufactured by BRD Noise and Vibration Control or engineer approved equal.

2.3 EVAPORATOR, CONDENSER AND REHEAT COILS

A. Provide the evaporator and hot gas reheat coil constructed of copper tubes with mechanically bonded aluminum fins and stainless-steel end casings.

B. Provide the condenser coil constructed of an aluminum microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannel layered between the refrigerant manifolds.

C. Provide an evaporator coil with interlaced circuitry. Provide a minimum of 12" clearance downstream of the evaporator and hot gas reheat coils.

D. Provide factory installed louvered hail / vandalism guards for condenser coils.

E. Provide coils with stainless steel casings, end plates, tube supports and top and bottom plates.

F. Provide the condenser, evaporator and reheat coils coated with corrosion resistant epoxy utilizing a dip and bake. Coating shall be flexible and uniformly bonded to all condenser coil surfaces and shall meet a minimum of 6,000 hours corrosion resistance per ASTM B117.

G. Provide a hinged access doors with quick release handle adjacent to each coil for inspection and maintenance.

2.4 EVAPORATOR FANS

A. Unit shall be equipped with a direct drive, backward curved airfoil blade, centrifugal evaporator fan.

B. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.

C. Motor shall contain premium efficiency TEFCP with self-aligning ball bearings rated for 200,000 hours service with external lubrication ports grouped near the motor access side of the unit. Provide motor HP as indicated on the drawings.

2.5 GAS HEATING SECTION

A. Unit shall be equipped with stainless steel burners and heat exchangers.

B. Gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature set point shall be adjustable on the electronic controller within the controls compartment.

C. Gas Controls.
1. Automatic gas valve and pressure regulator.
2. A manual shutoff valve.
3. Pilot valve.
4. Two flame rollout limit switches.

5. An adjustable fan control.
6. Fixed high limit controls

D. Unit shall be equipped with an electric spark pilot ignition system.
1. Electronic flame detection.
2. 100% safety shutoff.

E. Combustion air shall be induced by a positive pressure power venting fan.
1. Pre-purge of combustion chamber.

2.6 CASING, FILTERS AND DUCT CONNECTION

A. Provide a cabinet constructed of galvanized or zinc-coated steel, primed and coated with baked enamel and suitable for outdoor installation. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B117-95 test procedure.

B. Unit shall be equipped with duct connections on the bottom of each unit to coordinate with a ground mounted discharge curb as indicated on drawings.

C. Provide two-position, motorized spring return outdoor air damper constructed of extruded aluminum air foil blades with rubber edge and end seals. Damper assembly shall be Class 2 AMCA Certified.

D. Unit shall be equipped with an outside air hood with a minimum of 1” thick aluminum mesh pre-filters.

E. Unit shall be equipped with a filter frame to match the filter requirements specified in Section 23 41 00.

F. Provide with stainless steel condensate drain pan with positive slope in all directions to outlet.
1. Externally line the condensate drain pan with 1-1/2" waterproof insulation.
2. Provide a hinged access door with quick release handle adjacent to condensate drain pan for inspection. Install access door on drain connection side of unit.
3. Drain pan shall be insulated with a minimum 2’ thick foam insulation.

G. Double wall casing construction
1. Construct roof, wall, and floor with minimum 2-inch-thick, 2 lb. density, R-13 injected polyurethane foam insulated, double wall panels with thermal break for superior energy efficiency and casing longevity.
2. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
3. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
4. Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors. Units without full hinged access doors in the cooling coil section are not acceptable.

2.7 CONTROLS

A. Provide safety and operating controls factory wired and mounted in an integral controls and electrical enclosure. Include thermostatic expansion valve, high and low-pressure switches and

compressor motor overload devices. Furnish a time delay device to prevent short cycling. Employ a control transformer, a pressure relief device and suction and discharge valves with service connections. Include a high condensate level switch that shuts down the unit when a high-water level is detected in the drain pan.

B. Unit shall be provided with a fully functional DDC control system with BACnet MS/TP integration. BCMS system shall have the ability to remotely start/stop the unit, adjust supply air temperature heating and cooling setpoints, and adjust targeted supply air dew point setpoint during dehumidification mode.
   1. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
   2. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
   3. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
   4. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a BACnet network.

2.8 ROOF CURB

A. Install a insulated (R-8 Minimum) welded ground mounted curb with supply air discharge as specified on Drawings.
   1. Curb shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
   2. Level curb according to manufacturer's recommendations.
   3. Curb height shall be a minimum of 14".

2.9 OUTDOOR FANS

A. Unit shall be equipped with a direct drive propeller type fan with permanently lubricated TEFC motor. Fan shall discharge upward.

B. Condenser fans shall be VFD driven variable speed for active condenser head pressure control.

2.10 CONVENIENCE OUTLET

A. Unit shall be equipped with a factory installed and field wired 120V, 20 AMP GFI outlet in unit cabinet.

2.11 SERVICE DISCONNECT SWITCH

A. Unit shall be equipped with a factory installed field wired, circuit breaker with external locking handle.

2.12 TEMPERATURE AND FAN CONTROL

A. Unit shall be controlled by maintaining a constant supply air temperature as scheduled on the

drawings. When the outside air temperature drops below the scheduled leaving air temperature, the unit shall enter heating mode and the natural gas heater shall modulate to maintain the heating mode supply air temperature setpoint. When the outside air temperature is above the scheduled supply air temperature, the unit shall enter dehumidification priority mode, the compressor capacity shall be modulating to maintain the active evaporator coil temperature setpoint and the modulating hot gas reheat valve shall be controlled to maintain the cooling mode supply air temperature setpoint. The evaporator coil temperature must be controlled by the use of suction pressure transducers installed on each refrigeration circuit. The use of an evaporator coil temperature sensor is not allowed. The unit shall be able to independently control the supply air dry bulb and wet bulb temperatures under all OA loads during cooling mode. Open outside air damper prior to starting fan and close damper during unoccupied mode.

B. Unit shall be provided in a variable air volume configuration. Provide unit with a duct mounted pressure sensor to control the fan speed and a duct mounted discharge air temperature sensor to control unit discharge air temperature.

2.13 PHASE MONITORING PROTECTION

A. Provide unit with phase monitoring protection to protect motors and compressors against issue associated with phase loss, phase imbalance and phase reversal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install according to manufacturer's recommendations and as shown on drawings.

B. Unit is to be provided with a through-the-bottom service connection accessory package and must be used for electrical connections to unit. Use bulkhead connectors to make a waterproof connection.

C. Seal all duct connections to roof curb for air tight connection. Install a 90 degree flanged ductwork connection to the roof curb. Provide and install gasketing around duct flanges. Provide and install gasketing around outer edge of roof curb.

3.2 START UP

A. Provide the services of a factory trained service technician employed full time by the unit manufacturer to start-up the system, or manufacturer's factory authorized representative under the supervision of the factory trained service technician. Upon completion of the installation, the system shall be started and commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system. The factory authorized representative will verify that accessories are installed and performing the specified functions. (Contractor startup is unacceptable.)

B. The written startup report shall be provided to the owner and engineer upon completion.

C. Manufacturer shall provide 8 hours of technician time for coordination and BMCS startup and programming.

END OF SECTION

SECTION 23 81 26

VARIABLE REFRIGERANT VOLUME DX SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01, apply to this Section.

B. Refer to Document 00 21 13, Instructions to Bidders and 00 22 13 Supplementary Instructions to Bidders, for substitution of materials and products.

C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

A. Provide and install a multiple evaporator, direct expansion, variable capacity air conditioning system with simultaneous cooling and heating configurations. System shall consist of multiple fan coil units, branch selector boxes, refrigerant piping joints and headers, control wiring, sensors and matched variable speed outdoor heat recovery condensing units.

1.3 RELATED WORK

A. Division 23 Mechanical:
   1. Ductwork
   2. Air Balance
   3. Electrical provisions for mechanical work
   4. Air Filtration
   5. Vibration Isolation
   6. Refrigerant piping

1.4 QUALITY ASSURANCE

A. All system components shall be manufactured in an ISO 9001 and ISO 14001 facility.

B. All system wiring, internal and external to components, shall be in accordance with the National Electrical Code.

C. System shall be safety certified by ETL and be UL listed.

D. All units shall be certified, for both performance and efficiency, to AHRI 1230 standard.

E. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings." Provide certified efficiency ratings per AHRI-1230 standard. (DOE Waiver is not acceptable) Scheduled EER and IEER ratings scheduled shall be considered minimum efficiency allowed.

F. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings." Provide certified efficiency ratings per AHRI-1230 standard. (DOE Waiver is not acceptable) Scheduled COP ratings scheduled shall be considered minimum efficiency allowed.

1.5 PERFORMANCE

A. Provide performance as scheduled on drawings.

B. Each fan coil unit or group of fan coil units associated with each individual branch cool/heat selector box shall be independently capable of operating in either heating or cooling mode regardless of the modes of the other zones on the system. The system shall have a five minute maximum cooling/heating changeover time.

C. Each zone shall be capable of operating separately with individual temperature controls.

1.6 SUBMITTALS

A. Product Data:
   1. Literature shall be provided that indicates dimensions, operating and shipping weights, certified capacities, ratings, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided.

B. Shop Drawings:
   1. Unit drawings shall be provided that indicates assembly, unit dimensions, construction details, service and air flow clearances, and connection details. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

C. Submit a manufacturer generated detailed refrigerant piping diagram indicating each condensing unit system, each fan coil unit, each branch selector boxes, each line length and each line size.

D. Submit coordination drawings as specified. Give consideration to adjacent structures as they affect air flow patterns.

E. Provide a comprehensive list of the total pounds on refrigerant and type of refrigerant required by each variable refrigerant volume system.

F. Submit sequence of operation in narrative form.

G. Contractor must have completed the manufacturer’s installation training. The contractor shall submit a copy of the training completion certificate for the project manager and at least 2 pipe installers with this submittal.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be shipped with doors bolted shut to prevent damage during transport and thereafter while in storage awaiting installation.

B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation and Maintenance manual.

1.8 WARRANTY

A. The VRF manufacturer shall provide a full parts warranty for all VRF equipment and controls for 10 years and a 5 years labor warranty from the date of substantial completion.

B. All warranty shall be executed by the manufacturer’s authorized representative. Contractor warranty shall not be allowed.

C. Copies of the warranty paperwork and startup documentation shall be submitted upon close out of the installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier (Houston Direct Sales Office)

B. Daikin

C. Trane

2.2 GENERAL DESCRIPTION

A. The variable capacity, heat recovery air conditioning system shall be a Variable Refrigerant Volume (heat and cool model) split system as specified. The system shall consist of multiple evaporators, branch selector boxes, manufacturer supplied refrigerant joints and headers, a two or three pipe refrigeration distribution system using PID control, and matched variable speed outdoor condensing units. The outdoor unit is a direct expansion (DX), air-cooled heat recovery, multi-zone air-conditioning system with variable speed driven compressors using R-410A refrigerant. All zones are each capable of operating separately with individual temperature control.

B. The operation of the system shall permit either individual cooling or heating of each fan coil simultaneously or all of the fan coil units associated with one branch cool/heat selector box. See drawings for Branch Selector locations and associated fan coil units.

C. Branch selector (BS) boxes shall be located as shown on the drawing. The branch selector boxes shall have the capacity to control up to 96 MBH (cooling) downstream of the BS box. The BS box shall consist of five electronic expansion valves, refrigerant control piping and electronics to facilitate communications between the BS box and main processor and between the BS box and fan coils. The BS box shall control the operational mode of the subordinate fan coils. The use of five EXV's ensures continuous heating during defrost, no heating impact during changeover and reduced sound levels. If solenoid valves in the selector box cause a "clicking" sound upon changeover, then the contractor shall be required to provide additional acoustic wrapping of the box until sound levels are acceptable to the owner and engineer.

C. The indoor units shall be connected to the condensing unit utilizing manufacturer specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable. All joints shall be installed per manufacturer's instructions.

E. Equipment capacities to meet leaving air temperatures (LAT) and Total and Sensible capacities as scheduled.

2.3 AIR COOLED VARIABLE REFRIGERANT VOLUME CONDENSING UNIT

A. General:
1. The outdoor unit shall be used with only variable refrigerant volume system components of the same manufacturer.
2. Unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. Dual and triple frame outdoor units shall be field piped with factory supplied fittings per the manufacturer's instruction.
3. The units' onboard controls shall perform all functions required to effectively and efficiently operate the variable refrigerant volume system.
4. Each unit shall be run tested at the factory.

5. The unit shall incorporate an auto-charging feature and a refrigerant charge check function. If units are provided without the auto-charge feature, a factory service representative must be present at startup.
6. The unit shall include an automatic oil recovery cycle which occurs 2 hours after startup and then once every 8 hours of operation.
7. The unit shall be provided with a minimum of the following safety devices; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal compressor protectors, thermal fan motor protectors, overcurrent protection for the inverter and anti-short cycling timers.
8. The system shall store all setting and programs such that reprogramming is not required upon power failure. In addition, the system shall automatically restart operation after a power failure.
9. Units shall be capable of operating down to zero degree F ambient air.
10. Unit shall have a tested sound rating no higher than 58 dB throughout the full range of unit capacity modulation.
11. VFD Inverter Control – Each condensing unit shall use a high efficiency, variable speed "inverter" compressor coupled with inverter fan motors for superior part load performance. Compressor capacity shall be modulated automatically to maintain constant suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads.
12. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
13. Condenser fan shall be direct drive motors that have multiple speed operation via a DC (digitally commutating) inverter.

B. Frame and Casing:
1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed milled steel panels coated with a baked enamel finish.
2. Provide with access panels at control boards, fans, motors and expansion valves. Access panels shall not require a unique tool for removal.

C. Compressor:
1. The inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency or STD ON/OFF) shall be controlled to eliminate deviation from target value.
2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll "G2-type" with a maximum speed of 7,980 rpm.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 4% to 100%.
5. Each non-inverter compressor shall also be of the hermetically sealed scroll type.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.
8. The compressor shall be spring mounted to avoid the transmission of vibration.

9. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours.

D. Fan:
1. Fan shall be direct drive variable speed propeller type.
2. Fan shall be configured for vertical discharge airflow.
3. Fan motor shall have inherent protection and have permanently lubricated bearings.
4. All fans shall be provided with a raised guard to limit contact with moving parts.
5. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps as shown below.

Operation Sound (dB)	Night Mode Maximum Sound Pressure Level (dB)
Step 1	55
Step 2	50
Step 3	45

E. Condenser Coil:
1. Provide copper tubes with mechanically bonded aluminum fins and aluminum end casings.
2. Provide factory installed louvered hail / vandalism guards for condenser coils.
3. Provide coils with a factory applied corrosion resistant coating.

F. Electrical and Controls:
1. Unit shall be provided with electrical power characteristics as specified on drawings.
2. Unit shall be capable of operation within voltage limits of +/- 10%.
3. Low voltage control power shall be factory provided from the units' main power supply. A separate control voltage power supply shall not be required.
4. The system shall be controlled by integral microprocessors.
5. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
6. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

2.4 BRANCH SELECTOR BOXES (HEAT RECOVERY SYSTEMS)

A. ISOLATION VALVES - Full port, bi-directional flow isolation valves shall be installed upstream of all Branch Selector boxes. Where multi-port boxes are used, provide isolation valves both upstream and downstream of the box to facilitate isolation of individual fan coil units. Ensure Schrader fitting is positioned on the downstream side of the valve.

B. During simultaneous heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.

C. Construction:
1. The Branch Selector boxes shall have a galvanized sheet plate casing.
2. Each Branch Selector shall house 5 electronic expansion valves for refrigerant control. (Multi-port boxes shall maintain independent EEV construction. Sharing of valves between zones is not allowed)
3. Where multiple boxes are installed on the same system, the piping shall be such that isolation of one box shall not disrupt refrigerant flow to other boxes. "Pass through" of refrigerant should not be used where isolation for service will prevent usage of other

zones.

4. The cabinet shall contain a subcooling heat exchanger.
5. The unit shall have a sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
6. All pipe connections shall be brazed type.

D. Electrical:

1. The unit electrical power shall be as specified on drawings.
2. The control voltage between the indoor units and condensing unit shall be low voltage and installed by BMCS Contractor.

2.5 AIR HANDLING UNIT INTEGRATION KIT

A. Where specified, the Variable Refrigerant Volume system shall be capable of integrating to a modular built up air handling unit. The unit shall be of construction as specified in section 23 73 13 Air Handling Units.

B. Refer to 23 09 33 Building Management and Control System for operating sequence.

C. ISOLATION VALVES - Full port, bi-directional flow isolation valves shall be installed upstream of Air Handling Unit integration kit. Ensure Schrader fitting is positioned on the downstream side of the valve.

D. The integration kit shall allow connection and control in addition to full integration of non VRF air handling equipment into a VRF system.

E. The integration kit shall include an electronic expansion valve capable of 2000 steps to control refrigerant flow to coil.

F. Integrated control module shall communicate with VRV condensing unit.

2.6 INDOOR UNIT - EVAPORATOR-FAN UNIT – VERTICAL DUCTED

A. Refer to Fan Coil Unit specification 23 82 19.

2.7 CONTROLS

A. Zone Controller: Each zone/FCU shall include a wall mounted temperature sensor with the following features:

1. Backlit LCD display. Display of temperature information shall be Fahrenheit. The controller shall be able to display and adjust room temperature in one degree increments or be locked out from allowing user input.
2. The controller shall have COOL, HEAT, FAN ONLY, DRY (dehumidification), and AUTO-CHANGE-OVER modes.
3. For AUTO change over mode, the controller shall allow independent setpoints for heating and cooling to eliminate wide swings in temperature and unnecessary change over. Independent setpoint control shall be available at both local controller and the central controller
4. Setback function shall be included with adjustable setback temperature override.
5. The programmable controller shall have the capability of individually disabling the following buttons:
    a. Menu/OK
    b. ON/OFF
    c. Mode
    d. Fan Speed
    e. Setpoint Adjustment (Up/Down Keys) (Set point adjustment shall be in 1 deg F

increments)

6. The controller shall allow for a local (controller-level) adjustable limitation of user setpoint range.
7. SCHEDULING: (Schedules shall be controlled via the BAS Interface - See control sequence.)
8. The Remote Controller shall display error codes on the screen in the event of a system error.
9. The following Fan Coil Unit sensor values shall be available at the wall mounted remote controller:
    a. Controller thermistor temp
    b. (Refrigerant) Liquid line temperature
    c. (Refrigerant) Gas line temperature
10. 48 Hour battery backup of clock/date. All other settings shall be stored in non-volatile memory to ensure that settings are not lost upon power failure.

B. Central Controller:

1. The building shall be installed with a web-enabled factory native central controller with BACnet IP connection for BAS system. The manufacturer's controller shall provide (via BACnet) ability for users to manipulate the following functions:
    a. On/Off Control
    b. Schedule-Adjustment (schedules to be maintained by BAS)
    c. Mode Selection – See control sequence for heat/cool changeover control
    d. Setpoint Control (Independent heating and cooling setpoints available)
    e. Operational Status and Alarm Notifications
    f. Provide with battery backup and USB port for software updates
    g. User and Administrator Levels with password protection.
    h. Customize groups and zones

C. Control Sequence:

1. The VRF system shall be provided with required hardware and software to perform the core operational sequences detailed in this section. In addition to the manufacturer's control system, the VRF supplier will provide a BACnet gateway to provide the monitoring and control points to the Building Automation Contractor. A fully functional VRF system to be provided to the owner including interface to the BAS system. Through the VRF BACnet gateway, the BAS system shall provide operation schedule, zone setpoints to the VRF controller. In addition the BAS shall be able to view individual zone temperature and humidity. The specified interaction is minimum.
2. The VRF manufacturer shall be responsible for coordinating installation, by BAS manufacturer, of all low voltage communication wiring between their components and central controller to facilitate these sequences
3. The VRF central controller shall be provided onsite as a touch screen panel located in the administration office mechanical room (or as directed by the district). It shall additionally be capable of being accessed to the internet via a district provided IP address and Ethernet connection. All functions detailed below shall be available via touch screen interface and internet access.
4. Display interface: The controller shall provide a floor plan layout of the building with the fan coil icons and temperature information visible on the screen. At commissioning, the fan coil units shall have the tagging updated to provide the applicable room numbers for the as-built installation. The visual interface shall provide clear indication of what fan coil units are connected to which particular condensing unit system.
5. The controller shall combine all indoor units onto a single central controller interface. The central controller shall provide these basic functions per zone:
    a. Alarm Identification per fan coil unit (also available on the BAS system)
    b. Min/Max set point limiting
        01. Heating set point and cooling set points shall be controlled individually
        02. Set points shall be adjustable at the zone level with adjustable limits

controlled by the VRF central controller (initial programming shall limit cooling setpoint control to between 73 – 76 deg. Heating initial range to be 69 – 72 deg)

c. Occupied/Unoccupied set point control – Each room served by a dedicated ceiling cassette shall be provided with a motion sensor compatible with the VRF system controls (Sensor provided by the VRF supplier and installed by the BAS contractor). The motion sensor shall be used to facilitate an automatic set point adjustment when a room is unoccupied. During the regular operation hours (determined by the district's central control system) these zones shall control between the district set point limits. When the room is vacant for more than 5 minutes, as indicated by the motion sensor the fan coil unit(s) shall be turned off. The VRF controller shall automatically enable the fan coil unit(s) if the room temperature rises more than 2 degrees above the standard 75 deg cooling set point (adj) or 2 deg below the standard 72 deg heating set point (adj). The unit shall return to normal operation when motion is detected.

d. Timed override for after-hours air conditioning: During periods where the building is not in use (determined by the district schedule and BAS system) the fan coil units shall be capable of being turned on at the wall mounted controller via a local override button. The VRF system shall automatically turn off after 60 minutes (adj) of operation. This shall not require additional programming by the BAS central control system. District personnel shall have the ability to override the after-hours operation to prevent operation (see applicable portion of the BAS system control sequence)

e. When the system is off according to the district schedule, the VRF controller shall cycle the cooling/heating if the temperatures exceed the unoccupied threshold temperatures. (85 cooling & 60 heating)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be installed by a manufacturer's factory trained and certified contractor. Submit proof of factory certified training with bid package.

B. Install according to manufacturer's recommendations and as shown on drawings.

C. Installing contractor shall install field installed components, in accordance with Installation, Operation and Maintenance manual instructions.

D. Manufacturer shall inspect, test and adjust field assembled components and equipment installation, including connection, and assist in field testing. Report all findings to the architect and engineering in writing.

E. Manufacturer or factory-authorized representative shall visit the site regularly during the installation process to ensure proper means and methods are being employed. Include a minimum of two (2) such visits.

F. The equipment manufacturer shall be responsible for providing a complete equipment commissioning report which includes the following:
1. Current Installation Training Certificate from the installing contractor.
2. Pre-piping jobsite visit report.
3. Final system layouts and line sizes based on actual line lengths.
4. Post-piping inspection report.
5. Vacuum verification report. (This must be witnessed by the equipment manufacturer).
6. Warranty approval verification.
7. Final reports shall be provided to owner/engineer on company letterhead.

G. All tubing must be ACR type UNS C12200 grade copper.

H. All pipe sizes to be installed per manufacturers specifications.

I. The brazing alloy should be no less than 15% silver.

J. All brazing to be performed with a nitrogen purge.

K. No inline refrigeration components, except for full port ball valves when applicable.

L. All piping support must allow for thermal expansion and contraction of the copper pipe, i.e. around the insulation.

M. Each pipe must be individually insulated.

3.2 PARTS AVAILABILITY

A. The installed system shall have a minimum of one local parts distributer with local stock of all critical components. Local availability shall include all fan blades, fan motors, compressors, circuit boards, valves, sensors, etc. If local stock of parts is not available, the manufacturer shall provide all parts with next day freight at no additional cost to the owner for a period of 5 years from the date of substantial completion.

3.3 SPARE PARTS

A. Provide with a spare set filters for each indoor unit.

3.4 START UP

A. Provide unit with a factory start up performed by a factory representative or factory certified technician.

B. Provide the owner with a minimum of 8 hours of training and certifications classes such that the owner is equipped with the knowledge to adjust, operate and maintain the variable refrigerant volume system.

C. Provide a minimum of 8 hours of BAS coordination and BAS setup time. During this time VRF manufacturer shall work side by side with BAS contractor to ensure all communications between the VRF BACnet controller and the BAS is fully functional. A fully functional system includes proper mapping of zones in the BAS graphics.

D. The installing contractor shall complete the installation and complete a total system pressure test of 550 psi for 24 hours prior to startup. Manufacturer shall witness and sign off before pressure test is completed.

E. The manufacturer shall be responsible for all evacuation and charging of refrigerant for each system at startup. Contractor startup is not allowed.

F. The manufacturer’s agent shall provide the following startup services:
   1. Evacuation of the piping system to a 400 micron vacuum (hold 3 hours)
   2. Proper charging of the system with R-410A (Refrigerant provided and installed by the installing contractor)
   3. Execution of all standard diagnostics.
   4. Connection to the system with the manufacturer’s Service Checker software and creating an operational log of the following information for verification:

5. Each system operates with proper temperatures, delta T and superheat conditions in both cooling and heating modes.

G. Each fan coil unit is heating/cooling properly (verification that piping work has been installed properly.

H. A digital copy of these operational logs shall be stored by the manufacturer's agent as well as delivered to the owner with warranty documentation.

I. The manufacturer shall visit the project site 4 times throughout installation in addition to the required startup items listed above. The manufacturer shall inspect the pipe installation, typical ceiling cassette installation, typical ducted fan coil installation, VRF condensing unit installation and controls wiring installation. Engineer shall be notified in writing of the results and findings of these site visits.

END OF SECTION

SECTION 23 81 27

AIR ROTATION UNIT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Indoor packaged pre-wired air handling units consisting of cabinet, supply fans, electric heat, DX coils and accessories.

1.2 REFERENCES

A. ANSI/ARI 410 - forced-circulation air cooling and air heating coils.

B. ASTM B75- Standard for copper tubing pressure application.

C. National Electrical Code.

1.3 SUBMITTALS

A. Submit Shop Drawings and Product Data as specified.

B. Submit fan performance curve for each unit:
1. Plot fan volume against static pressure, horsepower and efficiency.
2. Show point of rating based on static requirements of the system.

C. Submit a chart of specific sound power level at each octave band center frequency.

D. Submit manufacturer's certified capacity curb with selections plotted.

1.4 CAPACITY

A. Refer to equipment schedule.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Johnson Air Rotation Systems

B. Powermatic

2.2 UNIT HOUSING

A. Base Cabinet Construction: Vertical frame members shall be a minimum of 16-gauge G-90 galvanized steel, suitable for attachment of exterior panels. Exterior base walls shall be constructed of double-wall 1-1/2” foam-injected panels, consisting of 20-gauge bonderized steel exterior liners suitable for factory painting. Interior liners shall be constructed of a minimum of 22-gauge G-90 galvanized steel. Unit shall be factory painted using factory standard enamel finish.

B. Extension Section Construction: Exterior liners shall consist of 20-gauge bonderized steel suitable for factory painting. Extension sections shall have ½” thermal insulation installed using welded pin construction.

C. Outlet Section Construction: Exterior liners shall consist of a minimum 20-gauge bonderized steel suitable for factory painting. Extension sections shall have ½" thermal insulation installed using permanent adhesive.

D. Lifting provisions shall be included on all units as an integral piece of the equipment.

2.3 ACCESS PANELS

A. Access Panels: Removable access panels in the unit housing shall be provided to permit ready access to all internal components. The access panels shall be a minimum of 20-gauge steel. The unit's fan compartment access for inspection and adjustment shall be UL approved. A warning placard shall be affixed at the access door indicating that the unit is to be shut off before opening the access panel and entering the fan compartment.

2.4 ELECTRICAL AND CONTROLS

A. Controls
1. The power panel shall have a locking dead front main power cabinet with disconnect and containing necessary fuses, sub-circuits, and relays.
2. The unit shall incorporate factory-mounted transformers to step down the main power supply voltage to be 120 volts and 24 volts.
3. Cooling thermostat/controls – Space thermostat to provide output.
4. DDC type controller provided by ARU manufacturer.
5. MODBUS interface.
6. Actuator power and control by ARU manufacturer.

2.5 FAN AND MOTOR

A. The supply fans, a minimum of per unit, shall consist of a direct-drive axial fan with a composite blade and housing. The fan motor shall be EC, with integral soft-start and speed control. Fan blades shall be profiled, sickle shaped. The fan size and speed shall be designed for low noise and high static efficiency.

B. Fans shall have the capacity, and class, as scheduled.

C. Supply fans with cooling coils in the 'Blow-Through' configuration are not accepted.

2.6 COILS

A. Cooling Coils:
1. Coils shall be placed in a draw through position located in the base section of the unit for ease of maintenance.
2. Coils shall use a minimum of 0.013" copper tubes and 0.006" aluminum fins. Coil casings shall be galvanized steel.
3. Drain pans shall be pitched for complete drainage and be constructed of 304 stainless steel. The underside of the drain pan shall be completely double-wall insulated with a minimum of 1.5 inches of spray on foam insulation. The drain pan connection shall be 6" above the unit base for trapping by the installing contractor.
4. Face velocity of cooling coils shall not exceed 500 fpm.
5. Access panel(s) shall be provided into base and extension sections.

2.7 FILTER SECTION

A. Permanent quick release latching devices. Filter tracks shall be constructed of 16-gauge steel and positioned exterior of the unit for ease of inspection and replacement without the need to shut down unit to accomplish filter maintenance.

B. Arrange to accommodate the filters as specified.

2.8 DAMPERS

A. Low leak outside air dampers with blade and jamb seals (Ruskin CD-60 or equivalent) sized for outside air.

B. Belimo 120V two-position actuators to be provided, mounted, and wired by ARU manufacturer at all damper openings.

2.9 DISCHARGE

A. Discharge Louvers:
1. Adjustable vertical louvers shall be painted to match cabinet finish.
2. Turning vanes will be factory installed in air discharge section of units. Substitutions to the basis of design manufacturer that do not provide turning vanes shall account for loss of air flow due to system effect by adding 0.25" of internal static pressure loss to their fan selections. Manufacturer shall be responsible for any additional cost due to higher unit MCA/ MOCP to achieve scheduled air flow.

2.10 IDENTIFICATION AND LABELING

A. The unit nameplate shall include the unit model number, serial number, Full Load Amps, and supply voltage.

B. The units shall be permanently marked with the equipment number ARU-# as identified in the performance section.

C. Proper warning labels for high voltage and/or moving parts shall be permanently affixed to access panels.

D. An electrical ladder diagram shall be permanently affixed inside of the electrical control panel. The schematic shall be specific to the project and not be a generic type encompassing features or options not present on the unit. The schematic shall include the fuse replacement values and types.

2.11 THERMOSTAT

A. Provide each unit with a Honeywell T4 Pro Programmable Thermostat. BMCS contractor shall wire, install, and program thermostat.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Store and ship in accordance with manufacturer's recommendations.

B. Unit is to be provided with a through-the-bottom service connection accessory package and must be used for electrical connections to unit. Use bulkhead connectors to make a waterproof connection.

C. Seal all duct connections to roof curb for air tight connection. Install a 90 degree flanged ductwork connection to the roof curb. Provide and install gasketing around duct flanges. Provide and install gasketing around outer edge of roof curb.

3.2 START UP

A. The services of a factory trained Field Engineer will be provided at no extra cost to owner to supervise placing the system in operation and good adjustment. The Field Engineer will instruct the owner's personnel in good equipment operation, and review maintenance procedures with owner's qualified personnel or representatives.

The start-up shall include but not be limited to:

3. Verification of proper supply power and fuel.
4. Verification that electrical terminals are secure.
5. Proper Airflow balance.
6. Verification of combustion efficiency and proper burner and induced draft fan adjustments
7. Testing of all safety and operating controls.
8. Setting of High and Low/Modulation fire.

END OF SECTION

SECTION 23 81 46

WATER SOURCE HEAT PUMP UNIT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install water source heat pump unit.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Electrical provisions of mechanical work
   2. Building Management and Control System
   3. Pipe and pipe fittings
   4. Vibration isolation

1.3 REFERENCES

A. AHRI – Water Source Heat Pumps

B. AHRI – Forced Circulation Air Cooling and Air Heating Coils

C. National Electrical Code

1.4 SUBMITTALS

A. Submit manufacturer's dimensioned product data sheets.
   1. Show location of filter access doors.

B. Submit fan performance curve for each unit:
   1. Plot fan volume against static pressure, horsepower and efficiency.
   2. Show point of rating based on static requirements of the system.

C. Submit the fan performance plot at each motor speed position with consideration for the reduced internal static.

D. Submit a chart of specific sound power level at each octave band center frequency.

E. Submit manufacturer's certified heating and cooling coil capacity data.

F. Submit filter manufacturer's product data sheets and capacity information.

G. Submit manufacturer's data on housing insulation material.

H. Submit manufacturers wiring diagrams.

I. Mark-up a copy of the specifications, indicating in the margin of each paragraph, the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

1.5 WARRANTY

A. Provide a manufacturer’s warranty to include parts and labor for a period of (2) two years from substantial completion.

B. Provide a manufacturer's warranty to include parts on refrigerant circuit (coils, reversing valve and compressor) and control board for a period of (5) five years from substantial completion.

1.6 ACCEPTABLE MANUFACTURERS

A. Comfort-Aire (Geologix HBV Series)

B. Daikin

C. Water Furnace

PART 2 - PRODUCTS

2.1 CABINET

A. Corrosion resistant heavy duty galvanized steel construction.

B. Provide a duct flange on four sides of the return air inlet and supply air outlet of the unit.
1. Sized to permit connection of the flexible connection to the ductwork
2. Extend beyond the primary drain pan
3. Minimum dimension 2"

C. Provide insulated, removable panels for access to the interior.
1. Plated captive screws and nuts
2. Neoprene gaskets

D. Internally insulate the entire unit with 1/2" foil faced fiber insulation, applied to internal surfaces with adhesive and weld pins. Insulation shall not have exposed edges within the airstream.

E. Insulation, vapor barriers, facings and adhesives:
1. Flame spread not higher than 25
2. Smoke developed rating not higher than 50

F. Condensation on the exterior of the cabinet is not approved.

2.2 COMPRESSOR

A. The unit shall be provided with a Two-Stage high efficiency scroll compressor.

B. Equip each compressor with:
1. Protection against excessive discharge pressure is provided by means of a high pressure switch.
2. Protection against a loss of charge is provided by a low pressure safety.
3. Loss of charge protection
4. Internal thermal overload protection shall be provided.

C. The compressor shall be dually isolated. External vibration isolation is provided by rubber mounting devices located underneath the mounting base of the compressor. A second isolation of the refrigerant assembly shall be provided under the compressor mounting base.

D. Locate the compressors in a sound attenuating compartment located in the unit cabinet.

E. Provide a sound reduction package that includes vibration isolation to the compressor and water-to-refrigerant coil, unit base stiffeners, insulated metal compressor enclosure, and a second stage of vibration isolation to the compressor and water-to-refrigerant base pan.

F. Provide unit with a compressor sound blanket constructed from sound absorption materials. Sound blanket shall have a vinyl reinforced jacket.

2.3 FAN ASSEMBLY

A. Fan shall be a forward-curved centrifugal wheel style constructed of corrosion resistant galvanized material. The fan is placed in a draw-thru configuration and is arranged for top, back or side supply air. This assembly shall attach the wheel and motor to the fan housing providing single side service access.

B. Fan motor shall be premium duty, VFD compatible, permanently lubricated with thermal overload protection. Units supplied without permanently lubricated motors 86 Design Guide - HBH/HBV Large Series HBH/V Series 60Hz Engineering Specifications – Page 3 must provide external oilers for easy service. The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule. Airflow/Static pressure rating of the unit shall be based on a wet coil and a clean filter in place.

C. The fan assembly on horizontal units shall be arranged for back, left, or right discharge. The discharge must also be capable of being changed in the field.

D. Removal of the motor and fan wheel shall be made with the assistance of a factory provided orifice ring assembly. This assembly shall attach the wheel and motor to the fan housing providing single side service access.

2.4 CONDENSATE DRAIN PANS

A. IAQ style drain pans shall be provided under all coils.
1. Pitch to drain connection
2. Fabricated from 16 gauge 304 stainless steel
3. Triple pitched for complete drainage with no standing water
4. Insulated to prevent condensation
5. Welded corners
6. Stainless drain connection
7. Equipped with a solid state electronic condensate overflow protection with auxiliary BMCS contacts.

2.5 REFRIGERANT CIRCUIT

A. All units shall have a sealed refrigerant circuit that is charged, and factory tested. The unit will have a bi-directional thermostatic expansion valve that allows equipment operation between 30°F and 120°F entering water temperature. The refrigerant tubing shall be copper. This system shall be clean and free from contaminants and conditions such as drilling fragments, dirt and oil.

B. The water-to-refrigerant heat exchanger shall be of a high quality co-axial coil for maximum heat transfer. The copper coil shall be deeply fluted to enhance heat transfer and minimize fouling and scaling. The coil shall have a working pressure of 650 psig on the refrigerant side and 400 psig on the water side.

C. The water-to-refrigerant heat exchanger, water lines, and refrigerant suction lines shall be insulated to prevent condensation at low temperatures below 60°F.

D. The air-to-refrigerant coil shall contain copper tubes mechanically expanded into evenly spaced aluminum fins. All coils are to be factory leak tested. The test must be performed at 650 psig operating pressure and the leak test at 450 psig operating pressure with helium. In addition, the tubes are to be completely evacuated of air prior to shipment. The refrigerant coil distributor assembly shall be of orifice style with round copper distributor tubes. The tubes shall be sized

consistently with the capacity of the coil. Suction headers shall be fabricated from rounded copper pipe.

E. Access ports shall be factory supplied within the refrigerant circuit on the high and low pressure sides for easy refrigerant pressure or temperature testing. A filter drier shall be provided and factory installed within the refrigerant circuit. Protection against excessive discharge pressure and loss of charge shall be provided.

F. Units shall come standard with a reversing valve for heating and cooling operation. The reversing valve is a pilot operating sliding piston type with replaceable encapsulated magnetic coil. This valve shall be energized in cooling. Refrigerant Metering shall be accomplished with a Bi-directional thermal expansion valve (TXV).

G. The refrigerant tubing shall copper. This system shall be free from contaminants and conditions such as drilling fragments, dirt and oil. All water lines that are located in the indoor air stream shall be insulated with 3/8 inch thick elastomeric insulation. The refrigerant lines that are located in the indoor air stream that are not directly over the drain pan area shall be insulated with 3/8 inch thick elastomeric insulation.

2.6 CONDENSER COIL PIPING CONNECTION

A. Provide supply and return balancing valve assemblies. Each assembly shall have a pressure and temperature port with the return assembly having a memory stop. Ball valves shall be of brass or bronze body, blow out proof chrome plated ball with virgin teflon packing, brass stem, and a steel handle.

B. Provide supply and return hoses in 3-foot lengths. Hoses shall consist of a stainless steel outer braid with an inner core of tube made of a nontoxic synthetic polymer material. The hoses shall be suitable for water temperatures ranging between 33°F and 211°F without the use of glycol.

C. Provide an automatic flow limiting device. The automatic flow limiting device shall be factory set and limit flow to within 5% of the specified amount. For 1/2" to 1-1/2", the flow cartridge shall be removable from the Y-body housing for regulatory change out, inspection and cleaning without breaking the main piping. Device shall be rated 400 psig @ 250 °F.

D. Provide one Y-strainer with blow down plug for each pair of supply and return hoses supplied. Strainer shall be of cast or forged bronze with 20 mesh stainless screen and removable cap. Assembly shall be rated for 400 psig @ 275 °F.

2.7 ELECTRICAL

A. Provide unit with a factory tested and installed control panel shall contain all necessary devices to allow heating and cooling operation of the equipment to occur from a remote zone thermostat. These devices shall be as follows:
   1. 24 VAC contactor for compressor control.
   2. 18 pole terminal strip located inside the control panel behind the service access panel. This terminal strip shall be used for low voltage (thermostat/zone sensor) connections.
   3. An electrically operated safety lockout relay shall help prevent cycling of the compressor during adverse conditions of operation. This device shall be reset either at the remote thermostat/zone sensor, or by cycling power to the unit.
   4. A high pressure switch shall help protect the compressor against operation at refrigerant system pressure in excess of 650 psig.
   5. A low pressure switch shall help prevent compressor operation under low charge or catastrophic loss of charge situations.

2.8 CONTROL SYSTEM

A. Units shall have a solid-state control system. The control system microprocessor board shall be specifically designed to protect against building electrical system noise contamination, EMI, and RFI interference. The control system shall interface with a heat pump type thermostat. The control system shall have the following features:
   1. Anti-short cycle time delay on compressor operation.
   2. Random start on power up mode.
   3. Low voltage protection.
   4. High voltage protection.
   5. Unit shutdown on high or low refrigerant pressures.
   6. Unit shutdown on low water temperature.
   7. Condensate overflow electronic protection.
   8. Option to reset unit at thermostat or disconnect.
   9. Automatic intelligent reset. Unit shall automatically reset the unit 5 minutes after trip if the fault has cleared. If a fault occurs 3 times sequentially without thermostat meeting temperature, then lockout requiring manual reset will occur.
   10. Ability to defeat time delays for servicing.
   11. Light emitting diode (LED) on circuit board to indicate high pressure, low pressure, low voltage, high voltage, low water/air temperature cut-out, condensate overflow, and control voltage status.
   12. The low-pressure switch shall not be monitored for the first 120 seconds after a compressor start command to prevent nuisance safety trips.
   13. 24 V output to cycle a motorized water valve or other device with compressor contactor.
   14. Unit Performance Sentinel (UPS). The UPS warns when the heat pump is running inefficiently.
   15. Water coil low temperature sensing (selectable for water or anti-freeze).
   16. Air coil low temperature sensing.

B. Safety devices shall be monitored and interlocked to prohibit compressor short cycling.

C. Provide identified terminal strips for low voltage terminal wiring.

D. Provide equipment for heat pump reverse cycle operation.

2.9 FILTERS

A. Filter section shall contain 1" thick disposable filters.

B. Arrange the filter section to permit filter change without unit shutdown or cabinet panel removal.
   1. Give particular attention to construction of filter section to ensure easy removal of filters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work

B. Verify that required utilities are available, in proper location, and ready for use.

C. Beginning of installation means installer accepts existing surfaces.

3.2 INSTALLATION

A. Install and start-up the system in accordance with the manufacturer's installation start-up and service instructions.

B. Locate units as indicated, level and shim units, and anchor to structure.

C. Protect units with protective covers during balance of construction.

D. Bring electrical connections to a common junction box.

3.3 CLEANING

A. Clean work.

B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

C. Install new filters.

3.4 STORAGE

A. Storage and shipping in accordance with manufacturer's recommendations.

3.5 SPARE PARTS

A. Provide the following spare parts and material to the Owner for use after the warranty period.
   1. One spare fan motor for each size of fan motor on the project.
   2. One spare set of filters or filter media for each fan coil unit on the project.

3.6 STARTUP

A. Provide the services of a factory trained service technician employed full time by the unit manufacturer to start-up the system, or manufacturer's factory authorized representative under the supervision of the factory trained service technician. Upon completion of the installation, the system shall be started and commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system. The factory authorized representative will verify that accessories are installed and performing the specified functions. (Contractor startup is unacceptable.)

B. The written startup report shall be provided to the owner and engineer upon completion.

END OF SECTION

SECTION 23 82 16

HEATING AND COOLING COILS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install heating and cooling coils.

1.2 SUBMITTALS

A. Submit manufacturer's product data sheets and unit capacity information as specified.

B. Submit manufacturer's Installation, Start-Up and Service Instructions.

C. Submit internal wiring diagram.
1. Electrical interlocks.

1.3 RELATED WORK

A. Division 23 Mechanical.
1. Air Handling Units.
2. Fan Coil Units.
3. Weatherproof Roof Mounted Air Handling Units.
4. Ductwork.
5. Terminal Boxes.

PART 2 - PRODUCTS

2.1 DIRECT EXPANSION COOLING COILS

A. DX cooling coils:
1. Constructed of copper tubes and aluminum fins.
2. Designed and circuited for use with direct expansion refrigeration.

B. Cooling coil face velocity:
1. Not of magnitude to cause moisture to be carried off the coil.
2. Maximum velocity as scheduled.

C. Circuit cooling coil with interlaced tubes so the entire face is active under all modes of unloading. Refer to the schedule on the drawings.

D. Coils shall be constructed in casings as required for installation.

E. Where coils are stacked, provide intermediate drain pans with drop tubes to drain condensate to the main drain pan without flooding the lower coil.

2.2 ELECTRIC HEATERS

A. Capacity shall be as scheduled on the drawings. Heater shall have 80% nickel, 20% chromium, open resistance coils insulated by floating ceramic bushings, and be supported in an aluminum steel frame.

B. Ceramic bushings shall be recessed into embossed openings and staked into supporting brackets spaced 3-1/2" maximum center to center.

C. Coil shall be machine-crimped into threaded terminals and insulated with phenolic bushings. All terminal hardware shall be stainless steel.

D. Heater shall be listed by the Underwriters Laboratories for zero clearance to combustible surfaces and for use with central air conditioners.

E. For primary protection, furnish a disk-type automatic reset thermal cutout for pilot duty only.

F. For secondary protection, load-carrying manual reset thermal cutouts shall be wired in series with each heater circuit. Cutouts shall be rated at 480 volts minimum.

G. Voltage, phase and number of heating stages shall be furnished in accordance with duct heater schedule. Three-phase heaters shall have single-phase circuits for operation from a 3-phase, 4-wire power source. Circuits shall be rated at 48 amperes maximum. Furnish one set of line terminals to feed all circuits. Heater shall be tested dielectrically at 2000 volts before shipment. Field-installed conductors feeding the heater shall be sized for 125% of the connected load.

H. Built-in components shall be factory wired to terminal blocks for field connection. All internal wiring shall be insulated for 105°C. Built-in magnetic contactors shall disconnect all ungrounded conductors to each circuit. Furnish heaters with an air flow switch that will not allow heaters to energize without proof of air flow. Built-in transformer shall be dry industrial type, sized to carry full contactor holding coil load. Primary windings shall be fused at the factory. Built-in fuses shall be factory wired to each circuit to protect all underground conductors. Type NON or NOS fuses to be factory installed in phenolic fuse blocks. Built-in disconnect switch to be snap action, industrial type. Provide a door interlock mechanism to prevent hinged terminal box cover from being opened when the switch is on. Switch shall be unfused.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the duct heaters in accordance with the manufacturer's Installation, Start-Up and Service Instructions.

END OF SECTION 23 82 16

SECTION 23 82 19

FAN COIL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Vertical cabinet fan coil units configured as part of a Variable Refrigerant Volume DX System.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Air Balance
   2. Controls
   3. Electrical Provisions of Mechanical Work
   4. Ductwork
   5. Air filtration

1.3 REFERENCES

A. ANSI/AHRI 410 - force circulation air cooling and air heating coils

B. National Electrical Code

1.4 SUBMITTALS

A. Submit manufacturer's dimensioned product data sheets.
   1. Show location of filter access doors.

B. Submit fan performance curve for each unit:
   1. Plot fan volume against static pressure, horsepower and efficiency.
   2. Show point of rating based on static requirements of the system.

C. Submit the fan performance plot at each motor speed position with consideration for the reduced internal static.

D. Submit a chart of specific sound power level at each octave band center frequency.

E. Submit manufacturer's certified heating and cooling coil capacity data.

F. Submit filter manufacturer's product data sheets and capacity information.

G. Submit manufacturer's data on housing insulation material.

1.5 CAPACITY

A. Refer to equipment schedule.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. Daikin

C. Trane

2.5 CABINET

A. Unit will be supplied with 1-inch, double-wall panels. The cabinet is to be thermally isolated through injected foam insulation inside each cabinet. Single wall cabinets with fiberglass insulation exposed in the airstream are not acceptable. Frame channels which allow heat conductance between the inside and outside of the cabinet are not acceptable. Base rails used for unit mounting/hanging are acceptable. Panel shall have a minimum thermal insulation of R6.

B. Insulation, vapor barriers, facings and adhesives:
   1. Flame spread not higher than 25
   2. Smoke developed rating not higher than 50

C. Condensation on the exterior of the unit is not approved.

D. Provide a duct flange on four sides of the return air inlet and supply air outlet of the unit.
   1. Sized to permit connection of the flexible connection to the ductwork
   2. Extend beyond the primary drain pan
   3. Minimum dimension 2"

E. Provide insulated, removable panels for access to the interior.
   1. Plated captive screws and nuts
   2. Neoprene gaskets

2.3 FAN SECTION

A. Supply fans shall be a DWDI forward-curved type. Fan assemblies shall be balance tested dynamically by the manufacturer. Manufacturer must ensure maximum fan RPM is below the first critical speed.

B. The complete fan assembly, including motor and main drain pan shall be easily removable.

C. Fan motor(s) assembly shall be direct-drive style and not include belts, pulleys, or sheaves.

D. Fan motor(s) shall be of Direct Current Brushless type or minimum motor efficiency of 85 percent when rated in accordance of NEMA Standard MG 1-2016 at full load conditions.

E. Manufacturer’s supply fan motor must have means to adjust motor speed for field balancing.

F. Units shall be certified in accordance with the Central Station Air Handler certification program that is based on AHRI Standard 430.

G. Supply fan must be capable of delivering 1.5" w.g. external static pressure and 3.0" w.g. total static pressure at nominal cabinet CFM.

H. Select the fan motor so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate amperage rating.

I. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.

2.6 CONDENSATE DRAIN PANS

A. IAQ style drain pans shall be provided under all coils.
   1. Pitch to drain connection
   2. Fabricated from 16 gauge 304 stainless steel
   3. Triple pitched for complete drainage with no standing water
   4. Insulated to prevent condensation
   5. Welded corners
   6. Stainless drain connection

2.7 COILS

A. Reference Schedule and Specification Section 23 82 16.

2.8 FILTER SECTION

A. Locate behind access doors.
   1. Construct with substantial hinges
   2. Neoprene gaskets
   3. Permanent quick-release latching devices

B. Arranged to accommodate the 2" thick filters as specified.
   1. Single section filter

C. Provide full length tracks to support the filter.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Provide the following spare parts and material to the Owner for use after the warranty period.
   1. One spare fan motor for each size of fan motor on the project
   2. One spare set of filters or filter media for each fan coil unit on the project

3.2 ELECTRICAL REQUIREMENTS

A. Bring electrical connections to a common junction box.

3.3 STORAGE

A. Storage and shipping in accordance with manufacturer's recommendations.

3.4 INSTALLATION

A. Install unit so motor connections and filters are accessible.

END OF SECTION

SECTION 26 01 05

ELECTRICAL OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Compile electrical product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare electrical operating and maintenance data as specified in this Section and as referenced in other sections of specifications.

B. Instruct Owner's personnel in operation and maintenance of equipment and systems.

C. Submit 3 copies of complete manual in final form.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

A. Thirty (30) days after receipt of reviewed submittals bearing the Architect / Engineer's stamp of acceptance (including re-submittals), submit for review 1 copy of the first draft of the Electrical Operating and Maintenance Manual. This copy shall contain as a minimum:
   1. Table of Contents for each element
   2. Contractor information
   3. All shop drawings, coordination drawings and product data, bearing the Architect / Engineer's stamp of acceptance.
   4. All parts and maintenance manuals for items of equipment
   5. Warranties (without starting dates)
   6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
   7. Operating and maintenance procedures.
   8. Form of Owner's Training Program Syllabus (including times and dates)
   9. Control operations / equipment wiring diagrams
   10. Coordination Drawings
   11. Schedule of Lamps, Light Engines
   12. Schedule of Ballasts and Drivers
   13. Schedule of Fuses
   14. Other required operating and maintenance information that are complete.

B. Copy will be returned to the Contractor within 15 days with comments for corrections.

C. Submit the (3) completed manuals in final form to the Architect / Engineer.
   1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
   2. Include all specified data, test reports, drawings, dated warranties, certificates, along with other materials and information.

D. The Architect / Engineer shall review the manuals for completeness within 15 days.

E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.

F. Three complete manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

A. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.

B. Minimum ring size: 1"; Maximum ring size: 3".

C. When multiple binders are used, correlate the data into related groupings.

D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 ELECTRICAL OPERATION AND MAINTENANCE MANUAL

A. Form for Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
2. Format:
a. Size: 8-1/2" x 11"
b. Text: Manufacturer's printed data or neatly typewritten.
3. Drawings:
a. Provide reinforced punched binder tab and bind in text.
b. Fold larger drawings to size of text pages.
4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
a. Title of Project
b. Identity of separate structures as applicable
c. Identity of general subject matter covered in the manual.
6. Binder as specified

B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
a. Contractor, name of responsible principal, address and telephone number
b. A list of each product required to be included, indexed to content of the volume.
c. List with each product, name, address and telephone number of:
1) Subcontractor or installer
2) Maintenance contractor as appropriate
3) Identify area of responsibility of each.
4) Local source of supply for parts and replacement
d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
a. Include those sheets pertinent to the specific product.
b. Annotate each sheet to:
1) Identify specific product or part installed.
2) Identify data applicable to installation.
3) Delete references to inapplicable information.
3. Drawings:
a. Supplement product data with drawings as necessary to illustrate:
1) Relations of component parts of equipment and systems
2) Control and flow diagrams
b. Coordinate drawings with information in Project Record Documents to assure

correct illustration of completed installation.

c. Do not use Project Record Documents as maintenance drawings.

4. Written text as required to supplement product data for the particular installation:
   a. Organize in consistent format under separate headings for different procedures.
   b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued
   a. Provide information sheet for Owner's personnel, giving:
      1) Proper procedures in event of failure
      2) Instances that might affect validity of warranties or bonds
6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
   a. Description of unit and component parts:
      1) Function, normal operating characteristics, and limiting conditions.
      2) Performance curves, engineering data and tests.
      3) Complete nomenclature and commercial number of replaceable parts.
   b. Operating procedures:
      1) Start up, break-in, routine / normal operating instructions
      2) Regulation, control, stopping, shut down and emergency instructions
      3) Summer and winter operating instructions
      4) Special operating instructions
   c. Maintenance procedures:
      1) Routine operations
      2) Guide to trouble-shooting
      3) Disassembly, repair and reassembly
      4) Alignment, adjusting and checking
      5) Routine service based on operating hours
   d. Servicing and lubrication schedule
      1) List of lubricants required
   e. Manufacturer's printed operating and maintenance instructions.
   f. Copies of typed circuit directories of panel board to reflect actual room graphics numbers and room names (not architectural room numbers from the drawings).
      1) Electrical
      2) Controls
      3) Communications
   g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      1) Predicted life of part subject to wear
      2) Items recommended to be stocked as spare parts
   h. Schedule of fuses
   i. Complete equipment field accessible internal wiring diagrams
   j. Schedule of lamps
   k. Schedule of ballasts
   l. Each Contractor's coordination drawings
   m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
   n. Other data as required under pertinent sections of the specifications
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
4. Provide complete information for products specified in Division 26.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.

8. Provide training report and certificates.

END OF SECTION

SECTION 26 05 00

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, and Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.

B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Electrical work shall comply with applicable inspection services:
1. Underwriters Laboratories
2. National Fire Protection Association
3. State Health Department
4. Local Municipal Building Inspection Department adopted codes with amendments
5. National Electrical Code with local amendments
6. State Regulatory Agencies
7. Where the project is located outside a municipal jurisdiction, and has no municipal inspection services, the National Electrical Code with amendments of the municipality with extraterritorial jurisdiction shall govern.
8. Where the project is located outside any municipal jurisdiction, including extraterritorial jurisdictions, the National Electrical Code with local adopted amendments of the largest municipality located in the same county or parish shall govern.
9. International Energy Conservation Code
10. National Electrical Safety Code

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, APWA, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date proposals are received. Referenced specifications and standards are minimum requirements for all equipment, material and work. In instances where specified capacities, size or other features of equipment, devices or materials exceed these minimums, meet specified capacities.

B. Use electrical materials and equipment that is constructed and tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized commercial standard. If materials and equipment is labeled, listed, or recognized by any Nationally-Recognized Testing Laboratory (NRTL) acceptable to the Occupational Safety and Health Administration (OSHA), then provide NRTL-labeled, listed, or recognized material and equipment. Acceptable NRTLs include but are not limited to:
1. Underwriters Laboratories, Inc. (UL)
2. Factory Mutual Research Corp. (FMRC) (also referred to as "Factory Mutual Global," or "FM Global")
3. Intertek Testing Services NA, Inc. (ITSNA, formerly ETL)
4. Canadian Standards Association (CSA)
5. A complete listing of acceptable NRTLs is published on the OSHA website at http://www.osha.gov/dts/otpca/nrtl/.

C. Where material and equipment is not labeled, listed, or recognized by any NRTL, provide a manufacturer's Certificate of Compliance indicating complete compliance of each item with applicable standards of NEMA, ANSI, ASTM, or other recognized commercial standard.

D. Do not install or use electrical material or equipment for any use other than that for which it was designed, labeled, listed, or identified unless formally approved for such use by the Owner's AHJ. This *National Electrical Code*® requirement is re-stated for emphasis.

E. Codes and Standards applicable to this Division:
1. ANSI – American National Standards Institute
   a. ANSI Z535.1, Safety Colors
   b. ANSI Z535.2, Environmental and Facility Safety Signs
   c. ANSI Z535.3, Criteria for Safety Symbols
   d. ANSI Z535.4, Product Safety Signs and Labels
2. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers:
   a. ASHRAE Standard 90.1, *Energy Standards for Buildings Except for Low Rise Residential Buildings [ANSI, IESNA]*
3. ASTM – American Society for Testing and Materials
4. CBM – Certified Ballast Manufacturers
5. ICC – International Code Council
   a. International Building Code® (IBC)
   b. International Existing Building Code® (IEBC)
6. ICEA – Insulated Cable Engineers Association
   a. ICEA S-93-639, *Shielded Power Cables 5-46kV* (NEMA WC-74)
7. IEEE® - Institute of Electronics and Electrical Engineers
   a. IEEE C2™, *National Electrical Safety Code* (NESC) [ANSI]
   b. IEEE Std 141™, *Recommended Practice for Electric Power Distribution for Industrial Plans* ("Red Book")
   c. IEEE Std 143™, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* ("Green Book")
   d. IEEE Std 241™, *Recommended Practice for Electric Power Systems in Commercial Buildings* ("Gray Book")

e. IEEE Std 242 ™, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* (“Buff Book”)
f. IEEE Std 315 ™, *Graphic Symbols for Electrical and Electronics Diagrams*
g. IEEE Std 399 ™, *Recommended Practice for Power Systems Analysis* (“Brown Book”)
h. IEEE Std 446 ™, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications* (“Orange Book”)
i. IEE Std 493 ™, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (“Gold Book”)
j. IEEE Std 519 ™, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*
k. IEEE Std 739 ™, *Recommended Practice for Energy Management in Industrial and Commercial Facilities* (“Bronze Book”)
l. IEEE Std 902 ™, *Guide for Maintenance, Operation , and Safety of Industrial and Commercial Power Systems* (“Yellow Book”)
m. IEEE Std 1015 ™, *Recommended Practice Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems* (“Blue Book”)
n. IEEE Std 11oo ™, *Recommended Practice for Powering and Grounding Electronic Equipment* (“Emerald Book”)
o. IEEE Std 1584 ™, *Guide for Performing Arc-Flash Hazard Calculations*

8. IESNA – Illuminating Engineering Society of North America
   a. IESNA *Lighting Handbook*, Ninth Edition
   b. IESNA RP-1, *American National Standard Practice for Office Lighting*
   c. IESNA RP-7, *American National Standard Practice for Lighting Industrial Facilities*
9. NECA – National Electrical Contractors Association:
   a. NECA 1, *Good Workmanship in Electrical Construction* [ANSI]
   b. NECA 90, *Recommended Practice for Commissioning Building Electrical Systems* [ANSI]
   c. NECA 100, *Symbols for Electrical Construction Drawings* [ANSI]
   d. NECA 101, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)* [ANSI]
   e. NECA 104, *Recommended Practice for Installing Aluminum Building Wire and Cable* [ANSI]
   f. NECA / NEMA 105, *Recommended Practice for Installing Metal Cable Tray Systems* [ANSI]
   g. NECA 111, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)* [ANSI]
   h. NECA / NACNA 120, *Standard for Installing Armored Cable (Type AC) and Metal-Clad Cable (Type MC)*[ANSI]
   i. NECA 202, *Recommended Practice for Installing and Maintaining Industrial Heat Tracing Systems* [ANSI]
   j. NECA 230, *Standard for Selecting, Installing and Maintaining Electric Motors and Motor Controllers* [ANSI]
   k. NECA 331, *Standard for Building and Service Entrance Grounding and Bonding*
   l. NECA 400, *Standard for Installing and Maintaining Switchboards* [ANSI]
   m. NECA 402, *Standard for Installing and Maintaining Motor Control Centers* [ANSI]
   n. NECA / EGSA 404, *Standard for Installing Generator Sets* [ANSI]
   o. NECA 407, *Recommended Practice for Installing and Maintaining Panelboards* [ANSI]
   p. NECA 408, *Recommended Practice for Installing and Maintaining Busways* [ANSI]
   q. NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers* [ANSI]

r. NECA 410, *Recommended Practice for Installing and Maintaining Liquid-Filled Transformers* [ANSI]
s. NECA 411, *Recommended Practice for Installing and Maintaining Uninterruptible Power Supplied (UPS)* (ANSI]
t. NECA 420, *Standard for Fuse Applications* [ANSI]
u. NECA 430, *Standard for Installing Medium-Voltage Metal-Clad Switchgear* [ANSI]
v. NECA / IESNA 500, *Recommended Practice for Installing Indoor Lighting Systems* [ANSI]
w. NECA / IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems* [ANSI]
x. NECA / IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems* [ANSI]
y. NECA / MACSCB 600, *Recommended Practice for Installing and Maintaining Medium-Voltage Cable* [ANSI]
z. NECA / NEMA 605, *Installing Underground Nonmetallic Utility Duct* [ANSI]

10. NEMA – National Electrical Manufacturers Association
11. NETA – International Electrical Testing Association, Inc.:
    a. NETA ATS, *Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems*
    b. NETA MTS, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*
    c. NETA ETT, *Standard for Certification of Electrical Testing Technicians* [ANSI]
12. NFPA – National Fire Protection Association:
    a. NFPA 20®, *Standard for the Installation of Stationary Pumps for Fire Protection®*
    b. NFPA 70 ™, *National Electrical Code® (NEC®)*
    c. NFPA 70E, *Standard for Electrical Safety in the Workplace.*
    d. NFPA 101®, Life Safety Code®
    e. NFPA 110, *Standard for Emergency and Standby Power Systems*
    f. NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*
    g. NFPA 780, *Standard for the Installation of Lightning Protection Systems*
    h. All other NFPA codes and standards except NFPA 5000
13. OSHA – Occupational Safety and Health Administration
14. IECC – International Energy Conservation Code
15. ISO – International Organization for Standardization
16. State and Local Energy Conservation Code
17. Applicable County and Municipal Codes

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, elevator equipment, and all other devices / appliances requiring electrical power. It is the intent of the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage and that all HVAC, elevator equipment and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.

C. It is the responsibility of the Contractor to review the construction drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and all other drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.

D. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

E. No proposal shall be accepted which specifically excludes any of the provisions of paragraphs B, C, or D above.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.

B. At conclusion of project, obtain without cost to the Owner, electronic PDF and AutoCAD 2014 and / or Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: “2 sets of CDs and prints for Owner’s use, one set of CDs, prints, and mylars for Architect / Engineers Records”. Delivery of these as-built electronic, reproducibles and prints is a condition of final acceptance.
   1. 3 sets of electronic AutoCAD (2014 dwg) and / or Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
   2. One reproducible Dayrex Mylar film positive of each contract as-built drawing.
   3. Three sets of blue-line prints of each contract as-built drawing.
   4. Three sets of pdf prints of each contract as-built drawing on CD.

C. As-Built Drawings should indicate the following information as a minimum:
   1. Indicate all addendum changes to documents.
   2. Remove Engineer’s Seal, name, address, and logo from drawings.
   3. Mark documents RECORD DRAWINGS.
   4. Clearly indicate: DOCUMENT PRODUCED BY:
   5. Indicate all changes to construction during construction. Indicate actual routing of all conduits, etc. that was deviated from construction drawings.
   6. Indicate exact location of all underground electrical raceways, and elevations.
   7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
   8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
   9. Exact location of all electrical equipment in building. Label panel schedules to indicate actual location.
   10. Exact location of all electrical equipment in and outside of the building.
   11. Exact location of all outdoor lighting poles and equipment.

12. Location, size and routing of all feeder conduits, equipment, etc. shall be accurately and neatly shown to dimension.
13. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
14. Cloud all changes.
15. Update all panel schedules with all additional circuits added or deleted through construction. Identify each circuit to include all information specified for directory cards for circuit identification in panelboards.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
1. Make final electrical connections to all electrically operated equipment indicated on the drawings, except as noted.
2. The responsibility for alignment of motor and driven equipment is specified in the related division.

F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.

G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.10 GUARANTEE

A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. Replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, materials, energy efficiency characteristics (where applicable) and lighting performance characteristics (where applicable) equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work:
   1. Obtained from utility maps and other substantially reliable sources.
   2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.

B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.15 OPERATING TESTS

A. After all electrical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.16 WARRANTIES

A. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, normal freight / shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service calls required to diagnose and correct warranty problems.

B. Manufacturer’s warranty shall be from one year from date of substantial completion. Contractor shall be responsible for extending the warranties regardless of date of installation or commissioning.

C. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.17 BUILDING CONSTRUCTION

A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager Job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.18 TEMPORARY FACILITIES

A. General: Refer to Division 1 for general requirements on temporary facilities.

B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.

C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 IDENTIFICATION OF EQUIPMENT

A. Identification of Equipment:

1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions. All panels, cabinets, or equipment requiring 120 volt or higher power shall be labeled as required which includes circuit designation and circuit panelboard location, regardless of which discipline installs the equipment.
2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit breaker, transfer switches, remote generator transfer deices not installed inside light fixtures, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack, security panels, time clocks, BMCS cabinets, sound reinforcement cabinets and racks, miscellaneous control cabinets, equipment integral disconnect switches, toggle or motor switches, disconnects for equipment, exterior junction boxes, exterior pull boxes, exterior wireways and gutters, and rooftop equipment (i.e.: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.
   a. Utility Power: White letters on black background
      Generator Power (White letters on red background
      UPS Power: White letters on blue background
      Load Bank Circuits: White letters on green background
      Solar or Wind Power Generation: White on orange background

b. Identifying nameplates shall have 1/2-inch high, engraved letters for equipment designation and ¼-inch letters indicating source circuit designation, (i.e.: "PANEL HA –fed from MDP-6 located in Mech. Rm. 100"). The words "fed from" and "located" shall be included in the labeling.

Example: Panel HA
Fed From MSB
Located Main Elec. RM 100

Example: Disconnect for Panel LK
Location: Kitchen
Fed From Transformer TLK
Located Main Elec. RM 100

c. Each switchboard, distribution panel, transfer switch, generator transfer device (GTD) for emergency lighting, and motor control center feeder or branch circuit device shall have a nameplate showing the load and location of load served in ¼-inch high, engraved letters. Circuit breaker name and kirk key designation if applicable

d. Each section of multiple section panelboards shall also indicate panelboard section number (i.e.: Panel "HA-Section 2 – fed from MDP-6 located in Mech. Rm. 100")

e. Motor Controllers, starters, and contactors: Provide neatly typed label inside each motor controller and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating.

f. Individual motor controller and contactor nameplates shall include load served, location of load served, panel and circuit numbers serving load, location of panel serving load, panel and circuit number serving control circuit, location of panel serving control circuit (if different from panel serving load), description and location (if applicable) of control controlling contactor (i.e. Controlled: Switch in RM 100, and Controlled: BMCS). Contactor nameplate is to include whether it is a lighting or receptacle contactor and name of contactor. i.e. C-1.

Lighting Contactor Example	Receptacle Contactor Example
Lighting Contactor C1 West Parking Lot Pole Lights Fed From Panel HA-2,4,6 Located Main Elec. Rm. 100 Control Circuit-Panel LA 42 Located Main Elec. Rm. 100 Controlled-BMCS	Receptacle Contactor C2 Table Recpts Lab Rm 100 Fed From Panel LA-2,4,6,8 Located Mech. Rm. 110 Control Circuit-Panel LA-42 Controlled-Emer Shut Off Mushroom Switch Rm 101
GTD Example	
Exterior lighting wall packs / north soffit / west metal canopy Fed from Panels EHA-2 located in Elec. RM 105 and HA-1 via Lighting Contactor controlled by BMCS located in Elec. RM 200.	

g. Exterior J-boxes, pull boxes, and gutters shall have panel identification, circuit numbers, and location of panel listed on name plate. Low voltage shall be identified per contents, examples: DATA, BMCS, F/A

h. Name plates on equipment served from switchboards, distribution panels, I-Line panels, and motor control centers are not to include circuit numbers shown on drawings as the circuit numbers are for construction drawing purposes only.

i. Panel names for 277/480v shall start with the letter "H" and 120/208v, 120/240v shall start with the letter "L". No panel shall be named to include a number other than multi sectional panels, example HA-section 2. New panels installed in renovation or site additions shall have names approved or designated by Owner's electrical representative. Panel names shall not include the letter "I".

Transformer names shall start with the letter "T" followed by the panel name it serves, i.e. TLA.

j. Main service ATS label shall include equipment name, emergency source and location, normal power source and location, panel served and location. Wall mounted ATS serving lighting loads shall include type of lighting and location, emergency panel and circuit ID and location of panel, normal panel and circuit ID and location of panel.

Main Service ATS Example Wall Mounted Lighting ATS Example

ATS-1	ATS
Emer Power-Emer Generator	Exterior Wall Packs/Soffit Lights
Located Chiller Yard	North/West Metal Canopy Lights
Normal Power-MSB	Fed from EHA-2
Located-Mech Rm 100	Located Mech Rm 200
Serves Panel EHA	Fed From HB-4
Located-Mech Rm 100	Located Mech Rm 150

k. Name plates shall include rated bus amperage, voltage, number of phases, number of wires and type of essential electrical system as applicable.

l. Switchgear, switchboards, panelboards, motor control centers, or service equipment available fault current labeling: Provide a 2x3 inch permanently affixed (notice) label with white lettering on contrasting blue background permanently affixed to the equipment prior to energizing the equipment. The label shall include the date of installation and the date of calculation and comply with ANSI Z535.4 current standards design and durability. The date of calculation shall be the date indicated by the Engineer of Record's seal on the Construction Documents. Example:

AVAILABLE FAULT CURRENT: ##, ### AMPS
DATE OF INSTALLATION: MM/DD/YY
DATE OF CALCULATION: MM/DD/YY

3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as "corridors". Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect's final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.

4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.

5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner's motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.

B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.

C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.

D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.

E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red for 50 volts or above electrical, or orange for communications and control with suitable warning legend describing buried electrical lines; telephone lines and data lines per APWA recommendations. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.

G. Lighting Controls and Equipment: Provide self-adhesive machine typed tape labels with ¼" high white letters on ½" tall black background for digital lighting modules as "DLM". Modules or relays located above ceiling: adhere label to bottom of ceiling T-grid below relay location. Modules or relays located in mechanical or electrical rooms or other areas other than above ceiling: Adhere label to the cover of the module or relay and identify the area they control as "MAIN GYM", "BAND HALL", or "CORRIDOR 100", etc. Remote lighting control switches or push button stations located remotely from the area they control: Adhere label to device face plate, not obstructing screw fasteners, and intuitively identify function such as "GYM LTG LOW-HIGH" or "CAFE LTG DIM", etc.

3.2 CUTTING AND PATCHING

A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.3 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
   1. Provide the training during regular working day.
   2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
   3. Refer to other specification sections for additional training and commissioning requirements.

B. Time to be allocated for instructions.
   1. Minimum of 10 hours dedicated instructor time
   2. 1 hours on each of 10 days

3. Additional instruction time for specific systems as specified in other Sections.

C. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
   1. One copy to the Owner
   2. One copy to the Architect / Engineer

D. The Owner shall provide a list of personnel to receive instructions, and shall coordinate their attendance at the agreed upon times.

E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he / she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.4 OPENINGS

A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.5 HOUSEKEEPING PADS

A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.

B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.

C. Concrete pads:
   1. 6-inches thick minimum indoors; 8-inches thick minimum outdoors, or match existing if indicated on the drawings to extend existing pads, or in other sections of the specifications.
   2. Chamfer strips at edges and corner of forms.
   3. Smooth steel trowel finish.
   4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
   5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.6 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
   1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
   2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 VANDAL RESISTANT DEVICES

A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.

B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.8 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.9 COORDINATION OF BRANCH CIRCUIT OVERCURRENT AND PROTECTION DEVICES

A. Review with equipment specified which requires electrical connections. Review equipment shop drawings and manufacturer's nameplate data and coordinate exact branch circuit overcurrent protective device and conductors with equipment provided.
   1. Provide equipment manufacturer's recommended overcurrent protective device indicated on nameplate at no additional cost to the Owner.
   2. If branch circuit conductors and / or conduit sizing is less than the minimum required by equipment manufacturer, notify the Architect / Engineer immediately, prior to rough-in.
   3. If equipment manufacturer is a substitution to the specified equipment manufacturer, provide the greater of the conductors specified or those required for the installed equipment manufacturer’s minimum circuit conductors, at no additional cost to the Owner.
   4. If conductors indicated on plans are in excess of that permitted by equipment manufacturer, notify Architect / Engineer immediately, prior to rough-in.
   5. If conductors indicated on plans are in excess of that permitted by the equipment manufacturer, provide the maximum conductors permitted by the equipment manufacturer based on NEC ampacity tables, either in a single set, or as a set of parallel conductors as permitted by the NEC. Conductor size and quantity entering the equipment enclosures shall not exceed the equipment manufacturer’s maximum recommendations.

3.10 FAULT CURRENT AND ARC FLASH STUDY FOR OVERCURRENT DEVICE COORDINATION

A. Contractor shall provide a coordination study, fault current analysis, and Arc-Flash study report for new electrical distribution equipment downstream to the last new overcurrent device in each feeder or branch circuit, conducted and prepared by the switchgear manufacturer. The coordination study and fault current analysis shall include the manufacturer's recommendations for all adjustable overcurrent devices specified or provided. Study does not require inclusion of existing switchgear, except it shall include existing or new overcurrent devices in existing switchgear serving new switchgear. Contractor shall submit the report results prior to submitting switchgear submittals to allow changes or modifications to equipment selection.

B. Contractor shall adjust all overcurrent device settings based on manufacturer's recommendations, or as directed by Owner / Architect at no additional cost to Owner. Settings for GFI shall be set at maximum as permitted by the NEC.

C. Arc-Flash & Shock-Hazard Warning Labels: Provide arc-flash and shock hazard-warning labels that comply with ANSI Z535.4 on switchgear, switchboards, transformers, motor control centers, panelboards, motor controllers, safety switches, industrial control panels and other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. On renovation projects, install arc-flash warning labels on existing equipment where lock-out / tag-out will be required for the renovation work. Provide the information listed below on each label. Specify that arc-flash warning label information be produced by the electrical equipment manufacturer or supplier as a part of the final power system studies to be submitted by the Contractor in accordance with the electrical acceptance testing.
   1. Note: In addition to the final arc-flash analysis, the final power system studies include load flow and fault-current calculations, and an overcurrent protective device (OCPD) coordination study based on the actual equipment to be installed for the project.

D. Information to be determined and applied to electrical equipment:
   1. Arc-Flash Protection Boundary
   2. Arc-Flash incident energy calculated in accordance with IEEE Std 15841 ™
   3. Working distance calculated in accordance with IEEE Std 1584a ™
   4. NFPA 70E Hazard / Risk Category Number or the appropriate personal protective equipment (PPE) for operations with doors closed and covers on.
      a. Typical operations include operating circuit breakers, fused switches, and meter selector switches.
   5. System phase-to-phase voltage
   6. Condition(s) when a shock hazard exists (e.g. "With cover off")
   7. Limited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
   8. Restricted Approach Boundary as determined from NFPA 70E, Table 130.2(C)
   9. Prohibited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
   10. Unique equipment designation or code (described under "Component Identification"
   11. Class for insulating gloves based on system voltage (e.g., Class 00 up to 500V)
   12. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000V)
   13. Date that the hazard analysis was performed.
   14. "Served from" circuit directory information including the serving equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
   15. If applicable, the "serves" circuit directory information including the served equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
   16. An abbreviated warning label may be used where it has been determined that no dangerous arc-flash hazard exists in accordance with IEEE 1584a ™, paragraph 9.2.3.
   17. Use a "DANGER" label where the calculated arc-flash incident energy exceeds 40 cal/cm.

E. Submittals: Submit four copies of coordination study and certified fault current study results to the Architect for review.

3.12 TESTING

A. The contractors for the various sub-systems shall submit proposed testing procedures for their systems, subject to review and approval and Owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.

B. The project will not be declared substantially complete until the following has taken place.
   1. The "As-Built" drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner's Construction Representative.
   2. The building emergency lighting system and other systems including but not limited to those listed below have been tested, completed factory start-up and programming and adjusting as required for a complete and fully operational system acceptable to the Architect and Owner.
      a. Overcurrent devices
      b. Motor Controllers

3.13 LOAD BALANCING

A. Balance the loads on each low-voltage feeder so that the voltage on each phase is within +/- 1.0% of the average voltage of the three phases. Refer to the DOE Office of Industrial Technologies, "Motor Tip Sheet #7" dated September 2005 available for download to PDF format at no charge at: http://www1.eere.energy.gov/industry/bestpractices/pdfs/eliminate_voltage_un_balanced_motor-systemts7.pdf

END OF SECTION

SECTION 26 05 05

ELECTRICAL ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Inspection and service of existing equipment and materials to remain or be reused.

B. Handling of equipment and materials to be abandoned.

C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

A. Coordination with the Contractor prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

A. There is the possibility that there exist conditions and devices that are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractors responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Material used to upgrade and repair existing equipment shall conform to that specified.

B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.

C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer’s approved distribution channels, shall have manufacturer’s warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Notify the Architect / Engineer, in writing, accordingly.

B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect / Engineer, in writing.

C. Verify field measurements and circuiting arrangements.

D. Verify that abandoned wiring, panelboards, and switchboards, disconnect switches, and equipment

serve only abandoned facilities. Where abandoned wiring, panelboards, switchboards, and equipment which serve existing facilities are to remain, Contractor shall provide means and methods to ensure existing facilities remain energized with the correct voltage, overcurrent protection, conductors, and circuit ampacity required by the existing facilities to remain.

E. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.

3.2 APPLICATION

A. Existing materials and equipment indicated on the drawings or in the specification to be reused shall be cleaned and reconditioned, including tightening of feeder and bus bar lugs prior to installation and reuse in the modified system.

B. Remove existing luminaries for alterations/renovations. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. For each luminarie that is taken down for alteration and then reinstalled, replace damaged parts, provide new lamps and, with matching paint, touch-up scratched or abraded areas, and replace cracked, broken or missing lenses or diffusers. Replace unrepairable fixtures with new fixtures

C. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and shall be removed from the site.

D. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner’s use.

E. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner.

F. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.

G. Clean and repair existing materials and equipment that remain or are to be reused.

H. Panelboards Reused and Modified for Renovation: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.3 SEQUENCING AND SCHEDULING

A. Coordinate utility service outages with Utility Company, Architect and Owner.

B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.

C. Existing Electrical Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain written permission from Owner at least 10 business days before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Disclose the extent, exact time and expected duration of the outage in a written request to the Owner.

D. Remove and replace existing conduit, wiring, outlets, devices, lighting fixtures, panels and appurtenances as occasioned by new or remodeled construction. Re-establish service to lights, switches and devices that may be interrupted by remodeled construction.

E. Disconnect electrical systems in walls, floors and ceilings scheduled for removal. When outlets are removed, wire shall be pulled out of the conduit back to the nearest remaining box or cabinet.
1. Remove exposed conduit that has been abandoned.
2. Cap conduit beyond the finish line.
3. Provide unswitched circuit leg for emergency battery powered equipment; circuit from same branch circuit breaker as switched normal lighting circuit.

F. Where new/existing luminaries or devices are shown being connected to existing circuits:
1. Field verify existing system voltage
2. Provide ballast / device to match system voltage

G. Verify the loading of each circuit affected by remodeling work. The maximum load of any branch circuit shall not exceed 80% of its rating.

H. Remove equipment, systems, conductors, wiring, raceways, etc. abandoned or not required for existing or new systems. Coordinate with Architect / Owner for salvage by Owner. Remove abandoned / not required raceways and wiring back to nearest box serving load to remain, or back to panel if not serving remaining load.

I. Existing Power, and Lighting and Appliance Branch Circuit Distribution System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

J. Existing Lighting System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

K. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

L. Existing Telephone System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and Telephone Company at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

M. Existing Paging and Sound Reinforcement Systems: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

N. Existing Data Network: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

O. Existing Video Distribution System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or

completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

P. Existing Security System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

Q. Existing Video Surveillance System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

1. Remove abandoned electrical distribution equipment, utilization equipment, outlets and accessible portions of wiring, raceway systems, and cables back to the source panelboard, switchboard, switchgear, communications closet, or cabinet. Abandoned wiring and raceways can result from actions that include the following:
    a. Equipment is removed or relocated
    b. Fixtures are removed or relocated
    c. System is no longer used
    d. There is no demonstrable near term future use for the existing circuit or raceway system.
2. Leave abandoned electrical equipment, conductors, and material in place only if one or more of the following conditions exist:
    a. The removal requires the demolition of other structures, finishes, or equipment that is still in use. An example is abandoned conduit above an existing plaster ceiling.
    b. Removal is not feasible due to hazards, construction methods, or restricted access.
    c. Removal of abandoned conductors may damage conductors that must remain operational.
3. Remove conduits, including those above accessible ceilings, to the point that building construction, earth, or paving covers them. Cut conduit beneath or flush with building construction or paving. Plug, cap, or seal the remaining unused conduits. Install blank covers for abandoned boxes and enclosures not removed.
4. Extend existing equipment connections using material and methods compatible with the existing electrical installation and this division.
5. Restore the original fire rating of floors, walls, and ceilings after electrical demolition.
6. Use approved lock-out / tag-out procedures to control hazardous energy sources. Assure that an electrically safe work condition exists in the demolition area before beginning demolition. Where possible, disconnect the building from all sources of electrical power before beginning demolition.

B. All items to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore them to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.

D. Conduit and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Conduit and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed. Replace existing wiring devices and cover plates with new wiring devices and new cover plates in renovated areas. Any corridor, room, or area indicated to have any new wiring devices installed shall have all of the existing wiring devices and cover plates replaced with new wiring devices and new cover plates.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

K. Existing conduit raceway found to need additional hangers installed and/or junction box covers shall be added at no additional cost to the Owner.

L. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

3.5 PROTECTION OF THE WORK

A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.

B. Provide devices and methods to protect other portions of work from damage.

C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

A. Identification of Equipment: Provide new, typed panel directory cards (and card holders if needed) for existing panelboards located within the renovated areas. Ring out all new and existing circuits within these panelboards as specified in Section 26 05 00 Electrical General Provisions. Do not include the description “existing”. Provide new nameplates for all existing electrical equipment in renovated areas as specified in Section 26 05 00 Electrical General Provisions.

3.7 CORRECTIVE MEASURES FOR DAMAGE DURING CONSTRUCTION IN EXISTING LOW VOLTAGE SYSTEMS

A. Repairs, equipment replacements, and corrections to low voltage systems due to damage caused by contractor:
   1. Notify the Owner immediately of any disruption or damage to any low voltage system.
   2. Any disruption or damage to the existing access control system or fire alarm system shall be corrected the same day as the disruption or damage occurred. The access control system and fire alarm system shall be tested daily in the presence of the owner prior to the Contractor leaving the job site each day.
   3. For each low voltage system other than access control or fire alarm system, a manufacturer certified contractor and certified technicians shall perform corrective measures to each system component that was functional prior to demolition and renovation and found defective or non-functional within 14-days prior to estimated date of substantial completion.
   4. Corrective measures to all low voltage systems to correct components of the low voltage systems found damaged by the contractor shall be completed to the satisfaction of the Owner and Architect / Engineer prior to acceptance of substantial completion at no additional cost to the Owner.

END OF SECTION

SECTION 26 05 10

CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents. Submit a narrative outline of the Quality Control Program or Plan.

1.3 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. There shall be on-site supervision at all times, including punch list work, with that person having a minimum of journeyman license. Helpers, apprentices shall have a minimum of apprentice license.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes matching approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide manufacturer’s qualified personnel to observe:
   1. Field conditions
   2. Condition of installation
   3. Quality of workmanship
   4. Start-up of equipment
   5. Testing, adjusting, and balancing of equipment

B. Manufacturer’s qualified personnel shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL

A. Comply with recognized National rating and approval agencies as well as all codes and ordinances at the federal, state and city levels.

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

A. Contractor shall provide all adjustments and modifications as requested by the manufacturer’s qualified personnel at no additional cost to Owner.

B. Coordination Drawings:
1. Electrical room size and location required and to scale
2. Equipment and accessories, switchgear and piping
3. Indicate clearances and service access.

3.2 ELECTRICAL ACCEPTANCE TESTING

A. Perform electrical acceptance testing and inspections in accordance with the current edition of the International Electrical Testing Association (NETA), *Acceptance Testing Specification* (ATS).

B. Perform acceptance testing, inspection, function tests, and calibration to assure that installed electrical systems and components, both Contractor and user-supplied are:
1. Installed in accordance with design documents and manufacturer’s instructions.
2. Tested and inspected in accordance with applicable codes and standards (e.g. NFPA 110 and NFPA 111).
3. Ready to be energized.
4. Operational within industry and manufacturer’s tolerances.

3.3 INSPECTIONS BY LOCAL AUTHORITY HAVING JURISDICTION (AHJ)

A. Contractor shall notify design prime consultant and associated Architect / Owner’s Construction Manager when he requests an inspection by the AHJ.

END OF SECTION

SECTION 26 05 12

ELECTRICAL SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by Division 1 and as outlined below.

B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.

C. The term submittal, as used herein, refers to all:
1. Shop Drawings
2. Coordination Drawings
3. Product data

D. Submittals shall be prepared and produced for:
1. Distribution as specified
2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

A. The Architect / Engineer will:
1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
3. Return submittals to Contractor for distribution or for resubmission

B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.3 SUBSTITUTIONS

A. Do not make requests for substitution employing the procedures of this Section.

B. The procedure for making a formal request for substitution is specified in Division 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SPECIFICATION COMPLIANCE REVIEW

A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

3.2 COMPOSITE COORDINATION DRAWINGS

A. Produce a set of composite coordinate drawings for review and comment within four (4) weeks of receipt of Owner's official Notice to Proceed. Show coordination of structural and architectural elements with HVAC piping, ductwork, mechanical equipment, electrical conduit, low voltage systems cabling, lighting, electrical switchgear and panels, security and CCTV systems, domestic water piping, roof drains and storm sewer piping, sanitary sewer piping and fire sprinkler piping and a composite above-ceiling plan, below slab coordination drawings, and a composite mechanical and electrical equipment room floor plan.
   1. Prepare the composite plans at one-quarter inch (1/4") equals one-foot scale. Include larger scale sections with vertical elevations of elements as required to confirm coordinate of all elements.
   2. For each room containing major electrical switchgear and each outside equipment area with major electrical switchgear and other equipment also include NEC working space, NEC equipment space, and NEC access to NEC working space, and housekeeping pad location and dimensions.
   3. Prepare coordination drawings to coordinate installations for efficient use of available space allowing for future additional equipment wherever possible, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
   4. Identify field dimensions. Show relation to adjacent or critical features of work or products.

B. Submit composite coordination shop drawings in plan, elevation and sections, showing receptacles, outlets, electrical and telecommunication devices in casework, cabinetwork and built-in furniture.
   1. Verify location of wiring devices and outlets, communication devices and outlets, safety and security devices, and other work specified in this Division.
   2. Coordinate with drawing details, site conditions, composite coordination drawings, and millwork other equipment shop drawings prior to installation.
   3. Submit coordination and shop drawings prior to rough-in and fabrication.

3.3 EQUIPMENT SHOP DRAWINGS AND PRODUCT DATA

A. Submittals shall not be combined or bound together with any other material submittal.

B. Submittal Specification Information:
   1. Every submittal document shall bear the following information as used in the project manual:
      a. The related specification section number
      b. The exact specification section title
   2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

C. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.

D. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.

E. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.

F. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

G. Submit drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

H. Show all dimensions of each item of equipment in its to be installed assembled condition with all components assembled. Include a series of drawings of individual components as necessary for reference.

I. Identify field dimensions; show relation to adjacent or critical features or work or products.

J. Submit individually bound shop drawings and product data for the following when specified or provided. The Fault Current and Overcurrent Device Coordination Analysis shall be submitted prior to other switchgear.
1. Fault Current and Overcurrent Device Coordination Analysis. Submit this analysis three (3) weeks prior to any overcurrent device submittal to allow modifications to overcurrent device product selection submittal based on the manufacture’s analysis and recommendations at no additional cost to the Owner.
2. Enclosed Switches and Circuit Breakers
3. Enclosed Motor Controllers
4. Panelboards, load centers, and enclosures
5. Wiring devices
6. Lighting fixtures
7. Lighting Controls and Occupancy Sensors
8. Surge Protection Devices
9. Site Lighting Poles, Fixtures, Drivers, and Lamps
10. Electrical controls and time switches
11. Electrical Contactors
12. Modifications to existing motor control centers
13. Transformers
14. New circuit breakers for existing switchboards

3.4 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

3.5 CONTRACTOR RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
1. Field measurements
2. Field construction criteria

3. Manufacturer's catalog numbers
4. Conformance with requirements of Contract Documents

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations identified by the Contractor on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
1. Proper sizes and capacities
2. That the item will fit in the available space in a manner that will allow proper service
3. Construction methods, materials and finishes

I. Schedule submissions at least 15 days before date reviewed submittals will be needed by the Contractor for processing or for making corrections for re-submittal.

J. Contractor’s Stamp of Approval
1. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
2. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
3. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
4. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

3.6 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor. Product and equipment related to site work or other trades which require extensive rough-in, foundations, or structural support shall be submitted as soon as possible after given notice to proceed with construction.

B. Number of submittals required:
1. Shop Drawings and Coordination Drawings: Submit one electronic data file (pdf) and three opaque reproductions.
2. Product Data: Submit the number of copies the contractor requires, plus those to be

retained by the Architect / Engineer, and/or electronic data (pdf) files.

C. Accompany submittals with transmittal letter, in duplicate, containing:
   1. Date
   2. Project title and number
   3. Contractor's name, address and telephone number
   4. The number of each Shop Drawing, Project Datum and Sample submitted
   5. Other pertinent data

D. Submittals shall include:
   1. The date of submission
   2. The project title and number
   3. Contract Identification
   4. The names of:
      a. Contractor
      b. Subcontractor
      c. Supplier
      d. Manufacturer
   5. Identification of the product
   6. Field dimensions, clearly identified as such
   7. Relation to adjacent or critical features of the work or materials
   8. Applicable standards, such as ASTM or federal specifications numbers
   9. Identification of deviations from contract documents
   10. Suitable blank space for General Contractor and Architect / Engineer stamps
   11. Contractor's signed and dated Stamp of Approval

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
   1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
   2. Associated items requiring correlation for efficient function or for installation

3.7 RESUBMISSION REQUIREMENTS

A. Make resubmittals under procedures specified for initial submittals. Re-submittals shall be a complete submittal as if it were the initial submittal unless otherwise instructed in the review comments on the original submittal.
   1. Indicate that the document or sample is a resubmittal
   2. Identify changes made since previous submittals

B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

END OF SECTION

SECTION 26 05 19

CONDUCTORS AND CONNECTORS – 600 VOLT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical conductors, wire and connector work as shown, and specified.

B. Types: The types of conductors and connectors required for the project include the following:
1. 600V building conductors
2. 600V building conductor connectors

C. Application: The applications for conductors and connectors required on the project are as follows:
1. Power distribution circuitry
2. Lighting branch circuitry
3. Appliance, receptacle, and equipment branch circuitry
4. Motor branch circuitry
5. Control wiring
6. Line voltage

D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

1.2 QUALITY ASSURANCE

A. UL Label: Conductors and connectors shall be UL labeled.

1.3 REFERENCES

A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 – PRODUCTS – Provide products manufactured in the USA

2.1 CONDUCTORS AND CONNECTORS

A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.

B. Cable Lubricant: Fire resistant, nonflammable, water-based type for standard building conductors. Provide cable lubricants for fire rated cables as recommended by the cable manufacturer.

C. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.

D. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.

1. All wiring inside lighting fixtures shall be temperature rated per NEC.
2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.

2.2 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

A. Color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and local standards. Where such standards do not exist, color coding shall be as follows:

Color Code Table	**USE CONTINUOUS COLOR CODED INSULATION THROUGHOUT**					
System/ Phase	**A**	**B**	**C**	**N**	**G**	**IG**
120/208 3 Ph	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240 3 Ph	Black	Orange	Blue	White	Green	Green/Yellow Stripe
120/240 1 Ph	Black	N/A	Blue			
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Notes to Color Code Table:
1. 120/208, 120/240, and 277/480 Volt Systems shall be routed in separate raceways.
2. Switched legs of phase conductors for lighting and appliance branch circuits shall be of the same color as described above throughout the entire circuit.
3. Conductors shall be the same color from breaker to device or outlet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.

B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.

C. Conductors:
1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
2. No more than six phase conductors shall be installed in a single raceway. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
4. When more than four (4) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
5. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
6. Before any conductor is pulled into any conduit, thoroughly swab the conduit to remove foreign material and to permit the wire to be pulled into a clean, dry conduit.

7. Run feeders their entire length in continuous section without joints or splices.
8. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
9. Provide the same size wire form the panelboard to last outlet on circuit. For 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
10. Branch circuit voltage drop shall not exceed 3% of rated voltage.
    a. Total voltage drop from the point of service to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
    b. Total voltage drop from the point of service to transformers with adjustable taps, buck-boost transformers, uninterruptable power supplies (UPS), or voltage regulators shall not exceed five-percent of rated voltage.
    c. Total voltage drop from a separately derived system, transformer with adjustable taps, buck-boost transformer, uninterruptable power supply (UPS), or voltage regulator to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
    d. Total voltage drop from the point of service to distribution equipment of the same voltage shall not exceed two-percent of rated voltage.
    e. Branch circuit voltage drop from distribution equipment to the last outlet or utilization equipment shall not exceed three-percent of rated voltage.
    f. Provide the same size branch circuit conductors to last outlet on circuit unless specifically noted or indicated otherwise on the drawings. For 20 amp branch circuits operating at 150-Volts or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating above 150-Volts to 600-Volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
11. No tap or splice shall be made in any conductor except in outlet boxes, pull boxes, junction boxes, splice boxes, or other accessible locations. Make taps and splices using an approved compression connector. Insulate taps and splices equal to the adjoining conductor. Make splices or taps only on conductors that are a component part of a single circuit, protected by approved methods. Taps or splices in feed through branch circuits for connection to light switches or receptacles shall be made by pigtail connection to the device.
12. Support conductors in vertical raceways, as required by the NEC.
13. Do not permit conductors entering or leaving a junction or pull box to deflect to create pressure on the conductor insulation.
14. Make joints in branch circuits only where circuits divide. These shall consist of one through circuit to which the branch from the circuit shall be spliced.
15. Make connections in conductors up to a maximum of one #6 AWG wire with two #8 AWG wires using twist-on pressure connectors of required size.
16. Make connections in conductors or combinations of conductors larger than specified using cable fittings of type and size required for specific duty.
17. After a splice is made, insulate entire assembly with UL-approved insulating tape to a value equivalent to the adjacent insulation.
18. Make splices and connections in control circuit conductors using UL-approved solderless crimp connectors.
19. All conduits shall be installed with an insulated grounding conductor per NEC 250.122. Where green conductor insulation is not available, the ground conductor shall be identified with green phasing tape at all accessible locations.
20. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
21. Clean conductor surfaces before installing lugs and connectors.
22. Make splices, taps and terminations to carry full ampacity of conductors with no

perceptible temperature rise.

23. Provide stranded conductors connected with pressure type connectors / compression fittings and terminal lugs UL listed for the type of conductor used (AL-CU) and correctly sized to the diameter of the bare conductors.
24. Run mains and feeders their entire length in continuous pieces without splices or joints.
25. Color code conductors.
26. Do not install a pull string in conduits containing conductors.
27. Conductors shall be the same color from load side of overcurrent protection device to outlet or utilization equipment.
28. Spare conductors shall not be installed in any conduit, gutter, raceway, panel or enclosure unless noted otherwise.

D. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.

E. Splices and Joints:
1. In accordance with UL 486A, C, D, E, and NEC.
2. Aboveground Circuits (No. 10 AWG and smaller):
   a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220˚ F, with integral insulation, approved for copper and aluminum conductors.
   b. The integral insulator shall have a skirt to completely cover the stripped wires.
   c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
3. Motor connections:
   a. All AHU motors connections shall be split bolt connectors.
   b. All non-AHU motors 10 HP and larger shall be split bolt connectors.
   c. All non-AHU motors less than 10 HP shall be split bolt connectors or as recommended by the manufacturer.

F. Aboveground Circuits (No. 8 AWG and larger):
1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

G. Underground Branch Circuits and Feeders:
1. Submersible connectors in accordance with UL 486D, rated 600 V, 190˚F, with integral insulation.

3.2 TESTING

A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.

B. Service Entrance and Feeder Insulation Resistance Test: Each main service entrance conductor and each feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination. Testing shall be performed by qualified technicians who have been trained in testing procedures and in the use of all test equipment.
1. Make tests using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 VDC; measure resistance from conductor to conductor, conductor to neutral (if

present) and from conductor to ground. Insulation resistance shall not be less than the following:

Wire Size (AWG)	Insulation Resistance (Ohms)
#8	250 K
#6 through #2	100 K
#1 through #4/0	50 K
Larger than #4/0	25 K

2. Conductors that do not meet or exceed the insulation resistance values listed above shall be removed, replaced, and retested.

C. Submittals: Contractor shall furnish instruments and personnel required for tests. Submit 4 copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, relative humidity, temperature, and weather conditions.

D. Voltage and Current Values: The voltage and current in each conductor shall be measured and recorded after connections have been made and the conductor is under load.

SAMPLE DC HIGH VOLTAGE CABLE TEST REPORT
(Specification Paragraph 3.2, C)

Date_____

Contract and Work Location: _____
Contract (Project) No.: ___
Circuit Identification: _____
(Dwg., Title, Number and Ckt. Number)

Test Equipment: _
(Make, Model, Serial No., Etc.)
Applied Test Voltage _____
Normal Oper. Voltage _____
Cable Installation: New _____ Used _____
(Date) (No. Years)
Cable Size _____AWG
Cable Length _____Ft.
Cable Material _____Cu _____AI
Temperature _____ Humidity _____

TEST DATA - RESISTANCE IN KILO OHMS

CONDUCTOR PER PHASE	A-N	B-N	C-N	A-G	B-G	C-G	A-B	B-C	A-C

END OF SECTION

SECTION 26 05 27

EXPANSION OF EXISTING ELECTRICAL GROUNDING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Grounding shall conform to the requirements of:
   1. National Electrical Code
   2. Governing local codes
   3. Local Utility Company

B. Ground effectively and permanently.
   1. Verify existing neutral conductor bonding at the main service disconnect and at other new/relocated or reused separately derived systems.
   2. All new/relocated conduit or cable tray systems and busway
   3. All new/relocated electrical equipment and related current carrying supports or structures
   4. All new / relocated metal piping systems
   5. All new building structural metal frames

1.2 REFERENCE STANDARDS

A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."

B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."

C. Article 250 of the NEC (NFPA 70) for grounding.

D. NECA – Standard of Installation

E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

F. EIA / TIA 607

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Copperweld

B. nVent ERICO

C. Burndy

D. O.Z. Gedney

E. Eaton

2.2 GROUNDING ELECTRODES

A. Driven Rod Electrode
   1. 3/4" x 10'-0" copper clad grounding electrode, UL listed
   2. UL listed grounding electrode connector

3. Approved thermal fusion methods (exothermic)

B. Metal Frame of Building

C. Existing grounding electrode system

2.3 DRIVEN ELECTRODE ACCESS BOX AND COVER

A. Hubbell Tier 22 FRP 20-inch round bolt down cover with “GROUND” embossed on top.

2.4 MATERIALS AND COMPONENTS

A. Reference other sections of this specifications for materials specified there.

B. Heavy-duty, copper, two bolt type, copper alloy or bronze compression lugs for grounding and bonding applications, in configurations required for particular installation.

PART 3 - EXECUTION

3.1 SYSTEMS 600 VOLTS OR LESS

A. In the existing service equipment, field verify existing condition of ground bus.
   1. Field verify existing bond of the ground bus to the existing service grounding conductor, to the neutral bar.
   2. Tighten existing ground lugs and connections.

B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
   1. In rigid PVC conduit.
   2. Provide thermo fusion connection for each rod ground electrode.
      a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
      b. Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
      c. The minimum distance between driven ground rod electrodes shall be 10'.
   3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and for equipment grounds.
      a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
      b. Refer to drawings for project specific ground resistance requirements.

C. Field verify the grounding electrode conductor between the ground bus and the grounding electrode systems are in compliance with the NEC.

D. Provide an insulated grounding conductor inside all new conduits, raceways, surface raceways and cables used for power distribution. The ground wire shall be bonded to each box. All bonding jumpers shall be routed inside conduit or raceway.

E. Provide an insulated, isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and receptacles.

F. Provide all new/relocated conduits terminating in switchgear, transformers, switchboards, and panelboards with grounding bushings, where required and ground wire extended to ground bus in equipment.

G. Where modifications to the main service disconnect are required, main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.

H. Interface with lightning protection system when lightning protection system is specified.

I. Locate and install anchors, fasteners, and supports in accordance with NECA “Standard of Installation”.

J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

K. Do not use spring steel clips and clamps.

L. Do not use powder-actuated anchors.

M. Do not drill or cut structural members.

N. Do not use compression or mechanical connectors underground.

3.2 MISCELLANEOUS REQUIREMENTS

A. Continuity of the building equipment grounding system shall be maintained throughout the project. Grounding jumpers shall be inside conduit, fittings and boxes and shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6', and other non-electrically continuous raceway fittings.

B. Grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable PVC raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.

C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.

E. Ground new and removed/replaced lighting fixture bodies to the conduit grounding system.

F. Receptacles: Provide a ground wire bonded to the conduit ground system, except where and insulated isolated grounding receptacle is specified.

G. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire around flexible conduit.

H. Provide grounding access well for each new driven ground electrode, not located in manholes or pull boxes.
   1. Access well top shall be flush with finish paved surfaces.
   2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.
   3. Provide thermal fusion (exothermic) connectors approved for direct burial.

J. Exterior Electrical Equipment Racks:
   1. Provide driven ground electrode for racks mounted remote from building structure.
   2. Where mounted on roof, ground to be building structural steel.

K. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).

3.3 COORDINATION

A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

END OF SECTION

SECTION 26 05 33

CONDUIT SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a complete system of electrical conduits and fittings.

1.2 REFERENCE STANDARDS

A. National Electrical Code

B. Local codes and ordinances

C. UL

D. ETL

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – Provide products manufactured in the USA

A. Raceways:
1. Allied, International Metal Hose, Ipex, Heritage Plastics, Wheatland, Can-Tex, Carlon, Certain-Teed, Anamet, Inc., Electri-Flex Co., Western Tube and Conduit
2. PVC Coated RGC: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions
3. Stainless Steel: Robroy, Calbrite, Gibson
4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products
5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass, United Fiberglass

B. Fittings:
1. Appleton, Crouse Hinds, Topaz, Steel City, O.Z. Gedney, Carlon, Heritage Plastics, Raco, Ipex, International Metal Hose, Lew Electric Fittings Co.
2. PVC Coated ferrous fittings: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions
3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds
4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products
5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass

C. Condulets and Conduit Bodies:
1. Appleton, Form 85
2. PVC Coated: Robroy Perma-cote or Plasti-Bond, – no exceptions
3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds
4. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass

D. Steel MC Cable for light fixture whips:
1. AFC
2. Southwire
3. General Cable

4. Kaf-Tech

2.2 GENERAL

A. The minimum conduit size shall be ¾-inch unless indicated otherwise in Divisions 26, 27 or 28.
   1. Branch Circuits: Minimum conduit size shall be ¾-inch.
   2. Feeder Circuits: Minimum conduit size shall be ¾-inches.
   3. Technology, telecommunications, and low voltage systems: The minimum conduit size shall be ¾-inches unless noted or indicated otherwise.
   4. The minimum conduit size between buildings for technology, voice, data, fire alarm, video, security, surveillance, BMCS, and other telecommunications shall be 2-inch unless indicated otherwise.

B. The minimum conduit size for flexible metallic conduit for tap connections to individual light fixtures shall be ½ inch, or steel metal clad (MC) cable with insulated ground conductor maximum 6 feet.

C. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing shall not be used on this project.

D. BX and AC cable shall not be used on this project.

E. PVC elbows shall not be used on this project.

F. Intermediate metal conduit (IMC) shall not be used on this project.

2.3 RIGID METAL CONDUIT

A. UL labeled, Schedule 40:
   1. Mild steel pipe, zinc coated inside and out
   2. Aluminum Alloy 6063, T-1 temper
   3. Threaded ends
   4. Insulated bushings

B. Fittings shall meet the same requirements as rigid metal conduits.
   1. UL labeled
   2. Threaded fittings

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. UL labeled, standard weight:
   1. Cold rolled steel tubing, zinc coated inside and out
   2. Aluminum Alloy 6005, 6063. Temper T-1

B. Fittings shall meet the same requirements as EMT conduits.
   1. UL labeled
   2. Insulated throat connectors
   3. Steel fittings with setscrews with lock nuts on threaded ends, no snap locks
   4. Cast metal fittings are not approved
   5. Uni-couple type connectors are not approved
   6. Split ring, anti-short bushings are not approved

2.5 RTRC CONDUIT FITTINGS AND CONDUIT BODIES

A. UL listed

B. Standard wall thickness sizes ¼-inch through 4-inch

C. Underground medium wall thickness sizes 5 and 6-inch

D. Conduit interface joints above grade, gasket joint below grade

E. Extra heavy wall for above ground and/or UL Class 1 Division 2 and Class 1 Zone 2 applications.

2.6 PVC COATED RIGID STEEL WITH URETHANE INTERIOR COATING

A. The PVC coated galvanized rigid conduit and fittings must be ETL Listed and Verified. The PVC coating must have been investigated and verified by ETL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be ETL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed for the hazard conditions to which they are to be used. All conduit and fittings must be new, unused material. Applicable UL standards may include UL 6 Standard for Safety, Rigid Metal Conduit, and UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.

B. The PVC coated galvanized rigid conduit and fittings must be ETL Verified to the Intertek ETL SEMKO High Temperature H_2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

C. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.

D. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.

E. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.

F. Form 8 Condulets, ½-inch through 2-inch diameters, shall have a tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum) for 72 hours shall be available.

G. Form 8 Condulets shall be supplied with plastic encapsulated stainless-steel cover screws.

H. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.

I. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).

J. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.

K. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.

L. Independent certified test results shall be available to confirm coating adhesion under the following conditions
   1. Conduit and condulet exposure to 150°F (65°C) and 95% relative humidity with a

minimum mean time to failure of 30 days. (ASTM D1151)

2. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
3. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
4. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.

M. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts shall be provided with plastic encapsulated nuts that cover the exposed portions of the threads.

N. All fittings, clamps, straps, struts, and hardware used with PVC coated conduit shall be PVC coated or 316 stainless steel

2.7 STEEL FLEXIBLE CONDUIT

A. Steel flexible metallic conduit:
   1. Zinc coated inside and out
   2. 18-inches minimum length, 24-inches maximum length

B. Steel flexible metallic conduit for tap connections to light fixtures where steel MC Cable fixture whips are not used:
   1. 18 inches minimum length; 6 feet maximum length

C. Liquid tight flexible steel conduit
   1. Type L.A. - Grounded - UL Approved
   2. 18-inches minimum length, 24-inches maximum length

2.8 PVC CONDUIT

A. UL labeled Schedule 40 and Schedule 80

B. PVC fittings and solvent welded joints

C. Acceptable PVC condulet manufacturer: Ipex, Cantex

2.9 CONDULETS AND CONDUIT BODIES

A. UL Labeled

B. Form 85

C. PVC Coated: Form 8

D. LBC Condulets shall be used for size 2 inch and above.

E. LL and LR Condulets shall not be used for 2 inch and above

2.10 ROOF MOUNTED CONDUIT AND BOX SUPPORTS

A. Conduit supports and pads suitable for direct sunlight, conduit size, weight, quantity and roof system with unistrut supports and accessories. Conduit supports shall allow for conduit expansion and contraction.

B. Refer to roofing specifications for additional information. The limitations and restrictions contained in any roofing specification shall prevail and supercede these specifications for roof mounted supports for conduits and boxes.

C. Approved Manufacturer:
   1. Portable Pipe Hangers
   2. Eaton B-Line
   3. Miro Industries, Inc.

2.11 ALUMINUM CONDUIT

A. UL Labeled

B. Aluminum fittings shall meet the same requirements of aluminum conduits, compatible steel fittings.
   1. UL Labeled for use with aluminum conduit.

2.12 STAINLESS STEEL CONDUIT

A. UL Labeled

B. Rigid Stainless Steel:
   1. Type 304 Stainless Steel
   2. Threaded ends
   3. Insulated Bushings

C. EMT:
   1. Type 304 Stainless Steel
   2. Compression Fittings
   3. Insulated Bushings

D. Fittings, elbows, nipples, strut, device box, clamps straps, etc.
   1. Type 304 Stainless Steel

2.13 ELECTRICAL NON-METALLIC TUBING (ENT)

A. UL labeled Schedule 40

B. PVC fittings and solvent welded joints

C. Acceptable manufacture: Carlon

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electrical conduits and fittings for all wiring of any type unless specifically specified or instructed to do otherwise. Install conduits and fittings in accordance with local codes and applicable sections of the NECA “Standard of Installation”, concealed where possible.
   1. Fasten conduit supports to building structure and surfaces; do not support to roof deck.
   2. Arrange supports to prevent misalignment during wiring installation.
   3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
   4. Do not attach conduit to ceiling support wires.
   5. Arrange conduit to maintain head room and present neat appearance.
   6. Maintain 4-inch clearance between conduit and rooftop surfaces.

7. Cut conduit square using saw or pipe cutter; de-burr cut ends.
8. Bring conduit to shoulder of fittings; fasten securely.
9. Conduit penetrations to all individual motor controllers, VFDs, and motor control cabinets shall only be made at the bottom of the enclosure. For other equipment, provide listed water sealing conduit hubs to fasten conduit to sides or tops of electrical equipment enclosures, device box, gutter, wireway, disconnect, etc.
10. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
11. Ground and bond conduit as required.
12. Identify conduit as required.
13. Route all conduits above building slab perpendicular or parallel to building lines.
14. Do not use no-thread couplings and connectors for galvanized steel, PVC coated galvanized steel, or aluminum rigid conduit.

B. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

C. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.

D. Securely fasten conduits, supports and boxes, to ceiling (not roof deck), walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.

E. Provide separate raceway systems for each of the following when specified, indicated or required:
1. 120/208 volt circuits
2. 277/480 volt circuits
3. Emergency
    a. Life safety branch
    b. Critical branch
    c. Equipment branch
4. Voice/Data
5. Sound reinforcement
6. Theatrical and Architectural Dimming Controls
7. MATV/CATV
8. Security CCTV
9. Security System
10. Communications / PA Systems / Sound System Line Input and Speakers
11. Fire Alarm
12. Lighting and Building Management Control Systems

F. Unless shown otherwise, do not install conduit in or below concrete building slabs.

G. Unless shown otherwise, do not install conduit horizontally in concrete slabs.

H. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing. Conduit for equipment mounted on roof curbs shall be routed through the roof curb. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise. Where specifically indicated to be routed or mounted on the roof, supports shall be as specified, as recommended by roofing manufacturer and roof support manufacturer and as required by NEC. Place supports every five feet along conduit run and within 3 feet of all bends, condulets, and junction boxes. Provide roofing pad under stands at directed by Architect and as recommended by roofing manufacturer and roof support manufacturer. Provide additional unistrut supports and accessories as required.

I. PVC coated conduit shall have all nicks and cuts to the protective coating repaired using manufacturer's approved touch-up material as recommended by manufacturer. Provide a minimum of two-wraps of 3M-50 type tape over touch-up.

J. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit. Submit copies of training certification with submittal. Contractor shall coordinate installation with manufacturer's representative for field training and observation of installed PVC coated rigid galvanized conduit and fittings. Manufacturer's representative shall certify the installation is in accordance with manufacturer's installation instructions. Submit copies of installation certification prior to cover-up of underground installation.

K. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
1. Provide insulated throat connectors for EMT conduits.
2. Provide insulated bushing on all rigid conduit terminations.
3. Provide locknuts inside and outside of all boxes and enclosures.
4. Provide threaded type plastic bushing at all boxes and enclosures

L. In suspended ceilings, support conduit runs from the structure, not the ceiling system construction.
1. Do not support from structural bridging.
2. Do not support from metal roof deck.

M. Completely install each conduit run prior to pulling conductors. All boxes are to be accessible after completion of construction.

N. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pours.

O. Ream ends of conduits after cutting and application of cutting die to remove rough edges.

P. Install all above concrete slab conduits perpendicular or parallel to building lines in the most direct, neat and workmanlike manner.
1. Cable Tension:
   a. 0.008 lb./cmil for up to 3 conductors, not to exceed 10,000 pounds.
   b. 0.0064 lb./cmil for more than 3 conductors, not to exceed 10,000 pounds
   c. 1000 lbs. per basket grip.
2. Sidewall pressure: 500 lbs./ft.
3. Conduit runs within the following limits of bends and conduit length between pull points shall not exceed the above installation pulling tension and sidewall pressure limits.
   a. Three (3) equivalent 90-degree bends: not more than fifty feet (50') between pull points.
   b. Two (2) equivalent 90-degree bends: not more than one hundred feet (100') between pull points.
   c. One (1) equivalent 90-degree bend: not more than one hundred fifty feet (150') between pull points.
   d. Straight pull: not more than two hundred feet (200') between pull points.
4. Indicate sizes of conduits, wireway sections, and cable tray sections on the as-built drawings.
5. Hold horizontal and vertical conduits as close as possible to walls, ceilings and other elements of the building construction. Conduits shall be kept a minimum of 6 inches clear of roof deck / insulation, and 2 inches clear of above floor deck / insulation.
6. Install conduits to conserve building space and not obstruct equipment service space or interfere with use of space. Conduit shall not be routed on floors, paved areas or grade.
7. Where a piece of equipment is wired from a switch or box on adjacent wall, the wiring

shall go up the wall from the box, across at or near the ceiling, and back down to the equipment. Wiring shall not block the walkway between wall and equipment.

8. Horizontal runs of conduit on exposed walls shall be kept to a minimum.
9. Conduit for mechanical / plumbing equipment installed outdoors shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.
10. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks to bottom of roof deck or floor deck. Conduits shall be grouped for neat workman-like appearance.

Q. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-feet maximum, on center, on straight runs which exceed 400-feet, and where conduits cross building expansion joints.

R. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.

S. Run conduit to avoid proximity to heat producing equipment, piping surfaces with temperatures exceeding 104 degrees F., and flues, keeping a minimum of 13-inches clear.

T. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in a manner to ensure a tight joint. Fasten the entire conduit system into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting.

U. Conceal conduit systems in finished areas. Conduit may be exposed in mechanical and electrical rooms, and where otherwise shown or indicated only. Run the conduit parallel and perpendicular to the structural features of the building and support with malleable iron conduit clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners.

V. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing. Conduit hanger spacing shall be 10 feet or less and as required by the NEC for all conduit. Beam clamp attachments to steel joist chords is prohibited. Beam clamps may only be used at beams, no exceptions. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.

W. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Where rod pendants are not used, channel supports are to be secured to structure at each end. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt "wings" are not acceptable. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt and nut and threaded rod. Raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas. Do not support conduit from other conduit, structural bridging or fire rated ceiling system. Do not support more than one conduit from a single all-thread rod support. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners. Channel supports shall have cut ends filed smooth. When installed outside of the building, or in areas subject to moisture, the cut ends shall be painted with ZRC galvanized paint or equivalent.

X. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with

"Tee" conduit at motor outlet height for flexible conduit.

Y. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers. Tie wire and short pieces of conduit used as supports and or hangers are not approved.

Z. Where "LB" condulets are used, 2-inches and larger shall be type "LBD".

AA. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.

BB. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to equipment, light fixtures, power poles, etc. They are not to be used in lieu of conduit runs. They shall not be used for wall or roof penetrations unless they are installed in a PVC coated RGC conduit sleeve at least one size larger than the OD of the flexible conduit.

CC. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.

DD. "Daisy Chaining" light fixtures installed for lay-in ceiling areas is not allowed. Each light fixture shall have its own fixture whip from junction box. The only exception being light fixtures installed end to end using chase nipples between them, or light fixtures recessed in non-accessible ceilings.

EE. In above ceiling applications, do not install raceways, junction boxes, gutters, disconnects, etc. within 36 inches directly in front of HVAC control boxes or other equipment requiring access from a point starting from the top of control box / equipment down to ceiling.

FF. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.

GG. Install minimum size 2-inch nipple, at least one, between multi-sectional panels for branch circuit independent of feeder conductors.

3.2 CONDUITS

A. Conduit above grade indoors:
   1. Concealed Conduits: EMT with set screw fittings
   2. Exposed conduits:
      a. Below nine feet AFF where not directly attached and against building walls, ceiling, or structure: Rigid metal conduit or x-wall RTRC.
      b. Where subject to physical damage: Rigid metal conduit or x-wall RTRC.
      c. Wet locations: PVC coated galvanized rigid steel or aluminum conduit
      d. Damp Locations: Aluminum rigid conduit or x-wall RTRC.
      e. Exposed conduits in mechanical rooms or electrical rooms shall be rigid galvanized steel or x-wall RTRC when installed below 18-inches above finished floor.

B. Conduit installed above grade outdoors:
   1. Galvanized rigid steel or x-wall RTRC for conduits up utility poles and where subject to physical damage or where located less than four feet above finished floor.
   2. Aluminum or x-wall RTRC where not subject to physical damage and where located four feet above finished floor.

C. Conduit where indicated underground:
   1. PVC Coated Galvanized rigid steel or RTRC conduit elbows and Schedule 80 PVC,

RTRC, or PVC coated galvanized steel straight run conduits. PVC conduits for underground branch circuits shall be Schedule 80 or Schedule 40 PVC.

a. PVC conduit and fittings shall be used only for straight horizontal runs and for vertical risers at site lighting pole bases. Bending straight sections of PVC conduit to less than 25-foot radius or the use of PVC factory bends is not allowed.

b. Change in direction of conduit runs, either vertical or horizontal, shall be with RTRC or PVC coated galvanized steel elbows or long sweep bends of straight PVC conduit sections. Long sweep bends of straight PVC 20-foot sections shall have a minimum radius of curvature of 25 feet and a maximum arc of 22.5degrees. Multiple long sweep bends of straight PVC sections shall be separated by a minimum of 20-feet of straight, linear, PVC sections.

c. Provide RTRC or PVC coated rigid galvanized steel conduit elbows and fittings with urethane interior coating at all changes in direction with radius of less than 25-feet and at all vertical runs to 18 inches above finished floor elevation. For interior slab penetrations, provide continuous RTRC or PVC coated rigid galvanized steel conduit and fittings with urethane interior coating from change in direction to 18 inches above finished floor elevation, except where stubbed-up under and inside equipment or switchgear where conduit shall be terminated at minimum two inches above concrete housekeeping pad.

d. Elbows for underground electrical service entrance, feeders, transformer primary / secondary, telecommunication, and low voltage conduits shall be RTRC or PVC coated rigid galvanized steel with long radius as follows:

1) Up to 1-inch conduit, minimum 12-inch radius.
2) 1.5-inch conduit, minimum 18-inch radius.
3) 2-inch conduit, minimum 24-inch radius.
4) 2.5-inch conduit, minimum 30-inch radius.
5) 3-inch conduit, minimum 36-inch radius.
6) 3.5 to 6-inch conduit, minimum 48-inch radius.

e. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.

f. Conduits shall not be routed horizontally in building slab, grade beams or pavement.

2. Encase all underground conduits in concrete.

a. Concrete shall be tinted red throughout with a ratio of 10 pounds of dye per yard of concrete unless prohibited by utility for utility conduits. Concrete encasement for utility installed conductors shall be as specified by the utility and comply with their standards and specifications. Where utility does not require but allows concrete encasement of conduits, provide concrete encasement as specified herein.

b. Provide minimum 3-inch concrete encasement around conduits.

c. Provide conduit spacers for parallel branch/feeder conduits.

d. When prior written approval from Owner and Architect to omit concrete encasement of conduits below building slab is given, conduits either specified or approved in writing to be routed under building slab without concrete encasement for electrical branch circuits or voice / data / video / communications horizontal drops or outlets shall be installed 18 inches below finished floor and on select fill. All other conduits, including but not limited to electrical feeders, voice / data / video / communications vertical, riser, tie, trunk, or service cable conduits shall be installed 48-inches below finished floor and on select fill.

e. Use suitable manufactured separators and chairs installed 4 feet on centers. Securely anchor conduit at each chair to prevent movement during backfill placement.

3. Install building voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits with top of concrete encasement

minimum 48-inches below finished grade or pavement. Voice / data / video / communications conduits and electrical service primary conduits for utility owned electrical service transformers shall also comply with the respective utility company requirements and standards. All other underground conduits outside of building other than voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits shall have top of concrete encasement at 36 inches minimum below finished grade or pavement.

4. Provide two "caution" plastic tapes at 6-inches and 18-inches below finished slab, grade, or pavement; identify as specified in Section 26 05 00.
5. Conduits located outside building, provide magnetic locator tape at top of first compacted layer of backfill or concrete.
6. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel with diameter ¼-inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
7. Utility underground conduit for Utility Company cable shall be installed per Utility Company standards, and their specifications for this project.
8. Concrete shall be Portland Cement conforming to ASTM-C-150, Type 1, Type III or Type V if specified. Cement content shall be sufficient to product minimum strength of 2,500 PSI.
9. Contractor shall stake out routing and location of underground conduits using actual field measurements. He shall obtain approval of the Owner and Architect before beginning trenching, horizontal drilling, and excavation.
10. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways. Verify existing public utilities with Call811.

D. Conduit shown in concrete walls, floor or roof slab:
   1. PVC Coated Galvanized Rigid steel.

E. Conduits that penetrate concrete slab, or within 100 feet of cooling towers, or at designated corrosive locations.
   1. RTRC
   2. PVC coated galvanized rigid steel

F. Connections to equipment mounted on roof, rotating equipment, transformers, and kitchen or food processing equipment, or where flexible conduit is required outdoors.
   1. Liquid tight flexible metal conduit (1/2 inch may be used for roof top supply / exhaust fans only)
   2. Liquid tight flexible metal conduit for 24-inch maximum length
   3. Conduit for roof-mounted equipment shall be routed inside the roof curb assembly roof opening. Provide permanent lock-off device at panelboard circuit breakers serving roof equipment and accessories to enable tag-out procedures for all power routed through roof curb and to the roof mounted equipment and accessories.

G. Light fixture whips:
   1. Accessible ceilings and open structure: ½-inch flexible steel conduit or steel MC cable, length not to exceed 6-feet.
   2. Non-accessible ceilings: ½-inch flexible steel conduit. Length as required to make a tap at an accessible j-box. Recessed light fixtures in non-accessible ceilings may be daisy chained using the light fixture's integral, UL listed j-box or internal wire way that is accessible through fixture from below the ceiling.

3. Dedicated insulated ground wire.
4. Light fixture whips shall not rest on ceiling grid or tile.
5. Light fixture whips shall not be supported from the ceiling suspension system. Support from the structure with #13 AWG galvanized iron wire pendants and Caddy clips. Do not support conduit from structural bridging. Flexible conduit and steel MC cable shall be kept a minimum of 2 inches clear of roof deck.

3.3 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, all floors other than grade level, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
   1. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
   2. Sleeves shall extend 3-inches above the finished floor.

B. Sleeves in concrete or masonry walls shall be RTRC or Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.

C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.

D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to install a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.

E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with ¼-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.

F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.

G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.4 POWER DISTRIBUTION UNDERGROUND FEEDER CONDUIT AND UNDERGROUND SERVICE ENTRANCE CONDUIT

A. Power underground feeder and service entrance shall be of individual conduit encased in concrete. Unless shown otherwise, the type of conduit used shall not be mixed in any one underground conduit and shall be the size indicated on the drawings. The concrete encasement surrounding the underground conduit shall be rectangular in cross-section, having a minimum concrete thickness of 3-inches, except that conduit for 120V and above shall be separated from control and signal conduits by a minimum concrete thickness of 3-inches. Encasement concrete shall be tinted in red.

B. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel shall be drawn through until each conduit is

clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.

C. Furnish the exact dimensions and location of power underground conduit to be encased in time to prevent delay in the concrete work.

D. Conduit for service entrance underground conduits shall be as indicated on the drawings.

E. Primary power underground conduit shall be installed in accordance with utility company standards and the utility company specifications for this project.

3.5 TELECOMMUNICATIONS, LOW VOLTAGE AND EMPTY CONDUIT SYSTEM RACEWAYS

A. Conduit shall be installed in accordance with the specified requirements for conduit and with the additional requirements that no length of run shall exceed 100-feet for 1 inch or smaller trade sizes and shall not contain more than two 90-degree bends or the equivalent. Pull or junction boxes shall be installed to comply with these requirements. Provide plastic bushings at all conduit terminations. Provide a grounding bushing on each data and voice conduit.

B. Conduits shall be installed from outlet box to above an accessible ceiling. All cables routed through open spaces (no-ceiling below roof deck or above floor deck) shall be routed in conduit. Telecommunications systems, CATV, CCTV, fire alarm and BMCS cables can be installed above accessible ceilings without conduit. Cables installed above accessible ceiling shall be plenum rated. Conduit rough in of these cables shall include a 90-degree turn-out to an accessible location with insulated bushings on the end of the conduit.
   1. Provide conduit from each telecommunications outlet box to accessible ceiling plenum.
   2. Provide conduit from each security / surveillance device outlet box to accessible ceiling plenum.
   3. Provide two conduits for each multi-media outlet box and each outlet box indicated to contain more than four data, audio, or video drops to accessible ceiling plenum.
   4. Provide the following minimum conduits for telecommunications and multi-media wall, floor, and ceiling mounted outlet boxes. Use the largest diameter conduit indicated below unless instructed otherwise in writing from the Architect:
      a. Non-masonry outlet box: Two 1-inch conduits.
      b. Masonry outlet box: Two 1-inch conduits, or three 3/4-inch conduits.
      c. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation.

C. All conduit in which cable is to be installed by others shall have pull string installed. The nylon pull string shall have not less than 200 lb. tensile strength. Not less than 12-inches of slack shall be left at each end. Provide blank cover plate before substantial completion if box is for a future installation after substantial completion of the project. Conduit shall extend to a minimum six inches above nearest accessible ceiling and be turned horizontally with plastic bushing at terminations.

D. Conduits for Building Entrance Facilities:
   1. Underground Outside Plant: Install a pull box every 300-feet or after 180 degree turns.
   2. Inside Plant: Install a pull box every 150-feet or after 180 degree turns. All turns shall be large sweeps, not sharp 90s, with the radius of the sweep at least 10X the diameter of the conduit. Hence, a 4-inch conduit requires a 40-inch minimum radial sweep. If field conditions absolutely mandate a sharp 90-degree bend to be installed, then a pull box shall be installed at that location regardless of distance.
   3. Building entrance facilities shall not terminate in an IDF or any other space except the MDF.
   4. Coordinate the termination location of the building entrance facilities in the MDF with the room layout and equipment configuration.
   5. Provide 4-inch conduit unless indicated otherwise. Provide (3) fabric innerducts in each

4-inch conduit.

3.6 IDENTIFICATION

A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V or 277/480V) or signal / telecommunication conduit (Fire Alarm, BAS, BMCS, Security, CCTV, Access Control, Intrusion Detection, Telecom, etc.). Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

SECTION 26 05 35

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electrical connections as required and scheduled, and as specified.

1.2 RELATED WORK

A. Refer to other Divisions for specific individual equipment electrical requirements.

1.3 QUALITY ASSURANCE

A. UL Label: Products shall be UL listed to the extent possible.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide a complete assembly including, but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories needed to complete splices and terminations.

B. Raceways: Refer to related sections.

C. Conductors and Connectors: Refer to related section. Conductors at equipment terminations shall be copper.

D. Terminals: Provide electrical terminals as indicated by the terminal manufacturer for the application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.

B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.

C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.

D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.

E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.

F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable condulet, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. For all AHU or fan motors and all other motors 10 HP and larger, at the motor connection do not use wire nuts. Provide copper alloy split bolt connectors or compression lugs and bolts. Insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape, or Tyco Gelcap Motor Connection Kit.

G. Conduit connections to equipment including, but not limited to, Variable Frequency Drives, Manual and Automatic Transfer Switches, Surge Suppression Devices, motor controllers, electrical disconnects, food service / processing equipment, electronics, control panels and Owner furnished equipment:

1. Make conduit penetrations only at the bottom flat surface of the equipment and only where permitted by the equipment manufacturer to avoid un-intentional water entry. Coordinate installation of electrical connections for equipment with equipment installation work. Where equipment manufacture does not permit a bottom conduit entry, verify with Owner/Engineer and locate the conduit entry at the side surface as close as possible to the bottom of the enclosure.
2. Where conduit originates from an elevation above the conduit entry, provide a “T” condulet below the enclosure’s bottom elevation. Provide conduit from the condulet up to the enclosure bottom horizontal surface for electrical connection.

H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.

I. Equipment and Furnishings: Refer to other Divisions. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.

END OF SECTION

SECTION 26 05 37

ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

A. UL Label: Electrical boxes and fittings shall be UL listed.

PART 2 - PRODUCTS– Provide products manufactured in the USA

2.1 FABRICATED MATERIALS

A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
   1. Type of Various Locations:
      a. Wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613, 4-gang steel box with white trim plate.
      b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes. Raco #260H large capacity box with ½ through 2-inch knockouts.
      c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
      d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
      e. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be coordinated for each installation.
      f. Surface: Type FS or FD box with surface cover.
      g. Corrosive locations or natatorium areas: 316 stainless steel construction suitable for the installation.
      h. Hazardous (Classified) Locations: Explosion proof boxes, seals and fittings.
      i. Special: Where above types are not suitable, boxes as required, taking into account space available, appearance, and Code requirements
   2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.

B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate with spring-hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.

C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.

D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
   1. Type for Various Locations:
      a. Minimum Size: 4-inch square, 2-1/8-inches deep.
      b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
      c. Exterior or Wet Areas: 304 stainless steel NEMA 4X construction with gaskets and corrosion-resistant fasteners

E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.

F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.

G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

PART 3 - EXECUTION

3.1 INSTALLATION OF BOXES AND FITTINGS

A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.

B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.

C. Provide minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes for technology, data, voice, video, and multi-media outlet boxes at locations other than wall mounted interactive boards, video or visual displays. Provide single gang only, 3-inch deep outlet boxes mounted long axis vertically for security, access control, and video surveillance, coordinate with security equipment installation. Provide minimum 4-inch square (2-gang) 2-1/8-inch deep boxes for all other applications. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation. Box extenders or plaster rings shall not be used to increase size. Provide increased box size as required.

D. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light fixtures, mechanical equipment or other devices shall not be required to access boxes. Outlet boxes above ceiling for low voltage terminations shall face towards the floor.

E. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes can be used.

F. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.

G. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.

H. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.

I. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.

J. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.

K. Provide knockout closures to cap unused knockout holes in boxes.

L. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.

M. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.

N. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.

O. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.

P. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.

Q. Exterior boxes installed within 50-feet of cooling towers or water treatment areas shall be of 304 stainless steel, weatherproof NEMA 4X construction.

R. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes located above accessible ceilings or non-finished areas to correspond to the following colors:

1. Orange: - 480/277 VAC systems
2. Light Blue: - 240 VAC three phase delta systems.
3. Red – All Emergency circuits, regardless of voltage, and fire alarm system.
4. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
5. Yellow – Building Management and Control System - BMCS
6. White - Security and Surveillance equipment circuits

S. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example “MSB to Panel HA”). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example “LA2” referring to Panel LA sec. 2 is to be listed as “LA”). Label covers for special applications explaining contents (example “Emerg. Gen. Annunciator controls”, “IDF ground”). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers. Boxes that are not used shall be labeled as not used and include panel ID. Example “Not Used Panel LA”. Unused raceways not in sight of panel shall be terminated in a box and labeled not used and include panel identification.

T. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

U. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.

V. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

W. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.

X. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.

Y. Use stamped steel bridges to fasten flush mounting outlet box between studs.

Z. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.

AA. Use adjustable steel channel fasteners for hung ceiling outlet box.

BB. Do not fasten boxes to ceiling support wires.

CC. Support systems are to hang vertically straight down. All-thread supports, when used, are not to be installed at an angle or bent.

DD. Use gang box where more than one device is mounted together. Do not use sectional box.

EE. Use gang box with plaster ring for single device outlets.

FF. Support outlets flush with suspended ceilings to the building structure.

GG. Mount boxes to the building structure with supporting facilities independent of the conduits or raceways.

HH. Where multiple feeders are in one pull box, conductors shall be wrapped with 3M No. 7700 Arc and fireproof tape.

II. Provide plaster rings of suitable depth on all outlet boxes. Face of plaster ring shall be within 1/8 inch from finished surface.

JJ. Equip boxes supporting fixtures designed to accept fixture studs with 3/8-inch stud (galvanized malleable iron) inserted through back of box and secured by locknut. Boxes not equipped with outlets shall have level metal covers with rust-resisting screws.

KK. Do not mount junction boxes above inaccessible ceilings or in inaccessible spaces. Do not mount junction boxes above ceilings accessible only by removing light fixture, mechanical equipment or other devices. At inaccessible spaces use junction box furnished with light fixture or light fixture wiring compartment UL listed for through wiring.

LL. No more than 12 conduits containing branch circuits may be installed in any junction or pull box.

MM. All junction boxes shall be protected from building finish painters' over spray and from fire proofing overspray. Remove protective coverings when painting and fire proofing are complete.

NN. Bond equipment grounding conductor to all junction and pull boxes.

OO. Do not mount boxes or conduit bodies on walls directly above electrical panels or switchgear located next to walls.

PP. Do not mount boxes or conduit bodies within 18 inches of outside edges of roof access openings.

QQ. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box. Provide proper size box.

3.2 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

END OF SECTION

SECTION 26 05 40

ELECTRICAL GUTTERS AND WIREWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical gutter work as shown, as specified and as required.

B. Application: The types of electrical gutters required for the project include the following:
1. Electrical wiring gutters
2. Voice / Data / Video / Communication and signal distribution wireway

1.2 QUALITY ASSURANCE

A. UL Label: Gutters and wireways shall be UL labeled.

PART 2 - PRODUCTS

2.1 ELECTRICAL GUTTERS AND WIREWAYS

A. General: Provide hinged electrical gutters and wireways in the types and sizes indicated or required, minimum 16 gauge thickness, with rounded edges and smooth surfaces; constructed in compliance with applicable standards; with features required.

B. Size: Provide size indicated. Where size is not indicated, construct in accordance with the NEC and other standards. Gutters shall be of manufacturer’s standard lengths, without field cutting or field extensions.

C. Accessories: Provide gutter and wireway accessories where indicated, constructed of same metal and finish as gutters or wireways.

D. Supports: Provide gutter and wireway supports indicated, conforming to NEC, and as recommended by the manufacturer, and as specified in Section 26 05 33 Conduit Systems.

E. Materials and Finishes: NEMA 1 gutters and wireways shall have gray powder coat finish over galvanized steel. Gutters and wireways installed outside shall be NEMA 3RX minimum. Gutters or wireways installed within 100-feet of cooling towers, at kitchen or food preparation areas, and natatorium, spa or therapy pool areas shall be of 304 stainless steel NEMA 4X construction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide gutters and wireways only where specified or required. Use of gutters and wireways shall be kept to a minimum.

B. Finishing: Remove burrs and sharp edges of gutters and wireways wherever they could be injurious to conductor insulation or jacket.

C. Installation: Install gutters and wireways where shown or required, in accordance with the manufacturer's written instructions, NEC, NECA "Standard of Installation," and with recognized industry practices to ensure that the gutters and wireways comply with the specified requirements. Comply with requirements of NEMA and the NEC pertaining to installation of electrical gutters.

D. Grounding: Electrically ground gutters and wireways to ensure continuous electrical conductivity. Provide equipment grounding conductor.

E. Conductors:
   1. Complete gutter and wireway installation before starting the installation of conductors.
   2. Provide sufficient space to permit access for installing, splicing, and maintaining the conductors.

F. A maximum of 12 conduits containing branch circuits shall be allowed to be installed in any gutter or wireway.

END OF SECTION

SECTION 26 05 50

FIRESTOPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Nelson

B. 3M (Minnesota Mining Manufacturing)

C. Hilti

D. Specified Technologies, Inc.

E. Metacaulk

2.2 MATERIAL AND COMPONENTS

A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).

B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

SECTION 26 24 14

TESTING, MAINTENANCE, AND MODIFICATIONS TO EXISTING SWITCHBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included: Switchboard work to existing switchboards 600 volts or less as shown, scheduled, indicated, and specified.

B. Types: Switchboard work for the project includes power distribution switchboards.

1.2 QUALITY ASSURANCE

A. Original Manufacturer’s Installation and Maintenance Instructions

B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB2, "Dead-Front Distribution Switchboards."

1.3 SUBMITTALS

A. Indicate Original Manufacturer’s Installation and Maintenance Instructions for testing, exercising, cleaning, and lubrication where available.

B. Include electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time current curves of all new equipment and components.

C. Original Manufacturer’s Inspection Report

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Replacement parts shall be manufactured by Original Equipment Manufacturer, (OEM) when available. When OEM parts are not available, third party, UL recognized, manufactured parts shall be used. Provide written confirmation on Manufacturer’s letterhead indicating OEM parts are not available.

2.2 MATERIALS AND COMPONENTS

A. Except as otherwise indicated, provide switchboard manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended, and as required for a complete installation.

2.3 DEAD-FRONT DISTRIBUTION SWITCHBOARDS-NEW SWITCHBOARD SECTIONS AND/OR ACCESSORIES

A. New Feeder and Branch Protective Devices where indicated or required, greater than 1,200 Amps shall be individually mounted:
   1. Molded case circuit breakers:
      a. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
      b. Energy Reducing Maintenance System switch with local status indicator (ERMS).

c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.

2. Fusible switches:

a. Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.

b. Fused switches 600 Amps and below, equipped for class J fuses.

c. Fused switches 601 Amps and above shall be equipped with Class R or L rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.

d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

B. Feeder and Branch Protective Devices 1,200 Amps and below where indicated or required shall be group mounted:

1. Molded case circuit breakers:

a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.

b. 250 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.

c. 1,200 Amp frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

2. Fusible switches:

a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.

b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.

c. 600 Amps and below equipped for Class J fuses.

d. 601 Amps and above shall be equipped for Class R or L rejection type fuse holders.

e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

PART 3 - EXECUTION

3.1 INSTALLATION, MAINTENANCE, AND MODIFICATION OF SWITCHBOARDS

A. Comply with the requirements of NEMA and NEC, and NECA Standard of Installation, for installation of switchboards. Comply with Original Manufacture’s Operation and Maintenance Instructions for testing and periodic maintenance.

B. Torque all existing and new bus connections and tighten mechanical fasteners to manufacturer’s specifications.

C. Install fuses, of ratings shown, in each new or modified fused switch.

D. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as directed by the OEM for coordination with downstream overcurrent devices.

E. Cleaning: Vacuum the interior of the existing switchboard enclosures of all dust and foreign matter. Clean all existing switch contacts according to manufacturer's instructions.

F. Remove any existing circuit breakers or fusible switches that are not functional or not suitable to be reused as "spares".

G. Provide filler plates where required.

3.2 TESTING

A. Provide the services of the Original Manufacturer's Field Services personnel for initial testing at no additional cost to the Owner. The Original Manufacturer's Field Services personnel shall provide at minimum, a visual inspection of the existing switchboards and shall provide a written report on the Original Manufacturer's letter head with recommendations regarding the existing condition and recommendations to further testing, maintenance, and in regard to the specified modifications of the existing switchboard. The report shall include any deficiencies of the existing switchboard in relation to each component's intended function. In addition, provide deficiencies of the existing switchboard with regard to the current National Electrical Code. Provide the written report to the Architect within 14 days of notice to proceed and prior to any demolition or construction. All other testing, maintenance, and modifications shall be provided by the Contractor as specified at no additional cost to the Owner.

B. Pre-Energization Checks: Before energizing, check switchboards for continuous of circuits and for short circuits. Test existing Bolted Pressure Switches according to Original Manufacture's Instructions.

C. Switchboard Insulation Resistance Test: Each switchboard bus shall be insulation resistance tested after installation and modification is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-ground. Minimum acceptable value for insulation resistance is 2 megohms.

D. Ground Fault Protection System Test: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50 percent of the largest overcurrent device rating in the switchboard. Ground fault setting shall not exceed 1200 amperes.

E. Provide thermal infrared scan of the existing switchboard under full load prior to testing/maintenance and modifications and of the modified and new switchboard sections after construction as directed and witnessed by Owner. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to close-out. Provide digital video documentation with test results for comparison between prior condition and post construction modifications and future tests.

F. Submittals: Furnish instruments and personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 26 24 25

ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Safety and disconnect switch work where required, scheduled, indicated, specified, and required. For switches indicated or rated above 1,200 Amps, provide switchboard construction as specified for switchboards.

B. UL Approved: Safety and disconnect switches shall have UL approval and the UL label.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Schneider Electric - Square D

B. ABB-General Electric Co.

C. Siemens

D. Eaton

2.2 ENCLOSED SWITCHES

A. General: Provide heavy duty type, dead-front, sheet steel enclosed, surface-mounted safety switches of the type and size indicated. Safety switches shall be rated for the voltage of the circuit where they are installed. Safety switches used as motor disconnects shall be rated for the motor horse power served.

B. The overcurrent protective device short circuit, coordination and arch flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.

C. Switch Mechanism:
1. Safety switches shall be quick-make, quick-break type with permanently attached arc suppressor. Constructed so that switch blades are visible in the OFF position with the door open. The operating handle shall be an integral part of the box, not the cover. Switch shall have provision to padlock in the OFF position. Safety switches shall have a cover interlock to prevent unauthorized opening of the switch door when the switch mechanism is in the ON position, or closing of the switch mechanism when the switch door is open.
2. Cover interlock shall have an override mechanism to permit switch inspection by authorized personnel. Current-carrying parts shall be constructed of high conductivity copper with silver-plated switch contacts. Lugs shall be suitable for copper conductors and front removable.

D. Neutral: Provide safety switches with number of switched poles indicated. Where a neutral is

present in the circuit, provide a solid neutral with the safety switch. Where a ground conductor is present in the circuit, provide a separate solid ground with the safety switch.

E. Auxiliary Contacts: Disconnect switches related to all smoke control fans shall have auxiliary contacts for fire alarm system monitoring of the position of the disconnect switch.

2.3 ENCLOSED SWITCHES WITH OVERCURRENT AND/OR GROUND FAULT PROTECTION

A. Overcurrent protective devices 1,200 Amps and below:
   1. Where switch is intended as a building service disconnect provide solid neutral and ground bus and service entrance SE rating.
   2. Molded case circuit breakers:
      a. Greater than 800 Amp: Solid state true RMS sensing with adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
      b. 800 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
      c. 1,200 Amp and larger frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
   3. Fusible switches:
      a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
      b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
      c. 600 Amps and below equipped for Class J fuses.
      d. 601 Amps and above shall be equipped for Class R or L fuses.
      e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

B. Ground Fault Interrupter (GFI) protection: Where shown or required, ground fault protection shall be achieved with adjustable pickup for ground fault currents, field-adjustable from 200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system shall include necessary current sensors, internal wiring, and relays to coordinate opening the monitored faulted circuits.
   1. Ground fault protection shall be set at minimum setting for both current and time during construction. The manufacturer shall include in the submittal data the minimum setting of the device and the recommended setting for normal building operation.
   2. The ground fault system shall be factory-tested before shipment as specified:
      a. The manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the sensors and measure the tripping time for each phase and neutral. The measured time-current relationships shall be compared to the trip-characteristic curves. If the ground fault device trips outside the range of values indicated on the curve, the ground fault device shall be replaced or recalibrated.
      b. Relays, electrically operated switches, shunt-trip switches, circuit breakers, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.
      c. Upon completion of the factory ground fault protection system test, the current and time on each ground fault device shall be set to minimum values.

2.4 ENCLOSURES

A. Enclosures in indoor locations shall be NEMA 1 unless shown otherwise.

B. Enclosures in exterior locations shall be NEMA 3R.

C. Enclosures at kitchen and food preparation locations, exterior kitchen supply and exhaust fans, hose down areas, cooling towers, in greenhouses, and in other corrosive areas shall be NEMA 4X, stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install safety and disconnect switches where required or indicated, in accordance with the manufacturer's written instructions, requirements of the NEC, NECA Standard of Installation, and industry practices. Provide fuse identification label when fused switches are required showing type and size inside door of each switch. Include devices in coordination study to indicate overcurrent devices will selectively coordinate.

B. Location: Provide safety switches within 50’ and in sight of motor served. There shall be minimum code required clearance in front of safety switch and a clear path in which to access the switch. (i.e.: not having to walk and/or stand on obstacles such as drain pans on floor to service).

C. Supports: Provide all safety and disconnect switches with galvanized angle or other supports where mounting on wall or other rigid surface is impractical. Switches shall not be supported by conduit alone. Where safety and disconnect switches are mounted on equipment served, the switch shall not inhibit removal of service panels or interfere with access areas, not void the warranty of the equipment served. Provide mounting hardware that will allow removal of safety and disconnect switches with common work tools. Do not utilize drive pin anchors through enclosure.

D. Ground Fault Interrupter (GFI) test and settings: Where adjustable ground fault interrupter settings are provided or required, after completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50-percent of the overcurrent device rating.

E. Safety and Disconnect Switches: Install disconnect switches for motor-driven equipment, appliances, motors, and motor controllers within sight of the controller position unless indicated otherwise.

F. Variable Frequency Drive (VFD) Warning Plaque: Provide VFD warning plaque at safety disconnect switches which are located down-stream of VFDs. Secure plaque to disconnect switch or immediately adjacent to disconnect switch with fasteners. Plaque shall be Yellow-White-Yellow 3-layer plastic laminated engraved with: “WARNING” (1/2 Inch Letters). “TURN OFF VFD BEFORE OPENING THIS SWITCH FOR MAINTENANCE.” (1/4 inch letters).

G. Provide disconnect switch for electric duct heaters.

H. Where disconnect switch is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building’s grounding system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the disconnect switch.

I. Disconnect switches related to all smoke control fans shall have auxiliary contacts for fire alarm system monitoring of the position of the disconnect switch, coordinate with Division 28.

Coordinate with fire detection and alarm contractor for the fire alarm and detection system to monitor all disconnect switches open/closed position that serve the smoke control system. All fire alarm and control wiring directly related to the monitoring of the supply power disconnect switches and control of the smoke control fans shall be installed in conduit.

3.2 TESTING

A. General: Before energizing, check for continuity of circuits and short circuits.

B. Provide thermal infrared scan of the enclosed switches rated 200 Amps or larger under full load prior to testing / maintenance and modifications and of the modified and new switchboard sections after construction as directed and witnessed by Owner. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to closeout. Provide digital video documentation with test results for comparison between prior condition and post construction modifications and future tests.

END OF SECTION

SECTION 26 27 73

LINE VOLTAGE WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide wiring device work as shown, scheduled, indicated, and specified. Low voltage and/or digital control switches required for lighting controls and lighting control systems shall be as specified and required for the low voltage and / or digital control lighting system. Refer to drawings or other specification sections for low voltage / digital lighting control systems. Cover plates for lighting control systems shall be as specified in this section unless specifically required otherwise by the low voltage / digital control device bulkhead or form factor.

1.2 QUALITY ASSURANCE

A. UL Label: Wiring devices shall be UL labeled.

B. NEMA Standard WD1 and WD6.

C. Fed. Spec. WC596, W-S-896

1.3 SUBMITTALS

A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy of the specification section with the product data.

B. Submit a sample of each style and color of 120-Volt duplex receptacle and each 120/277- Volt switch with related cover plate. Attach plate to wiring device and label back side of plate with job description with permanent black marker.

C. Submit manufacturer's product data sheet for each style of device and plate on the project.

D. Submit drawings of plans, elevation and sections of receptacles and outlets in casework, cabinetwork and built-in place furniture. Coordinate dimensions with millwork shop drawings and related architectural drawing series.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Toggle switches, straight blade and twist lock devices, interior cover plates:
1. Leviton
2. Hubbell
3. Pass and Seymour
4. Eaton

B. Dimming
1. Leviton
2. Lutron

2.2 WIRING DEVICE COLOR

A. Device color shall be gray except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source shall be red, and heavy duty 30 Amp and larger simplex devices which shall be black in color where the building standard color is not available. Provide equivalent hospital grade devices where red is not available in grade specified. Verify with Owner / Architect prior to submitting for approval. Color change kits as required for dimming switches. Low voltage lighting control devices specified elsewhere shall match the line voltage wiring device color specified in this section.

2.3 RECEPTACLES

A. Industrial or hospital grade tamper resistant smooth face duplex receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mounting straps, locking plug-tail or back and side wired with screw type terminals, NEMA indicated, (X=color designation).
   1. 20A, 125V duplex NEMA #5-20R: Leviton #5362-SGX
   2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #5362-IGX
   3. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R weather and tamper resistant: Leviton #G5362-WTX
   4. 20A, 125V weather resistant (WR), tamper resistant: Leviton #TWR20-GY
   5. 20A, 125V plug load control, split circuit marked for “controlled”, tamper resistant: Leviton #TDR20-S1G
   6. 15A, with 20A feed-through, NEMA #5-15R, 125V duplex, arc fault (AFCI), tamper resistant: Leviton #AFTR1-HGX

B. Heavy-Duty Simplex: Single heavy-duty type receptacles, with green hexagonal equipment ground screw, with metal mounting straps, back or side wiring, black molded phenolic compound.
   1. 15-60A, 125-250V, straight blade, NEMA configuration as indicated or as required by Owner.
   2. 15-50A, 125-480V, twist lock, NEMA configuration as indicated or as required by Owner.

C. Hospital grade receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mount straps, locking plug-tail or back and side wired with screw type terminals, molded phenolic compound, NEMA configuration indicated.
   1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #8300-X
   2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #8300-LIG (orange)
   3. 20A, 125V ground fault circuit interruption (GFCI) with indicator light: Leviton NEMA 5-20R-8898-HGX
   4. 20A/125V Tamper Resistant Duplex NEMA 5-20R: Leviton 8300-SGX

2.4 WALL SWITCHES

A. Toggle: Industrial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.
   1. Single-pole, 120/277V, 20A switch: Leviton #1221-2X
   2. Double pole 120/277V, 20A switch: Leviton #1222-2X
   3. Three-way, 120/277V, 20A switch: Leviton #1223-2X
   4. Four-way, 120/277V, 20A switch: Leviton #1224-2G
   5. Pilot light single-pole, 120/277V, 20A switch: Leviton #1221-PL
   6. Momentary, 120/277V, 20A, single-pole double throw, center off: Hubbell only, #HBL 1557G

2.6 GFCI – GROUND FAULT CIRCUIT INTERRUPTER, BLANK FACE

A. 20A, 125V, GFCI, switch rated, blank face feed through, Hubbell #GFBF20GYL, gray finish, stainless steel cover plate black laser engraved with device protected, (example: DRINKING FOUNTAIN GFCI).

2.7 INTERIOR WALL COVER PLATES AND FASTENERS

A. Type 302 non-magnetic stainless-steel with satin finish (also required for wall box device cover plates for low voltage and digital lighting controls specified elsewhere).

B. Cover plate laser plate engraving for device identification (other than low voltage lighting controls).
1. Provide laser cover plate engraving with black filling for all wiring devices indicating panelboard name, circuit, and voltage.
2. Wiring devices connected to emergency/stand-by generator or inverter shall include the word “EMERGENCY”.
3. Text orientation shall be upright, readable from left to right when cover plate is installed.
4. Remotely located lighting switches shall also indicate the room or area and zone controlled by each switch. Coordinate specific wording with Owner/Architect.
5. Blank face GFCI cover plates shall also intuitively indicate the load or equipment served, device, or area protected downstream (“EDF” for drinking fountains, “RM RECEPTS”, “HOOD RECEPTS”, “VENDING”, “REFRIG”, etc.) For other loads, Owner/Architect shall determine name plate wording.

2.8 EXTERIOR COVER PLATES

A. Thomas & Betts CK Series, cast aluminum standard depth, locking mount, while-in-use, wet location, universal configuration.
1. Vertical mount receptacle: #CKSUV
2. Horizontal mount receptacle: #CKMU
3. Two-gang: #2CKU
4. 30-60 Amp Devices: #CKLSUV
3. 30-60 Amp, voltage, NEMA plug/receptacle as required by Owner, SOOW cable, number of conductors and length as required, mesh strain relief cord grips.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cover plates for receptacles and toggle switches shall be of the same manufacturer throughout unless otherwise noted.
1. Key switches and keys shall be as specified and also as approved by Owner.
2. Submit samples for each specified toggle switch and duplex receptacle color to Architect.

B. Install wiring devices where shown and as required, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.

C. Install receptacles and switches only in electrical boxes that are clean, free from building materials, debris, and similar matter.

D. Install wiring devices plumb and aligned in the plane of the wall, floor, ceiling or equipment rack.

E. Install switches in boxes on the strike side of doors as hung. Install so the up position will close the circuit or will be the highest level of illumination. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.

F. Provide a cover plate for every wiring device and blank cover plates for unused rough-in-only boxes that matches the building standard. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.

G. Mounting heights of all wiring devices shall comply with local accessibility standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.

H. Refer to Architectural drawing and elevations, etc. for exact location of wiring devices. Coordinate location of all wiring devices with other trades, specialty items, and millwork and resolve all conflicts prior to rough-in. Field coordinate exact mounting location with all trades to avoid and resolve conflicts during construction.

I. Locate receptacles for electric drinking fountains/coolers and bottle fill stations below equipment so that the receptacle is accessible and concealed as much as practical from public view by the equipment open cowling so that the receptacle remain readily accessible. For dual level basin equipment, locate receptacle under the upper basin.

J. Provide convenience outlet receptacle within 25-feet of all new electrically operated mechanical equipment.

K. Where exterior receptacles are intended for continuous use, mount in horizontal position with while in use cover plate. (Exterior electric drinking fountains, ice makers, ice storage bins, landscape lighting low voltage transformers, seasonal decorative lighting, etc.)

L. Install wall box dimmers to achieve full rating specified after de-rating for ganging as recommended by manufacturer.

M. Do not share neutral conductor on load side of dimming switches.

N. Install receptacles with grounding pole down, except in any of the following conditions where the grounding pole shall be installed in the up position: healthcare occupancies, if required by local AHJ, if required by Owner’s construction standards or if directed by Owner or Architect. If installed horizontally, install with neutral pole on top.

O. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

P. Provide pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap conductors around screw terminals. Tighten all screws and lugs as recommended by manufacturer.

Q. All receptacles and switches shall have a minimum of two wraps of Scotch 33 or equivalent tape around terminal screws.

R. Provide toggle switch within sight of all trap primers, circulation pumps, 120-Volt motors and motorized equipment to serve as the equipment disconnect switch.

3.2 GROUND FAULT PROTECTION FOR PERSONELL

A. When GFCI personnel protection receptacles are not commercially available or cannot be installed at a readily accessible location or indicated otherwise on the drawings, GFCI personnel protection shall be provided by a remote blank face GFCI wiring device or by an up-stream GFCI receptacle that also provides downstream GFCI protection and located in a readily accessible location. When branch circuit breaker device with integral GFCI protection is required or specified, it shall be within the manufacture’s recommended distance limitations of the connected receptacle(s) or load(s) for proper GFCI personnel protection at the farthest outlet.

B. GFCI personal protection locations include but are not limited to the following:
   1. For other than dwelling units: All single phase 125-250-Volt (150-Volts to ground or less) receptacles 50-Amperes or less, and all three phase 125-250-Volt (150-Volts to ground or less) receptacles 100-Ampres or less in the locations indicated below.
   2. Dwelling units: All single phase 125-250-Volt receptacles installed in the following locations indicated below.
   3. Provide personnel GFCI protection as indicated above in the following locations and all additional locations as required by the NEC.
      a. Outdoors (with exceptions for not readily accessible receptacles with dedicated branch circuits for snow melting, deicing, pipeline/vessel heat receptacles. Provide these loads with 30mA EGFI circuit breaker protection).
      b. Bathrooms/toilets/restrooms
      c. Janitors/custodial closets and mop sinks.
      d. Laundry areas
      e. Parking structures, service garages, garages and accessory buildings
      f. Basements, crawl spaces (including 120-Volt lighting)
      g. Within 6-feet of all water sources including sinks, mop-sinks, lavatories, bathtubs, shower stalls, faucets, eye wash stations, emergency shower stations
      h. Indoor damp and wet locations
      i. Locker rooms
      j. Indoor swimming pools and natatoriums areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
      k. Non-dwelling unit therapeutic tubs/pools/whirlpool areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
      l. Receptacles serving dwelling unit kitchen counter tops
      m. Vending machines
      n. Elevators, dumb waiters, escalators, moving sidewalks: receptacles in pits, hoist ways, well ways or those mounted on the cars of elevators and dumb waiters.
      o. Electric vehicle charging equipment.
      p. All receptacles serving kitchen or food preparation counter tops.
      q. Automotive vacuum machines
      r. Drinking water fountains/coolers and bottle fill stations
      s. Corded high-pressure spray washing machines
      t. Tire inflation machines
      u. Dish washers
      v. Receptacles at end of cord reels or drop cords.
      w. Boat houses, boat hoist, and all pier/dock receptacles and lighting (excludes shore power that requires GFPE).
      x. Central plant, mechanical rooms and electrical rooms
      y. Wood, metal, or other material fabrication or vocational training shops.
      z. Receptacles that serve educational science and science prep room counter tops.

C. Where a GFCI protected receptacle outlet is required or indicated behind vending machine, refrigerators or other equipment, provide remote GFCI blank face in same room as protected receptacle and at a readily accessible location with standard receptacle outlet behind equipment. Refrigerators shall be GFCI protected only where located within 6-feet of power cord distance from the edge of a sink to the surface of the refrigerator.

D. Unless indicated otherwise, locate blank face GFCI device near light switches at same height as light switches or ganged with the light switch. Provide GFCI protection for all receptacle outlets located below 42-inches in all infant through 2-year old day care and similar areas designated for occupancy by infant through 2-year old day care occupants so the GFCI device can easily be intentionally tripped or tested and reset.

E. Provide branch circuit breaker 30mA (EDP) or 100mA (EPE) equipment protection for utilization equipment as required by the NEC and where indicated on the drawings.

3.4 TESTING

A. Before energizing, check for continuity of circuits, short circuits, and grounding connections.

B. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization, voltage and phase orientation if intended 3-phase equipment is phase orientation dependent for proper motor rotation or operation.

C. Test each individual GFCI receptacle and all downstream receptacles protected by an upstream GFCI device with simulated ground fault tester, make corrections as necessary.

D. Operate each wall switch with circuit energized and verify proper operation.

END OF SECTION

SECTION 26 43 00

SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION/SCOPE

A. The Surge Protection Device (SPD) covered under this section includes all service entrance type surge protection devices suitable for use as Type 1 or Type 2 Devices per UL1449 4th Edition, applied to the line or load side of the utility feed inside the facility. The unit shall be connected in parallel with the facility's wiring system. The unit shall be manufactured in the USA by a qualified manufacturer of suppression filter system equipment, which has been engaged in the commercial design and manufacture of such products for a minimum of five years.

B. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to finish and install surge protection devices.

1.2 QUALITY ASSURANCE

A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
1. UL 1449 Fourth Edition
2. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
3. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
4. IEEE 1100 Emerald Book.
5. National Fire Protection Association (NFPA 70 (NEC), 75, and 78).
6. UL 1283 – Electromagnetic Interference Filters

1.3 SUBMITTALS

A. Submit shop drawings complete with all technical information unit dimensions, detailed installation instructions, maintenance manual, and wiring configuration.

B. Copies of Manufacturer’s catalog data, technical information and specifications on equipment.

C. Copies of documentation stating that the Surge Protection Device is listed from a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, etc.) and are tested and multi-listed to UL 1449 4th Edition and UL 1283.

D. Copies of actual let through voltage data in the form of oscilloscope results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.

E. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.

F. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

G. Provide detailed marked-up copy of this specification with line-by-line compliance or exception

statements to all provisions of this specification.

1.4 WARRANTY

A. The manufacturer shall provide a minimum 20-year warranty for high and very high exposure SPDs. Very high exposure unit warranties shall include exposure to temporary over-voltage conditions. Provide a minimum 15-year warranty for all medium exposure SPDs, and a minimum 10-year warranty for all other SPDs for parts from date of substantial completion against failure. Contractor shall install in compliance with applicable national / local electrical codes and the manufacturer's Installation, Operation and Maintenance Instructions. Contractor shall assist the Owner with manufacturer warranty registration.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURER

A. Low exposure, minimum 10-year parts warranty, minimum 50k Amps per mode, 100k Amps per phase, Type 1 and Type 2.
   1. Recessed mount panelboard extension with brushed stainless-steel front:
      a. ACT Communications:471- ###V-050-SS-F-PB flush series.
      b. ABB Current Technology PX3-050-VVV- #X-SF-X-F- # series.
      c. PSP Hurricane HxC100-4XN-S-F series.
      d. SSI Surge Suppression, Inc. CSMx12-FMPxSS series.
   2. Branch panelboard surface mounted:
      a. ACT Communications 455 series.
      b. ABB Current Technology CGC50 series.
      c. PSP Hurricane HxC100-4XH-S series.
      d. SSI Surge Suppression, Inc. CSMx12 series.

B. Medium exposure, minimum 15-year parts warranty, minimum 120k Amps per mode, 240k Amps per phase, Type 2.
   1. ACT Communications 471 series.
   2. ABB Current Technology CGP120 series.
   3. PSP Hurricane HxC300-4NT1-S series.
   4. SSI Surge Suppression, Inc. CSMx24 series.

C. High exposure, minimum 20-year parts warranty, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD.
   1. ACT Communications 471 x200 series.
   2. ABB Current Technology TG 200 series.
   3. PSP Hurricane HxC400-4NT1-S series.
   4. SSI Surge Suppression, Inc. CHLxM series.

D. Very high exposure at service entrance 1,201 Amps and above: Minimum 20-year parts warranty; minimum 200k Amps per mode; 400k Amps per phase, Type 2 SPD:
   1. ACT Communications 471 SEL series.
   2. ABB Current Technology SEL3 200 series.

The service entrance protector shall incorporate a combination of TPMOV and Selenium technology allowing for transient surge and temporary over voltage protection. The unit shall be able to prevent common temporary over voltages and high impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and Intermediate current TOVs can be caused by a loss of the neutral conductor in a split phase or three phase power system. The available fault current will be determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. Minimum 20-year parts warranty, extended over-voltage protection, minimum 200k Amps per

mode, 400k Amps per phase, Type 2 SPD. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

Overvoltage seen by MOVs as % of Nominal				
	available current			
time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

*To verify damage to the MOVs has been mitigated, the percent overvoltage seen at the MOV must be less than 200% for split-phase applications or 173% for three-phase applications (100% is nominal).

2.2 MANUFACTURED UNITS / ELECTRICAL REQUIREMENTS

A. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% overvoltage test in UL1449 will not be accepted.

B. Unit shall have not more than 10% deterioration or degradation of the UL1449, Voltage Protection Rating (VPR) due to repeated surges.

C. Protection Modes SVR (6kV, 500A) and UL1449 VPR (6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 section 37.6: Values Depicted are based on a system Without Disconnect / With Disconnect

System Voltage	Mode	MCOV	C3 Wave	UL 1449 VPR Rating
120/240	L-N	150	650/775	700/800
120/208	L-G	150	650/825	700/900
	N-G	0	500/500	900/1000
	L-L	300	950/1250	900/1200
277/480	L-N	320	1125/1225	900/1200
	L-G	320	1075/1225	1200/1200
	N-G	0	900/900	1200/1500
	L-L	550	1950/2200	1800/1800

D. Electrical Noise Filter- each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric noise shall be as follows using the MIL-STD-220A insertion loss test method.
1. 14 dB from 10 kHz to 1 MHz.

E. Each Unit shall provide the following features:
1. Phase Indicator lights, Form C dry contacts, counter and audible alarm.
2. Field testable while installed.
3. High performance interconnecting cable.
4. The UL 1449 Voltage Protection Rating (VPR) shall be permanently affixed to the SPD unit.
5. The UL 1449 Nominal Discharge Surge Current Rating shall be 20Ka
6. The SCCR rating of the SPD shall be 200kAIC without requiring an upstream protection device for safe operation.
7. The unit shall be listed as a Type 2 SPD per UL1449.

8. Power wiring: SPD shall be equipped with mechanical lugs that can accept up to #2 AWG wire on High Exposure units and up to #6 on Medium and Low Exposure units

2.3 POWER CABLES FOR CONNECTION

A. Power wiring: Conductors between all SPDs and switchgear shall be high performance interconnect system “Low Z Cable” cables with Ultra Low impedance characteristics at 10kHz and above.

B. Low Impedance cable shall be #6 AWG minimum for Very High, High, and Medium Exposure SPDs and #10 AWG minimum for Low Exposure SPDs.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

A. The unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be with high performance, low impedance cables in conduit and shall not be any longer than necessary, avoiding unnecessary bends. Minimum wire size and overcurrent protection shall be provided and as indicated or recommended by the manufacturer.

B. Units specified for lighting and appliance panel boards as panelboard extensions (EGPE) shall be mounted directly above or below the first section of the panel board it is protecting. Any other mounting location will not be acceptable and shall be corrected, without exception, at no additional cost to the Owner.

C. Units specified for panelboards, switchboards, or motor control centers shall be mounted directly above or adjacent to the panelboard, switchboard or motor control center using unistrut supports secured to structure as required. Conduit length between power distribution panelboard or switchboard shall be less than two inches. Mounting above equipment is not acceptable.

D. Overcurrent device and conductors for devices shall be the maximum recommended by the manufacturer. Manufacturer’s recommendations shall prevail over the information given in the plans and specifications.

E. Provide recessed mounted panelboard extension type enclosures for devices protecting recessed panelboards. Enclosure front shall match panelboard front. Provide brushed stainless-steel front at kitchens and food processing areas.

3.2 UNIT SELECTION BASED ON EXPOSURE LEVEL

A. (SPDVH) Provide very-high exposure SPDs with Selenium and TPMOV technology for the following new electrical equipment or where indicated:
1. Service entrance rated 1,201 Amps and above.

B. (SPDH) Provide high exposure SPDs for the following new electrical equipment or where indicated:
1. Service entrance rated 801 – 1,200 Amps.
2. Switchboards located outside.

C. (SPDM): Provide medium exposure SPDs at the following new electrical equipment or where indicated:
1. Service entrance rated 401 - 800 Amps.
2. Panelboards above 600 Amps.
3. Motor control centers.

4. Non-service entrance switchboards.

D. (SPDL): Provide low exposure SPDs at the following new electrical equipment or where indicated:
1. Service entrance rated 400 Amps and below.
2. Panelboards 600 Amps and below.

3.3 TESTING

A. Factory Trained Representative shall provide start-up to include initial verification of proper installation and initiate factory warranty. The technician will be required to do the following as a minimum:
1. Verify overcurrent device rating
2. Verify all wiring connections and installation conforms to manufacturer's recommendations.
3. Record information for each product installed and include in O&M Manual

B. A copy of the Factory diagnostic test report and written approval of the installation shall be included with the Electrical Operating and Maintenance Manual. The Contractor shall make all adjustments, changes, corrections, etc. as required by the Factory Trained Representative so that the installation follows the manufacturer's installation and operation instructions without additional charge to the Owner.

END OF SECTION