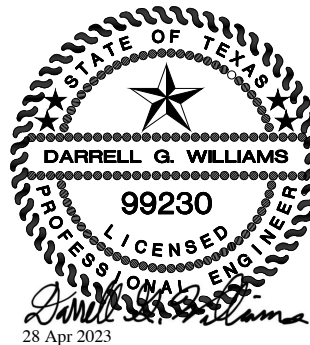
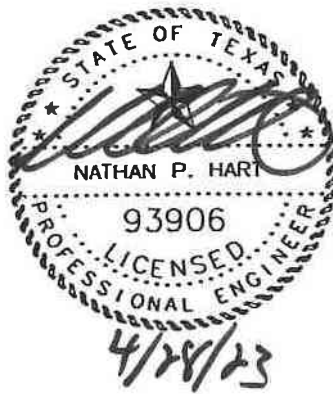


CONTRACT CONDITIONS
FOR
HVAC REPLACEMENT
AT
T.E. BAXTER ELEMENTARY SCHOOL
MIDLOTHIAN, TEXAS
MIDLOTHIAN
INDEPENDENT SCHOOL DISTRICT

Project Manual



ENGINEER
RWB CONSULTING ENGINEERS
12001 NORTH CENTRAL EXPRESSWAY, SUITE 1100
DALLAS, TEXAS 75243

RWB Project No. 22146.00
April 28, 2023

INDEX

00 03 00	REQUEST FOR COMPLETITIVE SEALED PROPOSALS
00 04 00	MIDLOTHIAN ISD INSTRUCTIONS TO PROPOSERS
00 05 00	MIDLOTHIAN ISD PROPOSAL INFORMATION FORMS
00 06 00	MIDLOTHIAN ISD ACADEMIC CALENDAR
00 23 00	EXISTING CONDITIONS
00 30 00	PROPOSAL FORM
00 42 00	CONTRACTOR QUALIFICATION REQUIREMENTS
00 61 00	PERFORMANCE BOND
00 62 00	PAYMENT BOND
00 62 50	TEXAS CERTIFICATE OF EXEMPTION
00 83 00	WAGE RATE SCHEDULE
01 01 00	SUMMARY OF WORK
01 02 00	ALLOWANCES
01 02 50	MEASUREMENT AND PAYMENT
01 04 00	COORDINATION
01 04 50	CUTTING AND PATCHING
01 05 00	FIELD ENGINEERING
01 06 00	REGULATORY REQUIREMENTS
01 07 00	DEFINITIONS AND TERMINOLOGY
01 12 00	ALTERATION PROJECT PROCEDURES
01 20 00	PROJECT MEETINGS
01 30 00	SUBMITTALS
01 40 00	QUALITY CONTROL
01 50 00	CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
01 60 00	MATERIALS AND EQUIPMENT
01 70 00	CONTRACT CLOSEOUT
01 73 00	OPERATION AND MAINTENANCE DATA
09 90 00	PAINTING
22 05 00	COMMON WORK RESULTS FOR PLUMBING
22 11 23	NATURAL GAS PIPING SYSTEM
23 00 00	HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) WORK
23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC
23 05 14	COMMON MOTOR STARTER REQUIREMENTS FOR HVAC EQUIPMENT
23 05 48	VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
23 05 53	IDENTIFICATION FOR HVAC DUCTWORK, EQUIPMENT AND PIPING
23 05 93	TESTING, ADJUSTING, AND BALANCING (TAB) FOR HVAC
23 07 00	INSULATION
23 08 00	MECHANICAL SYSTEMS COMMISSIONING
23 09 00	INSTRUMENTATION AND CONTROLS FOR HVAC
23 21 13	HYDRONIC PIPING

23 30 00	HVAC AIR DISTRIBUTION
23 34 00	EXHAUST AND SUPPLY AIR FANS
23 81 32	ROOFTOP AIR CONDITIONING UNITS (GAS-ELECTRIC) (BELOW 3 TONS)
23 81 33	SEMI-CUSTOMIZED ROOFTOP AIR CONDITIONING UNITS (GAS - ELECTRIC) (3 TONS AND LARGER)
26 00 00	ELECTRICAL
26 05 01	ELECTRICAL DEMOLITION
26 05 19	LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 20	CABLE CONNECTIONS
26 05 23	CONTROL – VOLTAGE ELECTRICAL POWER CABLES
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 32	RACEWAYS
26 05 33	BOXES FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 27 16	ELECTRICAL CABINETS AND ENCLOSURES
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 29 13	ENCLOSED CONTROLLERS



REQUEST FOR COMPETITIVE SEALED PROPOSALS

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

OWNER: **Midlothian Independent School District**
100 Walter Stephenson Road
Midlothian, TX 76065

ENGINEER: **RWB Consulting Engineers**
12001 North Central Expressway, Suite 1100
Dallas, TX 75243

PROJECT: **CSP 2223-04 Midlothian ISD**
Baxter Elementary HVAC Project
Midlothian Independent School District
Midlothian, Texas

PROPOSAL DATE AND TIME: Proposal Due: **Thursday, May 18, 2023 @ 2:00 PM**

LOCATION OF PROPOSAL OPENING: **Midlothian Independent School District**
Administration Building
100 Walter Stephenson Rd
Midlothian, TX 76065

Proposal Documents will be available May 1, 2023. Qualified Offerors may obtain a free electronic copy of the Project Manual.

A link to the digital copies of the project manual and drawings (if applicable) may be obtained from the MISD Website and/or Ms. Shana Volentine, e-mail: shana.volentine@misd.gs

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.

Name of Offeror
CSP 2223-04 Midlothian ISD Baxter
Elementary HVAC Project
Midlothian Independent School District

The Owner reserves the right to reject any and all proposals and to waive any irregularities in the Competitive Sealed Proposal process. No proposal shall be withdrawn within 30 days after the proposal opening without the specific consent of the Owner.



PROPOSAL BOND: Not Applicable

PAYMENT BOND AND PERFORMANCE BOND: A Payment Bond and Performance Bond, each in an amount equal to 100 percent (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.

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

All Offerors submitting a proposal are encouraged to attend the proposal opening. Subcontractors and suppliers intending to submit proposals to Construction Offerors are required to prepare their proposals based on a complete set of proposal documents. If after reviewing the complete set of proposal documents, Subcontractors and supplier Offerors desire to purchase individual drawings and specification sections for their proposal convenience, they may do so by ordering the specific drawings and specifications directly from the reproduction company.

All Offerors submitting a proposal are encouraged to visit the site.

END OF DOCUMENT

SECTION 00 04 00

MIDLOTHIAN ISD INSTRUCTIONS TO PROPOSERS

The following Instruction to Proposers were provided by the Midlothian Independent School District and are required to be reviewed by the contractor prior to submitting proposals.

END OF SECTION



INSTRUCTIONS TO PROPOSERS

EXAMINATION OF DOCUMENTS AND SITE

- Each proposer, by making his Proposal, represents that he has read and understands the Proposal Documents. Failure to do so may be materially non-responsive and result in non-consideration of the bid.
- Each proposer, by making his Proposal, represents that he has visited the site, performed investigations and verifications as necessary and familiarized himself with the local conditions under which the Work is to be performed and will be responsible for errors in his proposal resulting from his failure to do so.
- Each proposer by making his proposal represents that his proposal is based upon the materials, systems and equipment required by the Proposal Documents without exception.
- Any and all site visits shall be coordinated through:

Jose Martinez

Midlothian ISD

Email: jose.martinez1@misd.gs

QUESTIONS

- Proposers shall submit questions about the Proposal Documents to the MISD Purchasing Department in writing by the date identified in the proposal. Replies will be issued to proposers as an addendum to the Proposal Documents and shall become a part of the Contract. The Owner will not be responsible for oral clarification.
- Submit all questions to:

Shana Volentine

Midlothian ISD

Purchasing Coordinator

Email: shana.volentine@misd.gs

SUBSTITUTIONS

- Each proposer represents by submitting his proposal that his proposal is based upon the materials and equipment described in the proposal documents

STATUTORY PERFORMANCE BOND AND STATUTORY LABOR AND MATERIAL PAYMENT BOND

- A Statutory Performance Bond and a Statutory Labor and Material Payment Bond will be required of the successful proposer and shall be executed by a surety company acceptable to the Owner and authorized to do business in the State of Texas. Each bond shall be in an amount equal to one hundred percent (100%) of the contract price. The Performance Bond and the Labor and Material Payment Bond may be in one or separate instruments in accord with local law and are to be delivered to the Owner no later than the date of execution of the contract. Failure or neglecting to deliver said bonds, as specified, shall be considered as having abandoned the contract and the proposal security will be retained as liquidated damages.
- Bonds shall be executed by a Surety Company that is:
 - Approved by the school district, and duly authorized and admitted to do business in the State of Texas as determined by the State Board of Insurance.
 - Listed by the United States Department of the Treasury in that issue of the "Federal Register" covering the date on which the bond was executed and the date that Surety Company has obtained reinsurance, if applicable, from a reinsurer that is authorized and admitted as a reinsurer in this state and is the holder of a certificate of authority from the United States Secretary of the Treasury.

CERTIFICATE OF LIABILITY INSURANCE

- The successful proposer shall provide a Certificate of Liability Insurance in at least the amount of \$1,000,000.00. The Midlothian Independent School District shall be listed as additional insured.

MODIFICATION AND WITHDRAWAL

- No proposal may be changed, amended or modified after submittal. Proposers may withdraw proposals prior to proposal opening.
- No right or interest in this contract or delegation of any obligation shall be assigned by the vendor to another vendor. Any attempted assignment or delegation by the vendor shall be wholly void and totally ineffective for all



purposes.

SUBMITTAL

- Submit proposals in accordance with the Request for Proposals.
 - Enclose proposal in an opaque, sealed envelope. Clearly mark on the outside of the proposal envelope:
Project name and CSP Number
Name of proposer
Midlothian Independent School District
- Preparation of Proposals: Proposals shall be submitted on unaltered proposal forms. Fill in all blank spaces. If there are entries (blank spaces) on the proposal form which do not apply to a particular proposer, these entries shall be marked "N.A." (Not Applicable) by the proposer. No proposals will be considered that are amended or are qualified with conditional clauses, alterations, items not called for in the proposal, or irregularities of any kind which, in the Owner's opinion, may disqualify the proposer.
- Proposals meeting the requirements of the CSP shall be considered. Respondents taking exception to the specifications or offering substitutions shall state these exceptions.
- Each proposer shall submit one original, one duplicate copy, and one digital copy saved on a USB Flash Drive of each of the following. All shall be submitted in a single sealed envelope. Electronic signatures are acceptable.:
 - Checklist for CSP 2223-04 (Provided for Reference) *this is not all inclusive of required information, read entire CSP for all information for complete evaluation of submission.
 - Proposer Identification: Contractor shall add a Cover Sheet/Proposer Identification Form that includes the following information:
 - Date
 - Company Name
 - Full Address
 - Phone #
 - Email Address
 - Proposal Form
 - Proposer shall note any contract deviations. Midlothian Independent School District can consider such deviations but is not obligated to accept such deviations
 - CSP Response Form Page 1 and Page 2
 - SB 9 Contractor Certification: Contractor Employees
 - Reference Sheet
 - Felony Conviction Notice (Reference form attached to the end of this Section)
 - 1295 Certificate of Interested Parties - This form must be completed online, printed and signed. (Reference form attached to the end of this Section)
 - Conflict-of-interest Questionnaire (Reference form attached to the end of this Section)
 - Non-collusion & Non-Discrimination Form (Reference form attached to the end of this Section) HB 89/SB 252 Certification Form (Reference form attached to the end of this Section)
 - All other information that responds to the Selection Criteria listed.
 - Each proposer shall submit one original, one duplicate copy, and one digital copy saved on a USB Flash Drive listing any subcontractors to be acquired for this project.
- Proposals received in the District's Business Office after the date and time specified will not be considered. The District is not responsible for lateness or non-delivery of mail carrier, etc., and the date/time stamp in the Business Office shall be the official time of receipt. Proposals MAY NOT be submitted by facsimile or email.
- Pricing submitted on this proposal is firm for a period of **60 Days** from the proposal opening date.
- The person signing the proposal should show the title that gives the authority to bind the firm to a contract.

DETERMINATION OF SUCCESSFUL RESPONDENT AND AWARD OF CONTRACT

- In determining the Selected Offeror, the Owner will evaluate the information derived from the Offeror's (Contractor's) Qualification Statement required herein, the information submitted on the Proposal Form, and other selection criteria including the following Selection Criteria:

COST	25 POINTS	The purchase price will be scored mathematically as a ratio of the proposal price ranking to the total number of proposers.
REPUTATION	15 POINTS	The reputation of the Proposer's goods and services. Items



		considered: Proposer's past relationships with and input from provided project references regarding recommendation of the Proposer, the Proposer's performance as a team player and their ability to work with the Owner on Change Orders and Contingency Allowances.
QUALITY	20 POINTS	The quality of the Proposer's goods and services. Items considered: - Proposer's past performance with input from provided project references regarding the Proposer's quality of craftsmanship - All required items submitted - Information provided in the proposal is clear
EXPERIENCE	20 POINTS	The Proposer's overall experience as well as past record of completing similar size and scope of projects on time. Items considered: - Number of years in business - Number of similar size projects within the past five years - Number of similar scope projects within the past five years – project scope must include working on an existing, operational campus maintaining full functionality. - Proposer's past performance with input
WARRANTY WORK	10 POINTS	The Proposer's response to warranty work requests. Items considered: Proposer's past performance with input from provided project references regarding the ability to perform warranty work in a timely manner.
PROJECT TEAM	5 POINTS	Qualifications of the proposed project manager(s) and project superintendent (s). Items considered: - Time in the construction industry for each individual - Number of K-12 school projects completed by each individual - Time with company for each individual
PROJECT SCHEDULE	5 POINTS	The Proposer's anticipated construction schedule. Items considered: start date, substantial completion date, final completion date, and total construction duration in calendar days.

- The district does not award/purchase on the basis of low bid alone.
- The District may choose to conduct interviews with proposers as part of the evaluation and selection process. If interviews are necessary will be held at:
Midlothian Independent School District Administration building
100 Walter Stephenson Rd
Midlothian, TX 76065.
- The Selection Committee consisting of Midlothian ISD administrators, consultants and other staff will make an initial evaluation of the proposals. The committee's recommendation will be considered by the Midlothian ISD Board of Trustees ("Board"). The District reserves the right to review the recommendation with others deemed appropriate by the District prior to review by the entire Board. The final decision-making authority on the proposals rests with the full Board.
- The District will make such investigations as it deems necessary to determine the ability of the Offeror to perform the Work, and the Offeror shall furnish all such information and data for this purpose as may be requested. The District reserves the right to reject any proposal if the evidence submitted by, or investigation of, such Offeror fails to satisfy the District that such Offeror is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein.
- The District reserves the right to reject any or all proposals and to waive any formalities or irregularities and to make the award of the contract in the best interest of the District. The District also reserves the right as a sole judge of quality and equality.
- A decision regarding determination of the successful Offeror will be made by the District as soon as practical.
- If awarded, the successful vendor(s) will be notified by authorized District personnel.



EXECUTION OF CONTRACT (if applicable)

- The Owner reserves the right to accept any proposal, to reject any and all proposals, or to negotiate contract terms with the various proposers, when such is deemed by the Owner to be in his best interest.
- Notwithstanding delays in the preparation and execution of the formal contract agreement, each proposer shall be prepared, upon written notice of proposal acceptance, to commence work on or before a date stipulated in an official written order of the Owner to proceed.
- The accepted proposer shall assist and cooperate with the Owner in preparing the formal contract agreement, and within 5 days following its presentation shall execute same and return it to the Owner.
- Form for the contract agreement will be AIA Document A101, Standard Form of Agreement Between Owner and Contractor, Stipulated Sum, 2017 Edition. – Or
- The district limits its purchases through the use of properly drawn and authorized purchase orders. Consequently, the District is not responsible for items delivered or picked up and/or services that were not authorized via this method. Therefore, the purchase order number shall appear on ALL itemized invoices and packing slips to ensure payment.
- This contract, once accepted will include the period agreed upon between the District and the vendor(s) to complete the projects listed in the CSP. Any purchase order dated and issued within these dates will be subject to the terms and conditions of this contract.
- If, at any time, the vendor fails to fulfill or abide by the terms, conditions, or specifications of the contract, the District reserves the right upon written notice to the vendor to the following remedies (though not just limited to these): purchase the products/services elsewhere and/or cancel the contract.
- Proposals may not be withdrawn without written approval after a contract has been signed or a purchase order executed or after a partial performance of the proposal agreement has begun.
- The District reserves the right to utilize other District contracts, State of Texas contracts, contracts awarded by other governmental agencies, other school boards, or other cooperative agreements in lieu of any offer received or award made as a result of this proposal, if it is in the District's best interest to do so.

PAYMENT

- The title and risk of loss of the goods/services shall not pass to the District until the District actually takes possession of the goods/services at either the point of sale or the point of delivery.
- On purchase order contracts – itemized invoices shall be issued for only those items/services received. Payment shall not be due until the invoice(s) are submitted after delivery. Pursuant to Texas Government Code 2251.021, payments will be made within thirty (30) days. Invoices shall be mailed directly to:

MISD Business Office

100 Walter Stephenson Rd.

Midlothian, TX 76065

Attn: Accounts Payable

Or

Email to: accounts_payable@misd.gs

TIME OF COMPLETION AND LIQUIDATED DAMAGES

- The contract date will be established as the number of consecutive calendar days as set out on the proposal form from the "Notice-to-proceed" date issued by the Owner.
- Failure of the Contractor to complete the Work by the contract date will result in damages being sustained by the Owner. Such damages are, and will continue to be, impracticable and extremely difficult to determine. Due consideration will be given to delays as outlined in the Contract.
- The Contractor will pay the Owner the amount indicated on the Proposal Form and in the General Conditions for each calendar day of delay in finishing the Work in excess of time specified for completion, plus authorized time extensions. Execution of the Contract under these specifications shall constitute agreement by the Owner and Contractor that the amount indicated is the minimum value of the costs and actual damage caused by failure of the Contractor to Substantially Complete the Work within the allotted time, that such sum is Liquidated Damages and shall not be construed as a penalty, and that such sum may be deducted from payments due the Contractor if such delay occurs.

SALES TAX EXEMPTION

- The Owner qualifies for exemption from State and Local Sales Taxes as set forth in the Supplementary Conditions. Tax exemption certificates will be issued upon request.



TERMINATION OF CONTRACT

- The requirements of Government Code, Chapter 552, Subchapter J - Additional Provisions Related to Contracting Information, applies to this contract and the contractor or vendor agrees that the contract can be terminated if the contractor or vendor knowingly or intentionally fails to comply with a requirement of that subchapter.
- Each respondent must give notice to the District if a person, owner or operator of the business has been convicted of a felony. The District determines that the person or business failed to give such notice or misrepresented the conduct resulting in the conviction.
- Respondents shall note any and all relationships that might be a Conflict of Interest and include such information with the Proposal.
- Please note that a gift to a public servant is a Class A misdemeanor offense if the recipient is a government employee who exercises any influence in the purchasing process of the governmental body. This would certainly apply to anyone who helps establish specifications or is involved in product selection or directs a purchase.

PROHIBITION ON CONTRACTS WITH COMPANIES BOYCOTTING ISRAEL

- Pursuant to Texas Government Code Chapter 2271, if this contract is valued at \$100,000 or more and if Contractor has at least ten (10) full time employees, then Contractor represents and warrants to the Owner that the Contractor does not boycott Israel and will not boycott Israel during the term of this Contract. This section does not apply to a sole proprietorship. On April 25, 2019, the U.S. District Court for the Western District of Texas entered a preliminary injunction enjoining the enforcement of Chapter 2271 as it existed before the amendment in any state contract. In compliance with the Court's order, the Owner will not seek enforcement of the current Chapter 2271 until further order of this or higher court having jurisdiction over the issue.

ADDITIONAL TERMS AND CONDITIONS

- Delivery of goods/services will be made during normal working hours unless prior approval has been obtained.
- The successful proposer shall possess and maintain criminal background checks for all personnel working on District Property.
- MISD reserves the right to purchase additional services as listed on this proposal subject to the verification of the same or lower prices and conditions as the proposal.
- MISD also reserves the right to waive minor technicalities or formalities considered in the best interest of the district.
- In case of discrepancies within the drawings, within the specifications, or between the drawings and specifications, the better quality and greater quantity, shall be furnished and installed.

END OF DOCUMENT

SECTION 00 05 00

MIDLOTHIAN ISD PROPOSAL INFORMATION FORMS

The following forms were provided by the Midlothian Independent School District and are required to be completed and submitted with the proposal.

END OF SECTION



CSP RESPONSE FORM (Page 1)

2223-04 Baxter Elementary HVAC

Project

To: Midlothian ISD
Attention: Shana Volentine
100 Walter Stephenson Rd
Midlothian, Texas 76065

From:

Company Name

Address

City/State/Zip

Area Code & Phone Number

Fax Number

E-mail Address

Federal Tax Identification Number

I, the undersigned, as the owner or legally authorized representative of the above named company, by signing the following statement, agree that I have READ and UNDERSTAND all of the Instructions and Specifications contained herein, and that if accepted by the Midlothian Independent School District, all of the provisions are part of a binding contract between the MISD and our company. I also certify that this bid is made without previous understanding, agreement, or connection with any person, firm or cooperation making a proposal for the same contract, and is in all ways fair and without collusion or fraud.

Owner or Legally Authorized Representative

Signature

Title

Date

RETURN THIS PAGE

CSP RESPONSE FORM (Page 2)
2223-04 Baxter Elementary HVAC
Project

Remittance Address (if different):

Address

City/State/Zip

All purchases must occur with a district purchase order.

1) Our firm will accept orders using district purchase orders. YES ☐ NO ☐

2) Our firm hold a HUB certification. YES ☐ NO ☐
If YES, provide a copy of your certification with your response.

3) Our firm holds a MWBE/SBE Certification YES ☐ NO ☐
If YES, provide a copy of your certification with your response.

ADDITIONAL INFORMATION (If Applicable)

If your organization has multiple store locations, please list all store locations that will agree to all the terms and conditions set forth in this proposal/bid document. Please list additional store locations below (attach additional information if needed).

RETURN THIS PAGE



REFERENCES

Please list your customer references

1. Business Name: _____

Contact: _____

Address: _____

Phone Number: _____

Email: _____

Scope of Work/Project: _____

2. Business Name: _____

Contact: _____

Address: _____

Phone Number: _____

Email: _____

Scope of Work/Project: _____

3. Business Name: _____

Contact: _____

Address: _____

Phone Number: _____

Email: _____

Scope of Work/Project: _____



CHECKLIST FOR CSP
2223-04 Baxter
Elementary HVAC
Project

- _____ Proposal Form
- _____ CSP Response Form (Page 1 & 2)
- _____ Reference Sheet
- _____ SB 9 Contractor Certification: Contractor Employees
- _____ Felony Conviction Notice
- _____ 1295 Certificate of Interested Parties
- _____ Conflict-of-Interest Questionnaire
- _____ Non-Collusion & Non-Discrimination Form Resident
- _____ and Non-Resident Form
- _____ Statement of Debarment
- _____ HB 89/SB 252 Certification Form
- _____ Information for complete evaluation (see Evaluation Criteria)

SB 9 Contractor Certification: Contractor Employees

Background: Texas Education Code Chapter 22 requires entities that contract with school districts to obtain criminal history records on covered employees. Covered employees with disqualifying criminal histories are prohibited from serving at a school district. Contractors must certify to Midlothian ISD that they have complied and must obtain similar certifications from their subcontractors. *See SB 9 Contractor Certification: Subcontractor attachment.* The law requires each contractor to obtain the criminal histories of its covered employees. For more information or to set up an account, a contractor should contact the Texas Department of Public Safety's Crime Records Service at 512.424.2474.

Definitions:

Covered employees: Employees of a contractor who have or will have continuing duties related to the service to be performed at a school district and have or will have direct contact with students. Midlothian ISD will be the final arbiter of what constitutes *continuing duties* and *direct contact* with students.

Disqualifying criminal history: (1) a conviction or other criminal history information designated by Midlothian ISD; (2) a felony or misdemeanor offense that would prevent a person from being employed under Texas Education Code § 22.085(a), that is: if at the time of the offense, the victim was under 18 or was enrolled in a public school; (a) a felony offense under Title 5, Texas Penal Code; (b) an offense on conviction for which a defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; or (c) an offense under federal law or the laws of another state that is equivalent to (a) or (b).

On behalf of _____ ("Contractor"), I, the undersigned authorized signatory for Contractor, certify to Midlothian Independent School District ("Midlothian ISD") that [check one]:

[] None of Contractor's employees are *covered employees*, as defined above. If this box is checked, I further certify that Contractor has taken precautions or imposed conditions to ensure that its employees will not become *covered employees*. Contractor will maintain these precautions or conditions throughout the time the contracted services are provided.

Or

[] Some or all of Contractor's employees are *covered employees*. If this box is checked, I further certify that:

- (1) Contractor has obtained all required criminal history record information regarding its covered employees. None of the covered employees has a disqualifying criminal history.
- (2) If Contractor receives information that a covered employee subsequently has a reported criminal history, Contractor will immediately remove the covered employee from contract duties and notify Midlothian ISD in writing within 3 business days.
- (3) Upon request, Contractor will provide Midlothian ISD with the name and any other requested information of covered employees so that Midlothian ISD may obtain criminal history record information on the covered employees.

If Midlothian ISD objects to the assignment of a covered employee on the basis of the covered employee's criminal history record information, Contractor agrees to discontinue using that covered employee to provide services at Midlothian ISD.

I also certify to Midlothian ISD on behalf of Contractor that Contractor has obtained certifications from its subcontractors of compliance with Texas Education Code, Chapter 22.
Noncompliance or misrepresentation regarding this certification may be grounds for contract termination.

Signature

Title

Date



Felony Conviction Notice

Statutory citation covering notification of criminal history of contractor is found in the Texas Education Code

#44.034. Following is an example of a felony conviction notice:

FELONY CONVICTION NOTICE

Senate Bill 1, passed by the State of Texas Legislators, Section 44.034, Notification of Criminal History, Subsection (a) states, “a person or business entity that enters into a contract with a school district must give advance notice to the district if the person or owner or operator of the business entity has been convicted of a felony.” The notice must include a general description of the conduct resulting in the conviction of a felony.

Subsection (b) states, “A school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for services performed before the termination of the contract.

This notice is not required of a publicly held corporation.

I, the undersigned agent for the firm named below certify that the information concerning notification of felony conviction has been reviewed by me and the following furnished information is true to the best of my knowledge.

Vendor’s Name: _____

Authorized Company Official’s Name: (please print)

A. My firm is a publicly held corporation; therefore, this reporting requirement is not applicable.

Signature of Company Official: _____

B. My firm is not owned nor operated by anyone who has been convicted of a felony.

Signature of Company Official: _____

C. My firm is owned or operated by the following individual(s) who has/have been convicted of a felony: Name

of Felon(s): _____

Details of Conviction: _____

Signature of Company Official: _____

THIS COMPLETED FORM MUST BE RETURNED WITH PROPOSAL

CERTIFICATE OF INTERESTED PARTIES**FORM 1295**

Complete Nos. 1 - 4 and 6 if there are interested parties. Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

OFFICE USE ONLY

1 Name of business entity filing form, and the city, state and country of the business entity's place of business.

2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.

3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the services, goods, or other property to be provided under the contract.

4	Name of Interested Party	City, State, Country (place of business)	Nature of Interest (check applicable)	
			Controlling	Intermediary

5 Check only if there is NO interested Party. ☐

6 UNSWORN DECLARATION

My name is _____, and my date of birth is _____.

My address is _____, _____, _____, _____, _____.
(street) (city) (state) (zip code) (country)

I declare under penalty of perjury that the foregoing is true and correct.

Executed in _____ County, State of _____, on the _____ day of _____, 20____.
(month) (year)

Signature of authorized agent of contracting business entity
(Declarant)

ADD ADDITIONAL PAGES AS NECESSARY

CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. See Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 Name of vendor who has a business relationship with local governmental entity.

2 Check this box if you are filing an update to a previously filed questionnaire. (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 Name of local government officer about whom the information is being disclosed.

Name of Officer

4 Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ Yes

☐ No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐ Yes

☐ No

5 Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

Signature of vendor doing business with the governmental entity _____

_____ Date

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at <http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm>. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

- (A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;
- (B) a transaction conducted at a price and subject to terms available to the public; or
- (C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds \$2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed;
or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than \$100 in the 12-month period preceding the date the officer becomes aware that:

- (i) a contract between the local governmental entity and vendor has been executed; or
- (ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.



STATEMENT OF NON-COLLUSION AND NON-DISCRIMINATION

My signature certifies that the accompanying Proposal:

1. Is not the result of, or affected by, an unlawful act of collusion with another person or company engaged in the same line of business or commerce, or any act of fraud punishable under current local, state, and/or federal ordinances, statutes, regulations and/or policies. Furthermore, I understand that fraud and unlawful collusion are crimes under Federal Law, and can result in fines, prison sentences, and civil damage awards.
2. During the performance of any contract awarded, the Seller will not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin, or handicaps, except where religion, sex or national origin is a bona fide occupation qualification reasonably necessary to the normal operations of the Seller, The Seller agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this non-discrimination clause.
3. The Seller, in all solicitations or advertisements for employees placed by or on behalf of the Seller, will state that such Seller is an equal opportunity employer.
4. Notices, advertisements and solicitations placed in accordance with Federal Law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.
5. The Seller shall include the provisions of the foregoing paragraphs 2, 3 and 4 in every subcontract or purchase order over \$10,000.00 so that the provisions will be binding upon each subcontractor or vendor.

I hereby certify that I am authorized to sign as a Representative for the Seller:

NAME OF SELLER:

ADDRESS:

CITY & STATE:

NAME: (Print)

Signature:

TITLE: _____ DATE: _____

TELEPHONE: _____ FAX: _____

EMAIL ADDRESS: _____

RESIDENT/NONRESIDENT CERTIFICATION

Texas Government Code Chapter 2252 relates to bids by nonresident contractors. The pertinent portions of the Act are as follows:

Section 2252.001(3)

“Nonresident bidder” means a bidder who is not a resident (of the State of Texas).

Section 2252.001(4)

“Resident bidder” means a bidder whose principal place of business is in this state, including a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

Section 2252.002

A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident’s principal place of business is located.

I certify that _____ is a

Resident Bidder of Texas as defined in Texas Government Code Section 2252.001(4).

Signature: _____

Printed Name: _____

.....

I certify that _____ is a

Nonresident Bidder of Texas as defined in Texas Government Code Section 2252.001(3) and our principal place of business is:

City and State: _____

Signature: _____

Printed Name: _____

If the Bidder is a Nonresident Bidder of Texas, please answer the following:

Does the vendor’s ultimate parent company or majority owner employ at least 500 persons in Texas?

Yes _____ No _____

DEBARMENT OR SUSPENSION CERTIFICATION FORM

Debarment and Suspension (Executive Orders 12549 and 12689)—A contract award (see 2 CFR 180.220) must not be made to parties listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), “Debarment and Suspension.” SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

By submitting this offer and signing this certificate, this Proposer:

- (1) Certifies that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

Firm’s Name: _____

Address: _____

City/State/Zip: _____

Telephone: _____

Authorized Company Official’s Name: _____
(*Typed or printed*)

Title of Authorized Representative: _____
(*Typed or printed*)

Signature of Authorized Company Official: _____

Date Signed: _____



CERTIFICATIONS REQUIRED AS OF SEPTEMBER 1, 2017

**CERTIFICATION REGARDING TERRORIST ORGANIZATIONS
& BOYCOTTING OF ISRAEL
[Govt Code 808 (HB89) and Govt Code 2252 (SB252)]**

Vendor hereby certifies that it is not a company identified on the Texas Comptroller's list of companies known to have contracts with, or provide supplies or services to, a foreign organization designated as a Foreign Terrorist Organization by the U.S. Secretary of State.

Vendor further certifies and verifies that neither Vendor, nor any affiliate, subsidiary, or parent company of Vendor, if any (the "Vendor Companies"), boycotts Israel, and Vendor agrees that Vendor and Vendor Companies will not boycott Israel during the term of this Agreement. For purposes of this Agreement, the term "boycott" shall mean and include terminating business activities or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory.

Initials of Authorized Representative of Vendor

Vendor's Name/Company Name: _____

Address, City, State, and Zip Code: _____

Phone Number: _____ Fax Number: _____

Printed Name and Title of Authorized Representative: _____

Email Address: _____

Signature of Authorized Representative: _____

Date: _____ Federal Tax ID # _____

MISD PURCHASING OFFICE (INTERNAL REVIEW): SB 2252 Certification

Comptroller List was reviewed and The Vendor (IS) (IS NOT) on the lists (Circle one).

Verified by: _____

Request for Taxpayer Identification Number and Certification

Give Form to the
requester. Do not
send to the IRS.

► Go to www.irs.gov/FormW9 for instructions and the latest information.

Print or type. See Specific Instructions on page 3.	1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.	
	2 Business name/disregarded entity name, if different from above	
	3 Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only one of the following seven boxes. <input type="checkbox"/> Individual/sole proprietor or single-member LLC <input type="checkbox"/> Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ► _____ Note: Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is not disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner. <input type="checkbox"/> Other (see instructions) ► _____	4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3): Exempt payee code (if any) _____ Exemption from FATCA reporting code (if any) _____ <i>(Applies to accounts maintained outside the U.S.)</i>
	5 Address (number, street, and apt. or suite no.) See instructions.	Requester's name and address (optional)
	6 City, state, and ZIP code	
	7 List account number(s) here (optional)	

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number									
				-				-	
or									
Employer identification number									
				-					

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here	Signature of U.S. person ►	Date ►
-----------	----------------------------	--------

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to www.irs.gov/FormW9.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)

- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See What is backup withholding, later.

SECTION 00 06 00

MIDLOTHIAN ISD ACADEMIC CALENDAR

The following calendar was provided by the Midlothian Independent School District for the 2023-2024 academic year.

END OF SECTION

2023-2024 Learning Calendar

JULY 2023							AUGUST 2023							SEPTEMBER 2023							OCTOBER 2023						
SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA
						1			1	2	3	4	5						1	2	1	2	3	4	5	6	7
2	3	4	5	6	7	8	6	7	8	9	10	11	12	3	4	5	6	7	8	9	8	9	10	11	12	13	14
9	10	11	12	13	14	15	13	14	15	16	17	18	19	10	11	12	13	14	15	16	15	16	17	18	19	20	21
16	17	18	19	20	21	22	20	21	22	23	24	25	26	17	18	19	20	21	22	23	22	23	24	25	26	27	28
23	24	25	26	27	28	29	27	28	29	30	31			24	25	26	27	28	29	30	29	30	31				
30	31																										

NOVEMBER 2023							DECEMBER 2023							JANUARY 2024							FEBRUARY 2024						
SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA
			1	2	3	4						1	2		1	2	3	4	5	6					1	2	3
5	6	7	8	9	10	11	3	4	5	6	7	8	9	7	8	9	10	11	12	13	4	5	6	7	8	9	10
12	13	14	15	16	17	18	10	11	12	13	14	15	16	14	15	16	17	18	19	20	11	12	13	14	15	16	17
19	20	21	22	23	24	25	17	18	19	20	21	22	23	21	22	23	24	25	26	27	18	19	20	21	22	23	24
26	27	28	29	30			24	25	26	27	28	29	30	28	29	30	31				25	26	27	28	29		
							31																				

MARCH 2024							APRIL 2024							MAY 2024							JUNE 2024						
SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA	SU	M	TU	WE	TH	FR	SA
					1	2		1	2	3	4	5	6				1	2	3	4							1
3	4	5	6	7	8	9	7	8	9	10	11	12	13	5	6	7	8	9	10	11	2	3	4	5	6	7	8
10	11	12	13	14	15	16	14	15	16	17	18	19	20	12	13	14	15	16	17	18	9	10	11	12	13	14	15
17	18	19	20	21	22	23	21	22	23	24	25	26	27	19	20	21	22	23	24	25	16	17	18	19	20	21	22
24	25	26	27	28	29	30	28	29	30					26	27	28	29	30	31		23	24	25	26	27	28	29
31																					30						

	New Teacher Orientation (No school for students)		Professional Learning Day (No school for students)
	Teacher Work Day (No school for students)		Elementary Grading Periods
	Professional Development Day (No school for students)		Secondary Grading Periods
	Teacher Exchange Day (No school for students)		
	Student & Staff Holiday		

ATTENDANCE TIMES

Elementary	Secondary
7:30a-3:15p	8:30a-4:15p

Early Childhood Special Education
Morning Classes 7:30a-11:10a
Afternoon Classes 11:40a-3:15p

DATES TO REMEMBER

Jul 3-4	Staff Holiday	Dec 25-Jan 5	Student/Staff Holiday
Jul 31-Aug 3	New Teacher Orientation	Jan 8	Student Holiday/Teacher Work Day
Aug 4	Campus Orientation/Professional Development	Jan 15	Student/Staff Holiday
Aug 7-9, 11	Professional Development	Jan 26	Student Holiday/Professional Learning
Aug 10, 14	Teacher Work Day	Feb 16	Student Holiday/Professional Development
Aug 15	First Day of School	Feb 19	Student/Staff Holiday
Sep 1	Student Holiday/Professional Learning	Feb 20	Student Holiday/Professional Learning
Sep 4	Student/Staff Holiday	Mar 8	Student Holiday/Professional Learning
Sep 22	Student Holiday/Professional Learning	Mar 11-15	Student/Staff Holiday
Oct 13	Student Holiday/Professional Learning	Apr 5	Student Holiday/Professional Learning
Oct 16	Student/Staff Holiday	Apr 8	Student Holiday/Staff Exchange Day
Nov 3	Student Holiday/Professional Learning	Apr 26	Student Holiday/Professional Learning
Nov 17	Student Holiday/Staff Exchange Day	May 18	Graduation Day (subject to change)
Nov 20-24	Student/Staff Holiday	May 23	Last Day of School
Nov 27	Student Holiday/Professional Learning	May 24	Teacher Work Day
Dec 22	Student Holiday/Teacher Work Day	May 27	Staff Holiday

INSTRUCTIONAL TIME

1st Semester
37,200 minutes
80 days

2nd Semester
39,060 minutes
84 days

Professional Development
2,100 minutes

GRADING PERIODS

Elementary (9-Week)
1st: Aug 15-Oct 12
2nd: Oct 17-Dec 21
3rd: Jan 9-Mar 7
4th: Mar 18-May 23

Secondary (6-Week)
1st: Aug 15-Sep 21
2nd: Sep 25-Nov 2
3rd: Nov 6-Dec 21
4th: Jan 9-Feb 15
5th: Feb 21-Apr 4
6th: Apr 9-May 23

In the event of delays, cancellations or closures, MISD will notify you by:

• Social Media • News (WFAA8, NBC5, CBS11, FOX4) • MISD and campus websites • Text • Email • Recorded phone message

SECTION 00 23 00**EXISTING CONDITIONS****1.1 SITE VISITATION**

- A. Proposers shall visit site of Work, existing buildings, review any available existing drawings and all conditions affecting the work of this Project.
- B. Proposers desiring access to existing building after the formal walkthrough that will occur subsequent to the pre-proposal conference, shall contact the Midlothian Independent School District Representative for appointments to visit facility. The existing building is currently occupied. Formal examination of existing conditions will be scheduled at the convenience of the proposer and the available Midlothian Independent School District Staff.

1.2 VERIFICATION

- A. Prior to commencement of work, verify all existing conditions, control points, principal lines and elevations, presence of utilities, at or related to the site and existing building, and also examine all adjacent facilities upon which the work is in any way dependent. In the event of any inconsistency or conflict between existing conditions and the proposal documents, immediately notify Engineer of such inconsistency or conflict.
- B. Elevations of existing floors, tops of walls, parapets, beams and locations of existing columns, walls and other building elements are based on existing building drawings furnished by the Owner. Contract Documents are based on best available information regarding existing conditions. The intent of the Contract Documents is to integrate new construction with existing conditions. Contractor shall be responsible for verifying existing conditions with Contract Documents.
- C. Provide protections necessary to prevent damage to existing buildings, improvements, landscaping and trees, parking, streets, and walks to remain in place. Restore damaged buildings, improvements and other existing conditions to their original condition in manner acceptable to Owner.

1.3 EXISTING CONDITIONS

- A. The existing building must be kept functioning during the construction period, except as otherwise indicated. Existing functioning utilities cannot be interrupted without written approval from the Owner. Give two (2) weeks written notice to the Owner prior to planned interruption of any existing functioning utilities. Owner will then schedule

with Contractor for date and time of shutdown. Due to the need for continuous operation of the facility, Owner does not guarantee schedule shutdowns.

- B. Notify the Owner's representative when working in areas where utility lines might be encountered.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 00 30 00**PROPOSAL FORM**

SUBMITTED BY:

(Name of Proposer)_____
(Address)

Dear Sir:

The undersigned, having examined the drawings, specifications, related documents, and the site of the proposed work, and being familiar with all of the conditions surrounding the work, including the availability of materials and labor, hereby proposes to furnish all labor, materials, and equipment required for the HVAC Replacement at T.E. Baxter Elementary School, in accordance with the drawings and project manual prepared by RWB Consulting Engineers for the lump sum of:

For work at T.E. Baxter Elementary School, BASE PROPOSAL amount of (excludes TAB and Commissioning Services):

Dollars (\$_____).

Testing, Adjusting, and Balancing (TAB) and Commissioning Firms and Contractors shall provide pricing for this project as noted below. The Mechanical or General Contractor shall NOT include TAB or Commissioning Services in their Proposal.

For Testing, Adjusting and Balancing Services work ONLY at T.E. Baxter Elementary School, BASE PROPOSAL amount of:

Dollars (\$_____).

For Commissioning Services work ONLY at T.E. Baxter Elementary School, BASE PROPOSAL amount of:

Dollars (\$_____).

Provide the associated equipment cost and lead time of the equipment below and which manufacturer was included in the base bid proposal:

Equipment Type	Manufacturer	Equipment Lead Time	Equipment Cost	Included in Base Proposal (Y/N)
Roof-Top Units	Trane			
	Lennox			

Notes:

1. Amount shall be shown in both words and figures. In case of discrepancy, the amount shown in words shall govern.
2. Prices listed on Bid Form acknowledge that work for Baxter Elementary School cannot begin until Summer Break 2024.
3. The above amount does not include State of Texas Sales Tax.
4. The above amounts do include allowances as stated in Section 01 02 00.
5. The Base Proposal Work is intended to be performed during normal working hours, except for activities that create excessive noise or causes a disruption in building services. In these instances, work shall be performed only when scheduled by the Owner, after hours, or on weekends.
6. Building will not be available to contractors until summer. Summer Break starts Friday May 24, 2024. Phased work will need to be coordinated with the district.
7. All Base and Alternate Proposal work shall be substantially completed by 11:00 p.m., August 04, 2024.
8. Contractor shall include cost to work double shifts and/or weekends as required to complete project by required substantial completion date.
9. Contractor shall include any required equipment expediting cost and charges to complete the work within the timeline established based on the associated notice to proceed listed, site availability, and substantial completion date.
10. The following is the associated proposal and award schedule for the project:
 - a. Pre-Bid Meeting: May 10, 2023 @ 10am CST.
 - b. Questions Due: May 12, 2023 by 4pm CST.
 - c. Final Addenda: May 16, 2023, posted by 4pm CST.
 - d. Proposals Due: May 18, 2023 by 2pm CST.
 - e. Board Meeting: June 19, 2023
 - f. Notice to Proceed: June 20, 2023.
11. Testing, adjusting, and Balancing (TAB) work may need to be done on nights and weekends after substantial completion date. TAB contractor shall include this in their bid price. TAB and commissioning contractors shall use this same proposal form.

The undersigned affirms that the above stipulated base Proposal sum represents the entire cost per drawings, specifications, and addenda and that no claim will be made on account of any increase in wage scales, material prices, taxes, insurance, cost indexes, or any other rates affecting the construction industry and/or this project.

The undersigned Proposer agrees that this Proposal shall be good and may not be withdrawn for a period of 45 calendar days after the scheduled closing time for receiving Proposals.

The undersigned Proposer understands that the Owner reserves the right to reject any or all Proposals and to waive any informalities in the Proposal.

The Owner reserves the right to require Bonds of the successful Proposer. If written notice of acceptance of this Proposal is received within 45 days after date designated for opening of Proposals, the undersigned, within 10 days of receipt of the Contract, will sign and deliver to the Owner the contract and any required Performance Bond, Labor and Material Payment Bond and properly executed Insurance Verification Form required by the Owner.

Should the undersigned fail to deliver the signed Contract or the required Bonds or Insurance Form within the 10 day period, the Owner reserves the right to terminate the relationship.

TIME OF COMPLETION AND LIQUIDATED DAMAGES

1. The contract date will be established as the number of consecutive calendar days as set out on the proposal form from the "Notice-to-proceed" date issued by the Owner.
2. Failure of the Contractor to complete the Work by the contract date will result in damages being sustained by the Owner. Such damages are, and will continue to be, impracticable and extremely difficult to determine. Due consideration will be given to delays falling within agreed terms of the contract.
3. The Contractor will pay the Owner Five Hundred Dollars (\$500.00) for each calendar day of delay in finishing the Work in excess of time specified for completion, plus authorized time extensions. Execution of the Contract under these specifications shall constitute agreement by the Owner and Contractor that the amount indicated is the minimum value of the costs and actual damage caused by failure of the Contractor to Substantially Complete the Work within the allotted time, that such sum is Liquidated Damages and shall not be construed as a penalty, and that such sum may be deducted from payments due the Contractor if such delay occurs.

Addenda: The undersigned hereby acknowledges receipt of the following addenda to the Drawings and Specifications, all of the provisions and requirements of which addenda have been taken into consideration in the preparation of this Proposal.

Addendum No. _____ dated _____ Addendum No. _____ dated _____

Addendum No. _____ dated _____ Addendum No. _____ dated _____

Addendum No. _____ dated _____ Addendum No. _____ dated _____

Date: _____

Signed _____

Title _____

Name of Firm _____

Organized as a: (Mark one)

Proprietorship _____

Partnership _____

Corporation _____

Under the law of the State Of:

(Date)

Legal Address:

Telephone No. _____

Fax No. _____

E-mail _____

If Proposal is by a corporation, affix seal above address.

END OF PROPOSAL FORM

SECTION 00 42 00**CONTRACTOR QUALIFICATION REQUIREMENTS****CONTRACTOR QUALIFICATION REQUIREMENTS FOR HVAC REPLACEMENT AT
T.E. BAXTER ELEMENTARY SCHOOL**

The following requirements will be considered in determining the qualifications of prime contractors for proposing the construction referenced above. Failure to provide full information regarding all requirements may result in disqualification.

1. Contractor must have a Certificate of Authority to do business in the State of Texas.
2. Contractor must have an established office in the State of Texas.
3. Contractor must have been in similar construction business for at least five (5) years.
4. Negative responses from owners and architectural/engineering firms which are familiar with contractor's performance, depending on problems encountered, may be grounds for disqualification.
5. Contractor's own work staff must have performed at least 15% of the work on previous projects and must provide at least 15% of the Work of this Contract.
6. Contractor should have successfully completed in Texas at least two (2) projects of similar scope and complexity over the last four years.
7. As an attachment to the proposal, provide the following specific criteria citing special qualifications to execute this Contract as a prerequisite Contract award. Organize the information in the following format:
 - a. Organization:
 - 1) Stability and capability.
 - 2) Staff structure for this Project.
 - 3) Personnel assigned to this Project.
 - b. Experience:
 - 1) Projects of similar scope.
 - 2) Projects of similar contract amount.
 - c. Work Load:
 - 1) Current work under other contract.
 - 2) Bonding limitations.
 - d. Record of Cost Control:
 - 1) Examples of similar projects.
 - 2) Techniques.

- e. Record of Quality Control:
 - 1) Examples of similar projects.
 - 2) Techniques.
 - f. References:
 - 1) Owners.
 - 2) Architects.
 - g. Financial Strength:
 - 1) History.
 - 2) Resources.
 - 3) References.
8. Proposal will be compared on the basis of the proposed contract and qualifications of the firm to accomplish the projects outlined in Section 01 01 00.

END OF SECTION

SECTION 00 61 00**PERFORMANCE BOND**

THE STATE OF TEXAS KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF _____)

THAT we, _____

as Principal, and _____
as Surety, are hereby held and firmly bound unto MIDLOTHIAN INDEPENDENT SCHOOL DISTRICT, hereafter called Obligee, in the penal sum of \$_____ which is the full amount of Principal's contract with the named Obligee, for the payment of which sum the said Principal and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally firmly by these presents.

WHEREAS, the principal has entered into a written contract dated _____ with Obligee named, to do and perform certain construction work as provided in said contract and the related plans, specifications, general conditions and other contract documents, all of which are by reference made a part hereof.

NOW, THEREFORE, the conditions of this Obligation is such that if the Principal shall faithfully perform all of the work in accordance with the plans, specifications general conditions and contract documents, and shall faithfully perform each, every and all other obligations incumbent upon him under the terms of said written contract referred to, and shall fully indemnify and save harmless the Obligee from all costs, expense and damage which it may suffer or incur because of Principal's default, or failure so to do, then this obligation shall be void, otherwise it shall remain in full force and effect.

In the event Principal shall default in the faithful performance of the work called for by said written contract, plans, specifications and contract documents, the Surety shall within 15 days of the determination of default (determined as provided in said contract, general conditions and contract documents) take over and assume completion of said contract, or within such 15 day period make other arrangements satisfactory with the Obligee for completion of the contract, and said Surety shall become entitled thereupon to the payment or benefit of the balance of the contract price as the same matures according to its terms.

The Surety, for the protection of the Obligee herein, waives notice of, and hereby consents to any subsequent modification or alteration both in the work to be performed by the Principal, and the consequent price or sums to be paid by the Obligee, as well as any other change, or amendment, addition or deletion in the contract documents during the progress of the work, including but not limited to all extensions of time or other indulgences permitted the Principal.

Notwithstanding any other provision, the liability of the Surety on this bond shall never exceed the penal sum stated in first paragraph.

This Performance Bond is given in compliance with the terms and provisions of the Revised Civil Statutes of the State of Texas, and this bond and all of the provisions herein contained shall be solely for the protection of the named Obligee which has awarded the contract referred to.

The undersigned, corporate Surety, does by the execution of this Bond solemnly warrant and represent that it is duly authorized to do business in Texas.

Executed this _____ day of _____, 20____.

Attest: Principal _____

By _____

Title _____

Approved as to Form by Obligee:

_____ Surety

By _____ By _____

Title _____

NOTES:

1. This bond must be payable to the awarding authority, Midlothian Independent School District, as the named Obligee, and it must be approved as to form by such awarding authority.
2. This bond must be furnished before any work is commenced.
3. Surety must be a corporate surety duly authorized to do business in Texas.
4. This PERFORMANCE BOND must be in the full amount of the contract which it secures.
5. Power of Attorney from Corporate Surety should be attached to this Performance Bond.

END OF BOND

SECTION 00 62 00**PAYMENT BOND**

THE STATE OF TEXAS KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF _____)

THAT we, _____

as Principal, and _____

as Surety, are hereby held and firmly bound unto MIDLOTHIAN INDEPENDENT SCHOOL DISTRICT, hereafter called Obligee, for the sole use, benefit and protection of all claimants supplying labor and material (as hereinafter defined) in the prosecution of the work provided for in the written contract hereafter referred to in the penal sum of \$_____, which is the full amount of Principal's contract with the named Obligee, for the payment of which sum the said Principal and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally firmly by these presents.

WHEREAS, the principal has entered into a written contract dated _____ with Obligee named, to do and perform certain construction work as provided in said contract and the related plans, specifications, general conditions and other contract documents, all of which are by reference made a part hereof.

NOW, THEREFORE, the conditions of this Obligation is such that if the Principal shall promptly make payments to all claimants supplying labor and material (as hereafter defined) in the prosecution of the work provided in said contract, the related plans, specifications, general conditions and other contract documents, then this obligation shall be void, otherwise it shall remain in full force and effect.

The Payment Bond is given in compliance with the terms and provisions of the Revised Civil Statutes of the State of Texas, and the claimants referred to in this bond are those defined by such Civil Statutes, and this bond shall be solely for the protection of all such claimants supplying labor and material as defined in such amendment, in the prosecution of the work provided for in said contract, and shall be for the use of each such claimant and one others.

The undersigned, corporate Surety, does by the execution of this Bond solemnly warrant and represent that it is duly authorized to do business in Texas.

Executed this _____ day of _____, 20____.

Attest: _____ Principal

By _____
Title _____

Approved as to Form by Oblige:

_____ Surety

By _____ By _____

Title _____

NOTES:

1. This bond must be payable to the awarding authority, Midlothian Independent School District, as the named Oblige, and it must be approved as to form by such awarding authority.
2. This bond must be furnished before any work is commenced.
3. Surety must be a corporate surety duly authorized to do business in Texas.
4. This PAYMENT BOND must be in the FULL amount of the contract.
5. Power of Attorney from Corporate Surety should be attached to this Payment Bond.

END OF BOND

SECTION 00 62 50**TEXAS CERTIFICATE OF EXEMPTION**

Purchaser's Name

Street Address

City, State, Zip Code

I claim an exemption from payment of sales and use taxes for the purchase of taxable item described below or on the attached order or invoice:

Description of items (or attached order or invoice) to be purchased:

I claim this exemption for the following reason: _____

I understand that I will be liable for payment of sales tax which may become due for failure to comply with the provisions of the state, city, county and/or metropolitan transit authority/city transit department sales and use tax laws and Comptroller rules regarding exempt purchases. Liability for the tax will be determined by the price paid for the taxable items purchased or the fair market rental value for the period of time used.

I understand that it is a misdemeanor to give an exemption certificate to the seller for taxable items which I know, at the time of purchase, will be used in a manner other than that expressed in this certificate and, upon conviction, may be fined up to \$500 per offense.

Seller: _____

Street Address: _____

City, State, Zip Code: _____

Purchaser's

Signature: _____ Date: _____ Phone: _____

Title: _____

This certificate does not require a number to be valid.

Sales and use of tax "exemption numbers" or "tax exempt numbers" do not exist.

This certificate should be furnished to the supplier. Do not send the completed certificate to the Comptroller of Public Accounts.

END OF TEXAS CERTIFICATE OF EXEMPTION

DOCUMENT 00 83 00**WAGE RATE SCHEDULE****PART 1 - GENERAL****1.1 REQUIREMENTS**

- A. Pay not less than minimum wage scale and benefits indicated on "Minimum Wage Schedule" as outlined below.
- B. Listed wages are minimum rates only.
- C. No claims for additional compensation will be considered by the Owner because of payments of wage rates in excess of applicable rate contained in this Contract.

1.2 APPLICABLE STANDARDS

- A. The Midlothian Independent School District has adopted the Federal Davis-Bacon wage rates for the use of contractors in determining wage rates in the District's area. Contractors may access the Department of Labor website at the following address to obtain these rates: [http:// www.access.gpo.gov/davisbacon/index.html](http://www.access.gpo.gov/davisbacon/index.html).

1.3 PAYROLL

- A. The Owner reserves following rights:
 - 1. To receive weekly payroll records.
 - 2. To have Contractor provide required earning statements to employees.

1.4 MINIMUM WAGE RATES

- A. Pay prevailing basic wage rate listed below, plus any applicable fringe benefits.
- B. This determination of prevailing wage rates shall not be construed to prohibit payment of more than rates named. Under no condition shall any laborer, workman or mechanic employed on this job be paid less than minimum wage rate.
- C. In execution of this Contract, Contractor must comply with all applicable state and federal laws, including but not limited to laws concerned with labor, equal employment opportunity, safety and minimum wage.

END OF DOCUMENT

SECTION 01 01 00**SUMMARY OF WORK****1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Work of this Contract consists of the furnishing of all labor, materials, services, equipment, and appliances required in conjunction with or properly incidental to the HVAC Replacement at T.E. Baxter Elementary School (Midlothian, Texas) for the Midlothian Independent School District.
- B. The Drawings and Specifications do not necessarily indicate or describe all work required for completion of Project. Contractor shall provide and install all incidentals reasonably inferable from the Contract Documents that are required for a complete Project.
- C. These documents describe the essential elements sufficiently to determine the scope of the Project.
- D. Provide all items required for complete operating systems including items not necessarily shown in these documents, but that can be reasonably inferred as being required for a complete operating system.
- E. The Drawings and Specifications indicate the basic quality of material and quality of construction required for entire Project.

1.2 RELATED REQUIREMENTS

- A. Division 1 - General Requirements of Project Manual governs execution of Specification Sections within Divisions 2 through 28, inclusive.

1.3 WORK SEQUENCE

- A. Construct Work in stages to accommodate Owner's use of premises during construction period. Coordinate construction schedule and operations with Owner's Representative:
 - 1. Do not interrupt any existing utilities while school is in session.
 - 2. Existing utilities must be maintained and uninterrupted as noted above and in accordance with provisions in Supplementary Conditions to the Contract.
- B. Minimum disruption of school operation and use of adjacent facilities and access to those facilities is required. Cooperation with Owner to minimize inconvenience is essential.

- C. Construct the Work in stages to provide for public convenience. Do not close off public use of facilities until completion of one stage of construction will provide alternative usage.
- D. Stages of construction are those indicated on Drawings, unless noted otherwise.
- E. Owner may require certain work to be performed after normal working hours or on holidays or weekends. Refer to Supplementary Conditions of the Contract for specific requirements.

1.4 CONTRACTOR'S USE OF PREMISES

- A. Contractor shall have complete use of the immediate premises of the Project site for execution of the Work of this Contract after issuance of notice to proceed.
- B. Coordinate use of premises under direction of Engineer and Owner. Contractor shall be responsible for monitoring the use of premises by Contractor's employees and sub-contractors.
- C. Access routes for delivery of materials and equipment shall be as indicated by the Owner. Do not use access routes other than those indicated without permission of the Owner.
- D. Assume full responsibility for the protection and safekeeping of Products under this Contract, stored on the site. Store materials and products only in those areas indicated for staging.
- E. Move any stored Products, under Contractor's control, which interfere with operations of the Owner or separate contractor, or as required by Engineer. Do not unnecessarily encumber project site with materials and equipment.
- F. Staging and material storage shall be limited to the areas indicated by the Owner. Obtain specific permission from the Engineer for the use of other areas for storage and staging.
- G. Do not overload existing or new structures with weight that would compromise safety. Verify design loads for structure if necessary prior to loading structure.
- H. Obtain and pay for the use of additional storage or work areas needed for operations.
- I. Protect existing lawns, sidewalks, pavements, curbs and utilities subject to damage by work under this Contract. Repair or replace any existing work damaged by the Contractor. Replace existing lawns damaged by Contractor's activities with sod to provide full stand of replacement grass.
- J. Parking areas for Contractor's personnel shall be as acceptable to Owner.

1.5 WORK ON EASEMENTS, R.O.W., AND ADJACENT PROPERTY

- A. Obtain permission from other property Owners, obtain and pay all fees required by applicable governing authorities, prior to commencing with work on easements, right-of-ways, and adjacent property. This also applies to the transport of cranes and other related equipment.
- B. Post all notices and warning signs required by applicable governing authorities.
- C. Perform work on easements, right-of-ways, and adjacent property in accordance with local codes and ordinances and utility company requirements.

1.6 OWNER OCCUPANCY

- A. Cooperate with Owner's Representative in all construction operations to minimize conflict and to facilitate Owner usage.
- B. Contractor shall at all times conduct his operations as to ensure least inconvenience to general public.
- C. Maintain at all times safe access and egress from existing building. Maintain safe exit paths from building for emergency egress.
- D. All construction equipment, materials or work must be adequately fenced and protected.
- E. Any damage or interruption to any of Owner's existing utilities or services described above in Item 1.4 shall be repaired immediately. Contractor shall immediately place an adequate work force at place of disruption to minimize time required for repairs. Contractor shall make every effort to expedite repairs, regardless of cause of damage, or responsibility for damage, to return damaged utility or service to full operation as quickly as possible.

1.7 PARTIAL OWNER OCCUPANCY

- A. Contractor agrees to use and occupancy of Project by Owner prior to Substantial Completion of entire Project.
- B. Use and occupancy prior to Substantial Completion of entire Project does not relieve Contractor of responsibility to maintain specified insurance coverages on 100% basis for benefit of Owner, Contractor and subcontractors until Project is complete and accepted by Owner.
- C. Contractor provides for:
 - 1. Access for Owner's personnel.

2. Temporary operation of heating, ventilating, air-conditioning and electrical systems.
 3. Access for public to extent allowed by Owner.
- D. Operation: During occupancy, mutually acceptable arrangements shall be negotiated between Owner and Contractor regarding warranties and insurance requirements respecting portions of Work affected by partial occupancy and regarding operation and cost of building services so that costs attributable to partial occupancy shall be borne by Owner and costs attributable to performance of Work shall be borne by Contractor.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 02 00**ALLOWANCES****1.1 REQUIREMENTS INCLUDED**

- A. Include in Contract Sum allowances stated in the Contract Documents.
- B. Designate in construction progress schedule delivery dates for Products specified under each allowance.
- C. Designate in Schedule of Values quantities of materials required under each unit cost allowance.

1.2 RELATED SECTIONS

- A. Conditions of the Contract.
- B. Section 01 02 50: Measurement and Payment.

1.3 ALLOWANCES FOR PRODUCTS

- A. The amount of each allowance includes:
 - 1. The cost of the Product to the Contractor or Subcontractor, less any applicable trade discounts.
 - 2. Delivery to the site.
 - 3. Labor required under the allowance, except when labor is specified to not be included in the allowance.
 - 4. Applicable taxes.
- B. In addition to the amount of each allowance, include in the Contract Sum the Contractor's costs for the following, unless otherwise noted:
 - 1. Handling at the site; including unloading, uncrating, and storage.
 - 2. Protection from the elements and from damage.
 - 3. Labor for installation and finishing where labor is specified to not be a part of the allowance.
 - 4. Other expenses required to complete the installation.
 - 5. Contractor's and Subcontractor's overhead and profit.

1.4 SELECTION OF PRODUCTS UNDER ALLOWANCES

- A. Engineer's Duties:
 - 1. Consult with the Contractor in consideration of Products and suppliers or installers.
 - 2. Make selection in consultation with the Owner.
 - 3. Obtain Owner's written decision, designating:

- a. Product, model and finish.
 - b. Accessories and attachments.
 - c. Supplier and installer as applicable.
 - d. Cost to Contractor, delivered to the site or installed, as applicable.
 - e. Manufacturer's Warranties.
- 4. Transmit Owner's decision to the Contractor.
 - 5. Prepare Change Orders.

B. Contractor's Duties:

- 1. Assist Engineer and Owner in determining qualified suppliers or installers.
- 2. Obtain proposals from suppliers and installers when requested by Engineer.
- 3. Make appropriate recommendations for consideration of the Engineer.
- 4. Notify Engineer promptly of:
 - a. Any reasonable objections Contractor may have against any supplier, or party under consideration for installation.
 - b. Any effect on the Construction Schedule anticipated by selections under consideration.

1.5 CONTRACTOR RESPONSIBILITY FOR PURCHASE, DELIVERY AND INSTALLATION

- A. On notification of selection, execute purchase agreement with designated supplier.
- B. Arrange for and process Shop Drawings, Product Data and Samples, as required.
- C. Make all arrangements for delivery.
- D. Upon delivery, promptly inspect products for damage or defects.
- E. Submit claims for transportation damage.
- F. Install and finish products in compliance with requirements of referenced specification sections.

1.6 ADJUSTMENT OF COSTS

- A. Should the net cost be more or less than the specified amount of the allowance, the Contract Sum will be adjusted accordingly by Change Order.
 - 1. The amount of the Change Order will recognize any changes in handling costs at the site, labor, installation costs, overhead, profit, and other expenses caused by the selection under the allowance.
 - 2. For products specified under a unit cost allowance, the unit cost shall apply to the quantity listed in the Schedule of Values.

3. For products specified under unit allowance, unit cost allowance shall apply to quantities actually used with nominal amount for waste, as determined by receipts, invoices or by field measurement.
- B. Submit any claims for anticipated additional costs at the site, or other expenses caused by the selection under the allowance, prior to execution of the work.
- C. Submit documentation for actual additional costs at site, or other expenses caused by selection under allowance within 60 days after completion of execution of Work.
- D. Failure to submit claims within the designated time will constitute a waiver of claims for additional costs.
- E. At contract closeout, reflect all approved changes in contract amounts in the final statement of accounting.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 CONTINGENCY ALLOWANCE

- A. Include in Base proposal Contract Sum lump-sum general Contingency Allowances in the amount of:
 1. Eighty Thousand Dollars (\$80,000.00).
 2. Amounts authorized under a Contingency Allowance Expenditure Authorization (CAEA) shall not include any additional amounts for bonds, insurance, overhead or profit, as these additional costs for the allowance are to be included in the contract sum.
 3. Change orders will include such additional costs as provided in the Conditions of the Contract.
- B. Include in the Base proposal Contract Sum lump-sum Structural Testing Allowance for IBC 2018 required 3rd Party testing of various items as denoted on the structural drawings in the amount of Seven Thousand Five Hundred Dollars (\$7,500.00).
 1. Amounts authorized under a Testing Allowance Expenditure Authorization (TAEA) shall not include any additional amounts for bonds, insurance, overhead or profit, as these additional costs for the allowance are to be included in the contract sum.
 2. Change orders will include such additional costs as provided in the Conditions of the Contract.
- C. No additional contingency allowances shall be included in any of the alternates.

- D. Monies in contingency allowance will be used only on issuance of contingency allowance expenditure authorization or change order.
- E. At closeout of Contract, monies remaining in contingency allowance will be credited to Owner by change order.

END OF SECTION

SECTION 01 02 50**MEASUREMENT AND PAYMENT****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Unit prices.
- B. Application for Payment.
- C. Change Order Procedures.

1.2 RELATED REQUIREMENTS

- A. Conditions and Provisions of the Contract.

1.3 APPLICATIONS FOR PAYMENT

- A. Progress payments shall be made as the Work proceeds at intervals stated in the Contract.
- B. All Work covered by Progress Payments shall, at the time of payment, become the property of the Owner.
- C. Form of Application for Payment will be notarized AIA Document G702 - Application and Certification for Payment, supported by AIA Document G703 - Continuation Sheet, submitted in quadruplicate.
- D. Contractor to submit to Engineer within 15 days of execution of Owner/Contractor Agreement proposed sample of Lien Waiver and Bills Paid Affidavit forms for review and acceptance by Engineer for use on this Contract.
- E. Conditions governing regular schedule for applications, payment, and retainage are as stated in the Contract.
- F. Monthly Applications for Payment shall include Waivers of Liens for all Work included in the previous months' Application for Payment. Waiver of Liens for the subcontractors and materialmen shall be the total amount paid prior to the previous month's Application for Payment.
- G. With each Application for Payment, Contractor shall certify that such Application for Payment represents a just estimate of cost reimbursable to Contractor under terms of Contract, and shall also certify that there are not any Mechanics' or Materialmen's Liens outstanding at the date of this Application for Payment, that all due and payable bills

with respect to the Work have been paid to date or shall be paid from proceeds of that Application for Payment, and that there is no known basis for the filing of any Mechanics' or Materialmen's Liens against the surety in connection with the Work, and that Waivers and Bills Paid Affidavit forms from all subcontractors and materialmen have been, or will be, obtained in the form specified in the Contract.

1.4 CONSTRUCTION CHANGE ORDER PROCEDURES

- A. Contractor to submit to Engineer within 15 days of execution of Owner/Contractor Agreement name of individual 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. Computation for changes in Work will be computed in one of the manners described in the Conditions of the Contract.
- D. Initiation of Changes:
 - 1. Engineer may submit Proposal Request which includes detailed description of change with supplementary or revised Drawings and Specifications.
 - 2. Contractor may initiate a proposed change by submittal of a request to Engineer describing proposed change with statement of reason for change, and proposed effect on Contract Sum and Contract Time with full documentation, and a statement of the effect on Work of separate contractors. Document any requested substitutions. Submission of such requests and receipt of same by Engineer does not mean acceptance, or approval, of proposed change.
 - 3. Contractor shall incorporate into his Construction Progress Schedule sufficient time for Owner's review process. Proposed changes, not within the scope of the

Contingency Allowance described in Section 01 02 00, will be reviewed and approved or rejected only by the Midlothian Independent School District at their next regularly scheduled meeting after proposal is prepared by Engineer. Meetings of the School Board are regularly scheduled at four (4) week intervals.

4. Owner's schedule for review and acceptance or rejection of proposed changes will not be grounds for extensions in Contract Time.

E. Authorization:

1. The Owner may request, through the Engineer, a Construction Change Directive, in writing, instructing Contractor to proceed with changes of all or in part of Work, for subsequent inclusion in a Change Order that is pending. Directive will propose basis for necessary adjustments, if any, to Contract Sum or Time.
2. All changes that affect Contract Sum and/or Contract Time will require a Change Order signed by the Owner and the Engineer. Contractor's signature indicates agreement. Any other orders, written or oral, by the Owner through the Engineer or by the Engineer shall be treated as a Change Order only if Contractor gives Owner proper written notice as described in Conditions of Contract.
3. Promptly execute the change in Work only upon receipt of 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 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 any 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.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 04 00**COORDINATION****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. General Project coordination of different Contract phases, trades and disciplines.

1.2 RELATED REQUIREMENTS

- A. Section 01 01 00: Summary of Work.
- B. Section 01 04 50: Cutting and Patching.
- C. Section 01 30 00: Submittals.
- D. Section 01 60 00: Material and Equipment.
- E. Section 01 70 00: Contract Closeout.

1.3 GENERAL COORDINATION

- A. Coordinate scheduling, submittals, and work of various Sections of Specifications to assure efficient and orderly sequence of installation of construction elements with provisions for accommodating items furnished by Owner to be installed by Contractor.
- B. Coordinate sequence of Work to accommodate partial Owner occupancy as specified in Section 01 01 00.
- C. Contractor shall review and coordinate requirements of Divisions 22, 23, and 26 in Project Manual, and M.E.P. drawings with other Work. Report discrepancies to Engineer.
- D. Contractor shall maintain services of major subcontractors throughout duration of Contract, except as required by provisions of Conditions of Contract. Contractor shall notify Engineer in writing of intention to replace subcontractor(s), outlining reasons for the action and naming proposed replacement subcontractor.
- E. Contractor shall be responsible for coordination of Work of subcontractors, and for recording subcontractor installation data on Project Record Drawings in accordance with Section 01 70 00.
- F. Communications to Owner from Contractor regarding Contract requirements shall be through Engineer unless otherwise noted.

1.4 COORDINATION MEETINGS

- A. In addition to Progress Meetings scheduled in Section 01 20 00, Contractor shall hold coordination meetings and pre-installation meetings with Contractor's personnel, subcontractors, material men, and Engineer, as necessary, to assure coordination of different trades and disciplines.

1.5 COORDINATION OF SUBMITTALS

- A. Schedule and coordinate submittals.
- B. Coordinate Work of various trades having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate requests for substitutions to assure compatibility of space, of operating elements, effect on Work of other trades, and on Work scheduled for early completion.

1.6 COORDINATION OF SPACE AND INSTALLATION SEQUENCE

- A. Coordinate use of Project space and sequence of installation of equipment, walks, mechanical, electrical, plumbing, or other Work that is indicated diagrammatically on Drawings. Follow routings shown for tubes, pipes, ducts, conduits, and other items as closely as practical, with due allowance for available physical space. Make runs parallel with lines of building, unless noted otherwise. Utilize space efficiently to maximize accessibility for other installations, for Owner maintenance, and for repairs.
- B. In finished areas, except as otherwise shown, conceal ducts, pipes, wiring, and other non-finish items within construction. Coordinate locations of concealed items with finish elements.
- C. Coordinate with engineering reflected ceiling plans exact location and dimensioning of items which occur within hung ceilings. In event of conflict, request clarification from Engineer prior to proceeding with fabrication or installation.
- D. Contractor shall be responsible for coordination of Work. Each subcontractor shall be responsible for coordination of their respective Work with the Work of the Contractor and other trades.

1.7 COORDINATION OF CONTRACT CLOSEOUT

- A. Coordinate completion and cleanup of Work of separate phases and sections in preparation for Substantial Completion of portions of Work designated for Owner partial occupancy as designated in Section 01 01 00.

- B. After Owner occupancy of premises, coordinate access to site by requirements of individual Specification Sections regarding correction of defective Work and Work not in accordance with Contract Documents. Minimize disruption of Owner's operations.
- C. Assemble and coordinate Closeout submittals in accordance with Section 01 70 00.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 04 50
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Requirements and limitations of cutting and patching of Work.
- B. Contractor shall be responsible for all cutting, fitting and patching, required to complete the Work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Provide routine penetrations of non-structural surfaces for installation of mechanical and electrical Work.
 - 7. Uncover work that has been covered prior to Engineer's required observation.

1.2 RELATED REQUIREMENTS

- A. Conditions of the Contract: basic responsibilities of each party to Contract.
- B. Section 01 01 00: Summary of Work.
- C. Section 01 04 00: Coordination.
- D. Section 01 30 00: Submittals.
- E. Section 01 40 00: Quality Control.
- F. Section 01 60 00: Material and Equipment.
- G. Divisions 2 through 28: Cutting and patching incidental to Work of respective Sections.

1.3 SUBMITTALS

- A. Submit a written request to Engineer well in advance of executing any cutting or alteration which affects:
 - 1. Work of the Owner or any separate contractor.
 - 2. Structural value or integrity of any element of the Project.
 - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 4. Efficiency, operational life, maintenance or safety of operational elements.
 - 5. Visual qualities of sight-exposed elements.

B. Request shall include:

1. Identification of the Project.
2. Location and description of affected work.
3. The necessity for cutting, alteration or excavation.
4. Effect on work of Owner or any separate contractor, or on structural or weatherproof integrity of Project.
5. Description of proposed work:
 - a. Scope of cutting, patching or alteration.
 - b. Trades who will execute the work.
 - c. Products proposed to be used.
 - d. Extent of refinishing to be done.
 - e. Cost proposal when applicable.
 - f. Alternatives to cutting and patching.
6. Alternatives to cutting and patching.
7. Written permission of any separate contractor whose work will be affected.

C. Should conditions of Work or the schedule indicate a change of products from original installation, Contractor shall submit request for substitution as specified in Section 01 60 00.

D. Submit written notice to Engineer designating the date and the time the work will be uncovered or altered.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with specifications and standards for each specific product involved.
- B. Should conditions of work or schedule indicate change of products from original installation, submit a request for substitution as specified in Section 01 60 00.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine existing conditions of Project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of Products, or performance of work.
- C. Report unsatisfactory or questionable conditions to Engineer in writing; do not proceed with work until Engineer has provided further instructions.

- D. Beginning of cutting or patching operations shall be considered as acceptance of existing conditions by Contractor.

3.2 PREPARATION

- A. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of Work.
- B. Provide devices and methods to protect other portions of Project from damage.
- C. Provide protection from elements for that portion of the Project which may be exposed by cutting and patching work.
- D. Maintain excavations free from water.

3.3 DUST CONTROL

- A. Provide positive methods of dust control and apply dust control materials to minimize raising dust from cutting and patching operations.
- B. Conform to requirements for temporary barriers and enclosures described in Section 01 50 00 for cutting and patching operations, and additional temporary controls.

3.4 PERFORMANCE

- A. Execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.
- B. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
- C. Restore work which has been cut or removed; install new products to provide completed Work in accordance with requirements of the Contract Documents.
- D. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces. Where fire-rated separations are penetrated, fill space around pipe or insert with material with physical characteristics equivalent to fire-resistance requirement of penetrated surface.
- E. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
 - 1. For continuous surfaces, refinish to nearest intersection.
 - 2. For an assembly, refinish entire unit.

END OF SECTION

SECTION 01 05 00**FIELD ENGINEERING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Furnish and pay for field engineering services required for Project.
 - 1. Civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.
 - 2. Survey work required for execution of Work.
 - 3. Coordinate field engineering services with Project Engineer.

1.2 RELATED SECTIONS

- A. Conditions of the Contract.
- B. Section 01 01 00 - Summary of Work.
- C. Section 01 30 00 - Submittals.
- D. Section 01 70 00 - Contract Closeout.
- E. Divisions 2 through 26: Requirements of individual Sections.

1.3 QUALIFICATIONS OF ENGINEER

- A. Qualified engineer acceptable to Contractor and Owner.
- B. Registered professional engineer of discipline required for this Project licensed in the State of Texas.

1.4 SUBMITTALS

- A. Submit name and address of professional engineer to Project Engineer.
- B. Submit documentation to certify accuracy of field engineering work.
- C. Submit certificate signed by registered engineer certifying that locations of improvements are in conformance, or non-conformance, with Contract Documents.
- D. Maintain complete and accurate record data on all deviations in work as encountered during the execution of Work. Record data on Project Record Documents in accordance with requirements of Section 01 70 00.

22146.00

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 06 00**REGULATORY REQUIREMENTS****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- A. Division 1 - General Requirements of the Project Manual governs the execution of all Specification Sections within Divisions 2 through 26.

1.2 CODES

- A. Where references are made on Drawings or Specifications to codes, they shall be considered an integral part of the Contract Documents as minimum standards. Nothing contained in the Contract Documents shall be so construed as to be in conflict with any law, bylaw or regulation of the municipal, State, Federal or other authorities having jurisdiction.
- B. Perform Work in compliance with:
 - 1. 2018 International Building Code, with amendments.
 - 2. 2018 International Fire Code, with amendments.
 - 3. 2018 International Mechanical Code, with amendments.
 - 4. 2018 International Plumbing Code, with amendments.
 - 5. 2018 International Energy Conservation Code, with amendments.
 - 6. 2017 National Electric Code, with amendments.
 - 7. Applicable reference standards and requirements of:
 - a. American Society for Testing and Materials (ASTM).
 - b. National Fire Protection Association (NFPA).
 - 8. National, state and local barrier free codes, laws and ordinances.

1.3 GOVERNING LAWS

- A. Additional information with legal implications regarding applicable governing laws and jurisdictions can be found in Conditions of Contract.

1.4 FIRE RATINGS

- A. Where material, component, or assembly is required to be fire rated, fire rating shall be determined or listed by one of the following testing agencies or authorities:
 - 1. Underwriters Laboratories, Inc.
 - 2. Factory Mutual Laboratories.
 - 3. The National Board of Fire Underwriters.

- B. Where reference is made to only one testing authority, equivalent fire rating as determined or listed by another of above testing authorities is acceptable if approved by applicable governing authorities having jurisdiction.

1.5 PERMITTING

- A. Contractor shall, without additional expense to Owner, obtain necessary licenses and permits, and be responsible for complying with any Federal, state, county, and municipal laws, codes, and regulations applicable to the performance of the Work, including, but not limited to, any laws or regulations requiring the use of licensed contractors to perform parts of the Work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 07 00**DEFINITIONS AND TERMINOLOGY****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- A. Division 1 - General Requirements of the Project Manual governs the execution of all Specification Sections within Divisions 2 through 26.

1.2 SPECIFICATION TERMINOLOGY

- A. "Directed", "Designated", "Selected", or words of similar import: Direction, designation, selection, or similar action of Engineer is intended unless otherwise stated.
- B. "Require" and words of similar import: As required to complete the Work and as required by Engineer, unless otherwise stated.
- C. "Perform": Contractor, at his own expense, shall perform operations necessary to complete Work, including furnishing of necessary labor, tools and equipment, and further including and installing of materials indicated, specified or required to complete such performance.
- D. "Provide": Contractor, at his own expense, shall furnish and install Work complete in place and ready for use, including furnishing of necessary labor, materials, tools, equipment and transportation. Definitions apply same to future, present and past tenses, except word "provide" may mean "contingent upon" where such context is apparent.
- E. "Other acceptable manufacturer", "equal", "acceptable equal", "equivalent", or words of similar import: It shall be understood that such words are followed by expression "in sole opinion of the Engineer" even though such words may not appear in print, unless otherwise stated.
- F. "Acceptance", "acceptable", or words of similar import: Acceptance, acceptable or similar words shall be of Engineer, unless otherwise stated.
- G. "At no extra cost to Owner", "With no extra compensation to Contractor", "At Contractor's own expense", or words of similar import: Such terms shall be understood to mean that Contractor shall perform or provide specified operation of Work at no increase to Contract Sum stated in executed Contract.
- H. "NIC": Work of this Project which is not being performed or provided as part of Contract; term shall mean "Not in This Contract" or "Not a Part of the Work to be

Performed or Provided by Contractor". "NIC" work is indicated as aid to Contractor in scheduling amount of time and materials necessary for completion of Contract.

1.3 SPECIFICATION SENTENCE STRUCTURE

- A. Specifications are written in modified brief style. In general, words "the", "a", "an", "shall", "shall be", and "all" are not used. Requirements indicated and specified apply to all work of same kind, class, and type even though word "all" is not stated.
- B. Simple imperative mood of sentence structure is used in Specification Sections which places verb as first word in sentence. Where such words as "perform", "provide", "install", "erect", "furnish", "connect", "test", or words of similar import are used, it shall be understood that such words include meanings of phrase "The Contractor Shall..." before such words.
- C. Standard paragraph titles and other identifications of subject matter in Specifications are intended as aid in locating and recognizing various requirements in Specifications. Titles do not define, limit or otherwise restrict Specifications text. Capitalizing of words in text does not signify or mean that such words convey special or unique meanings having precedence over other parts of Contract Documents. Specification text shall govern over titling and shall be understood to be interpreted as a whole.

1.4 DOCUMENT ORGANIZATION

- A. Organization of Project Manual and Contract Drawings are not intended to control or to lessen the responsibility of Contractor in dividing Work among his subcontractors, or in establishing extent of Work to be performed by any trade.
- B. The Drawings, Specifications, and Supplementary Contract Documents are intended to be complimentary and to describe a complete Work. In cases of discrepancies, the Engineer shall be the sole determiner of the intent. Such interpretations by Engineer shall be in writing, and shall be consistent with, and reasonably inferable from, the intent of Contract Documents. In all other cases, the more expensive or higher quality of the questionable items will govern.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 12 00**ALTERATION PROJECT PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Division 1 - General Requirements of Project Manual governs the execution of all Specification Sections within Divisions 2 through 28.

1.2 RELATED REQUIREMENTS

- A. Section 01 01 00: Summary of Work.
- B. Section 01 04 50: Cutting and Patching.
- C. Section 01 30 00: Submittals.
- D. Section 01 50 00: Construction Facilities and Temporary Controls.
- E. Section 01 70 00: Contract Closeout.

1.3 SYSTEM DESCRIPTION

- A. Schedule Work in sequence and within time specified in Section 01 01 00.
- B. Submit separate detailed sub-schedule for alterations work, coordinate with Construction Schedules. Indicate the following as a minimum:
 - 1. Each stage of work and dates of occupancy of areas.
 - 2. Date of Substantial Completion for each area of alterations work, as appropriate.
 - 3. Trades and subcontractors employed in each stage.

1.4 QUALITY ASSURANCE

- A. Coordinate work of trades and schedule elements of alterations and renovation work by procedures and methods to expedite completion of Work.
- B. In addition to demolition work specified in Section 23 00 00 and that specifically shown, cut, move or remove items as necessary to provide access or to allow alterations and new work to proceed including items as follows:
 - 1. Repair or removal of unsanitary conditions.
 - 2. Removal of abandoned items and items serving no useful purpose, such as abandoned piping, conduit and wiring.

3. Removal of unsuitable or extraneous materials not indicated for salvage, such as abandoned furnishings and equipment, and debris, such as rotted wood, rusted metals and deteriorated concrete.
 4. Cleaning of surfaces, and removal of surface finishes as needed to install new work and finishes.
- C. Patch, repair and refinish existing items to remain, to specified condition for each material, with smooth transition to adjacent new items of construction.
 - D. Assign work of moving, removal, cutting and patching, to trades qualified to perform work in manner to cause least damage to each type of work and provide means of returning surfaces to appearance of new work.
 - E. Perform cutting and removal work to remove minimum necessary, and in manner to avoid damage to adjacent work. Cut finish surfaces such as masonry, tile, plaster or metals, by methods to terminate surfaces in straight line at natural point of division.
 - F. Perform cutting and patching as specified in Section 01 04 50.
 - G. Protect existing finishes, equipment and adjacent work which is scheduled to remain from damage. Protect existing and new work from weather and extremes of temperature. Maintain existing interior work above 60 degrees F. Provide weather protection, waterproofing, heat and humidity control as needed to prevent damage to remaining existing work and to new work.
 - H. Provide temporary enclosures to separate work areas from existing building and from areas occupied by Owner, and to provide weather protection.
 - I. Discoveries of construction, furnishings and articles having historic or private value shall remain in the possession of Owner.
 1. Promptly notify Engineer of discovery.
 2. Protect discovery from damage from elements of work.
 3. Engineer will promptly transmit Owner's decision for disposition of discovery.
 4. Contractor shall store items to be retained by Owner in safe, dry place on site, or shall dispose of items which Owner releases.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Salvage sufficient quantities of cut or removed material to replace damaged work of existing construction, when material is not readily obtainable on current market. Store salvaged items in dry, secure place on site.
- B. Items not required for use in repair of existing work shall remain property of Owner.

- C. Do not incorporate salvaged or used material in new construction except with permission of Engineer.

2.2 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

- A. Provide same products or types of construction as that in existing structure, as needed to patch, extend or match existing work. Generally Contract Documents will not define products or standards of workmanship present in existing construction. Contractor shall determine products by inspection and any necessary testing and by use of existing as sample of comparison.
- B. Presence of product, finish or type of construction, requires that patching, extending or matching shall be performed as necessary to make Work complete and consistent to identical standards of quality.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor's Examination of Site:
 1. By executing contracts, Contractor and each subcontractor shall represent that they have:
 - a. Visited the site.
 - b. Made due allowances for difficulties and contingencies to be encountered.
 - c. Compared Contract Documents with work in place.
 - d. Informed themselves of existing conditions and work by others being performed.
 - e. Notified the Engineer of any ambiguity, inconsistency or error they have discovered within the Contract Documents or between the Contract Documents and existing conditions.
 2. Failure to visit site shall in no way relieve Contractor or subcontractor from furnishing materials or equipment or performing work that may be required to complete Work in accordance with Contract Documents at no additional cost.
 3. Contractor or subcontractors will not be given extra payment for work related to conditions which can be determined by examinations of the site conditions.
 4. Contractor or subcontractors will not be given extra payment for work related to ambiguities, inconsistencies or errors within the Contract Documents and the existing conditions, when such ambiguities, inconsistencies or errors are known or should have been known by Contractor or subcontractors prior to execution of Contract, unless Contractor or subcontractors have notified Engineer in writing of such condition prior to execution of Owner/Contractor Agreement.

3.2 PREPARATION

- A. Existing building will remain in use by Owner.
- B. Access by Contractor to portions of Owner's property beyond the actual area of Work under this Contract is denied, except where necessary to perform the Work, and then only with specific written approval from Owner for each incidence.
- C. Contractor shall accept site and existing building in condition in which they exist at time he is given access to begin the Work.
- D. While Work under this Contract is in progress, protect existing buildings, grounds, contents and occupants, including those on adjacent property, whether private or public, from damage or harm due to Work under this Contract.

3.3 APPLICATION

- A. Quality of patched or extended work shall not be less than that specified for new work.
- B. When new work abuts or finishes flush with existing work, make smooth transition. Patched work shall match existing adjacent work in texture and appearance so that patch or transition is invisible at distance of 5'.
- C. When finished surfaces are cut in such manner that smooth transition with new work is not possible, terminate existing surface in straight line at natural line of division, and provide trim appropriate to finished surface.

3.4 ADJUSTING

- A. Where extreme change of plane of 2" or more occurs, request instructions from Engineer as to method of making transition.
- B. Provide adequate support of substrate prior to patching finish.
- C. Refinish patched portions of painted or coated surfaces in manner to produce uniform color and texture over entire surface. When existing surface finish cannot be matched, refinish entire surface to nearest intersections.

3.5 CLEANING

- A. Perform periodic and final cleaning.
- B. At completion of work for each trade, clean area and make surfaces ready for work of successive trades.

- C. At completion of alterations work in each area, provide final cleaning and return space to condition suitable for use by Owner.

END OF SECTION

SECTION 01 20 00**PROJECT MEETINGS****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- A. General requirements of all specification sections.

1.2 REQUIREMENTS INCLUDED

- A. Contractor shall schedule and administer pre-construction meeting, periodic progress meetings, and specially called meetings and conferences throughout progress of Work.
 - 1. Prepare agenda for meetings.
 - 2. Distribute written notice of each meeting four working days minimum in advance of meeting date.
 - 3. Make physical arrangements for meetings.
 - 4. Preside at meetings.
 - 5. Record minutes and attenders; include significant proceedings and decisions.
 - 6. Reproduce and distribute copies of minutes after each meeting to participants in meeting and to parties affected by decisions made at meeting.
 - 7. Furnish four copies of minutes to Engineer.
- B. Representatives of Contractor, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of entity each represents.
- C. Engineer will attend meetings to ascertain that Work is expedited consistent with Contract Documents and construction schedules.

1.3 PRE-CONSTRUCTION MEETING

- A. A pre-construction meeting will be held at the construction job site prior to beginning of work at a time designated by the Engineer, but not later than 15 days after date of Notice to Proceed.
- B. Representatives of the Owner, Engineer and Contractor, Contractor's Superintendent, and major subcontractors shall be present.
- C. The following shall serve as a minimum agenda:
 - 1. Major subcontractors and suppliers.
 - 2. Tentative construction schedule (ref. Item 1.4 below).
 - 3. Critical work sequencing and phasing of construction.
 - 4. Major equipment deliveries and priorities.
 - 5. Designation of responsible personnel.

6. Procedures and processing of field decisions, proposal requests, submittals, color coordination, change orders and applications for payment.
7. Adequacy of distribution of Contract Documents.
8. Procedures for maintaining Record Documents.
9. Review of Shop Drawings.
10. Use of premises.
11. Construction facilities, controls and construction aids.
12. Temporary utilities.
13. Safety and first-aid procedures.
14. Security procedures.
15. Housekeeping procedures.
16. Discussion of project quality control procedures and requirements.

1.4 PRE-CONSTRUCTION SCHEDULING MEETING

- A. Within 15 days of written Notice-to-Proceed, Contractor, major subcontractors, Engineer and Owner shall meet to review scheduling requirements.
- B. The following shall serve as a minimum agenda:
 1. Designation of each parties representative in regard to scheduling.
 2. Designation and discussion of scheduling methodology.
 3. Schedule content requirements.
 4. Preliminary Network.
 5. Detailed Network.
 6. Schedule and Cost Report.
 7. Updates.
 8. Revisions.
 9. Progress payments.
 10. Time Impact Analysis.

1.5 PROJECT PROGRESS MEETINGS

- A. Schedule regular periodic progress meetings at the project field office, as required.
- B. Hold additional meetings as necessary by progress of construction activity.
- C. Representatives of the Engineer and his consultants as needed, Owner's project representative as needed, Contractor's Superintendent and major subcontractors as appropriate to the agenda, shall be present.
- D. The following shall serve as a minimum agenda:
 1. Review/approval of memorandum of previous meeting.
 2. Review of work progress since previous meeting.
 3. Field observations, problems, conflicts.
 4. Problems which impede Construction Schedule.
 5. Review of off-site fabrication, delivery schedules.
 6. Corrective measures and procedures to regain projected schedule.

7. Revisions to Construction Schedule.
 8. Progress schedule for succeeding work period.
 9. Coordination of schedules.
 10. Review submittal schedules and status of submittals.
 11. Maintenance of quality standards.
 12. Pending changes and substitutions.
 13. Review proposed changes for effect on construction schedule, on completion, date and effect on other contracts of Project.
 14. Other applicable business.
- E. Additional progress meetings shall be held by the Contractor at the project field office as required.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 30 00**SUBMITTALS****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Prepare and submit Construction Progress Schedule immediately after award of Contract. The Construction Progress Schedule shall be the integration of a horizontal bar chart schedule and a progress payment schedule.
 - 1. The purpose of the schedule shall be to encourage adequate planning of the Work to establish the standard to monitor work progress and progress payment requests, and relating submittal processing to work.
 - 2. Designate in the schedule, or in a separate coordinated schedule, the dates for submission and the dates reviewed Shop Drawings, Product Data and Samples will be needed.
- B. Submit Shop Drawings, Product Data and Samples required by Contract Documents.
- C. Schedule of Values:
 - 1. Prepare and submit Schedule of Values prepared in AIA Document Forms G702 and G703. Contractor's standard forms and automated printout will be considered for approval by Engineer upon Contractor's request. Identify schedule with:
 - a. Title of Project and location.
 - b. Engineer and Engineer's project number.
 - c. Name and address of Contractor.
 - d. Contract designation.
 - e. Date of submission.
 - 2. Schedule shall list the installed value of the components parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.

1.2 RELATED WORK

- A. Conditions of the Contract.
- B. Section 01 01 00: Summary of Work.
- C. Section 01 20 00: Project Meetings.
- D. Section 01 70 00: Contract Closeout - Record Documents.

1.3 CONSTRUCTION PROGRESS SCHEDULE DEVELOPMENT

A. Format:

1. Schedule shall develop and identify major Contract milestones in accordance with the requirements of this Project.
2. Prepare schedules as a minimum in the form of a horizontal bar chart.
3. Listings shall read from left to right, in ascending order for each activity. Identify each activity with the applicable specification section number.
4. Scale and spacing shall be sufficient to allow for notations and revisions.

B. Schedule Requirements:

1. Prepare horizontal bar chart schedule showing sequence, interdependency and time estimates for activity required for complete performance of work. The horizontal bar time duration shall consider the following:
 - a. Work required to be completed before each activity can start.
 - b. Work activities that can be done concurrently.
 - c. Work required to start immediately following the completion of each activity.
 - d. Major construction methodology, procedure or manpower restriction associated with sequence, phasing and Owner occupancy.
2. Failure to include any element of Work in the schedule required for the performance of the Contract shall not excuse the proper completion of the Work required within the time allowed for completion regardless of the acceptance of the Construction Progress Schedule.
3. Provide a value for each activity. The total of the activity values shall equal the total Contract amount. General Conditions costs, profit and bonds costs, and other Contractor overhead costs shall be prorated to each activity. Activity values shall be related and summarized to match any schedule of values and shall be considered in determining project status. For this purpose, the rate of activity value installation into the Work shall be assumed to be linear with time.

C. Progress Schedule Updating:

1. Construction Progress Schedule, following its initial acceptance, shall be updated monthly for recording, monitoring, and development of Progress Payment requests.
 - a. Contractor and Engineer shall meet monthly to review actual progress made to date, activities started and completed to date, and the percentage of the work complete to date on each activity started but not completed.
 - b. To evaluate the percentage of completed work, a review of scheduled activities estimates and supporting data will be used.
 - c. Engineer will mark the schedule as to current project status and transmit data to Contractor.

- d. Concurrently with the processing of the schedule update, Contractor shall utilize percentage completions as required for preparation of his monthly requisition for partial payment.
- 2. Procedure for monthly progress revisions:
 - a. Any revisions require the Engineer be notified in writing, stating the reason for proposed revisions.
 - b. Upon review of these proposed revisions and acceptance, the Engineer may request proposed revisions to be incorporated into schedule, at no additional cost to Owner.
 - c. Revisions to be incorporated shall be approved in writing at least two weeks prior to schedule update. Written notice shall describe revisions and reasons for revisions.
 - d. Reasonable requests revisions will be implemented by Engineer at his discretion.
- 3. Revisions of schedule:
 - a) Schedule revisions shall be current to the date of the latest update.
 - b) Engineer will determine if the actual progress is in sequence with the schedule.
 - c) Engineer will be the determiner of schedule status.
 - d) Revisions concerning schedule of activity or redistribution of cost shall be made only in the approved manner and amounts.
- 4. When requested, provide a narrative report including:
 - a. Discussion of problem areas, including current and anticipated delay factors, and their impact.
 - b. Corrective action taken or proposed, and its effect.
 - c. Description of revisions:
 - 1) Effect on schedule due to change in scope.
 - 2) Revisions in duration of activity.
 - 3) Other changes that may affect schedule.

D. Progress Payments:

- 1. The monthly updated Construction Progress Schedule shall be an integral part and basic element for which Progress Payment Certification shall be made.
- 2. Upon failure or refusal to provide this information, the Owner shall deem this failure to provide the estimate and that progress payment shall not be made.
- 3. The exceptions to the progress schedule shall be made within ten days of the receipt of the schedule.
- 4. Partial payment will be verified on the basis of the sum of the value of percentage complete multiplied by activity cost values for activities in progress. The same percentage complete shall apply to both time and cost value.
- 5. Application for progress payment shall be in accordance with requirements of Conditions of Contract provided by Owner.

E. Distribution of progress schedule:

1. Distribute copies of Construction Progress Schedule to the following:
 - a. Job site.
 - b. Subcontractors.
 - c. Other concerned parties; Engineer to approve distribution to parties that do not have a contractual interest in the Project.

1.4 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- A. Furnish schedule listing submittals required by various specification sections for shop drawings, product data and samples. Indicate sequence of submittals and dates required, include dates reviewed submittals will be required back from Engineer to maintain schedule. Allow sufficient time of 12 working days for Engineers review per submission.
1. Engineer reserves right to hold submittals until all applicable and related submittals are in Engineer's office to allow selection of all related items.
- B. Shop Drawings:
1. Present drawings in clear and thorough manner.
 2. Identify details by reference to sheet and detail, schedule or room numbers as shown on Contract Documents.
 3. Consecutively number shop drawings for each section of Work. Retain numbering system throughout all revisions.
 4. Show detail, materials, dimensions, thicknesses, methods of assembly, attachments, relation to adjoining Work and other pertinent data and information.
 5. Verify dimensions and field conditions. Clearly indicate field dimensions and field conditions.
 6. Check and coordinate shop drawings of any section or trade with requirements of other sections or trades as related thereto and as required for proper and complete installation of Work.
 7. Prepare composite shop drawings and installation layouts when necessary or requested to depict proposed solutions for tight field conditions. Coordinate in field and with affected subcontractors for proper relationship to work of other trades based on field conditions.
- C. Product Data:
1. Preparation:
 - a. Clearly mark each copy to identify pertinent products or models.
 - b. Show performance characteristics and capacities.
 - c. Show dimensions and clearances required.
 - d. Show wiring or piping diagrams and controls.
 - e. Indicate finish.

2. Manufacturer's standard schematic drawings and diagrams:
 - a. Modify drawings and diagrams to delete information which is not applicable to the Work.
 - b. Supplement standard information to provide information specifically applicable to the Work.

D. Samples:

1. Provide 3 office samples of sufficient size to clearly illustrate:
 - a. Functional characteristics of the product, with integrally related parts and attachment devices.
 - b. Full range of color, texture and pattern.
2. Field samples and mock-ups:
 - a. Erect, at the Project site, at a location acceptable to the Engineer.
 - b. Size or area: That specified in the respective specification section.
 - c. Fabricate each sample and mockup complete and finished.
 - d. Remove mock-ups at conclusion of Work or when acceptable to the Engineer.
3. Pay costs of samples and prepay delivery charges.

E. Coordination of Trades:

1. Contractor shall be responsible for coordination of Work. Each structural, mechanical and electrical subcontractor shall be responsible for coordination of their portions of the Work with Contractor and with each affected trade.
2. Hold a coordination meeting with all trades attending to coordinate the work of the trades of each phase, each floor, and each mechanical area.
3. Coordinate with the architectural reflected ceiling plans the exact location and dimensioning of items which occur within hung ceilings. In the event of conflict, request a clarification from the Engineer as to the correct location of items in question.

F. Contractor Review:

1. Review submittals prior to transmittal.
2. Apply Contractor's stamp to submittals, initialed or signed by authorized person and dated, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of information within submittal with requirements of work and of Contract Documents.
3. Submittals without Contractor's stamp and submittals which, in Engineer's opinion are incomplete, contain numerous errors or have not been checked or have only been checked superficially, will be returned without disposition. Delays resulting therefrom shall be Contractor's responsibility.
4. Clearly note proposed deviations from Contract Documents or submittals.
5. Contractor shall be responsible for quantities and dimensions shown on submittals.

G. Submittals shall contain:

1. The date of submission and the dates of any previous submissions, when applicable.
2. The Project title and number.
3. Contract identification.
4. The names of:
 - a. Contractor.
 - b. Supplier.
 - c. Manufacturer.
5. Identification of the product, with the specification section number.
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 Specification numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8 in. x 3 in. blank space for Contractor and Engineer stamps.
12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification 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.
13. Submittal numbering system acceptable to Engineer.

H. Resubmission Requirements:

1. Make any corrections or changes in the submittals required by the Engineer and resubmit as required until approved.
2. Shop Drawings and Product Data:
 - a. Revise initial drawings or data, and resubmit as specified for the initial submittal.
 - b. Indicate any changes which have been made other than those requested by the Engineer.
3. Samples: Submit new samples as required for initial submittal.
4. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by Engineer's review of submittals unless Engineer gives written acceptance of specific deviations.

I. Engineer's Duties:

1. Review submittals with reasonable promptness and in accord with schedule for conformity to requirements of Contract Documents and to design intent.
2. Review of submittals is only for conformance with the design concept of the Project and compliance with the information given in the Contract Documents. Contractor is responsible for dimensions to be confirmed and correlated at job site, information that pertains solely to the fabrication process or to techniques of construction and for coordination of the work of all trades. Approval shall not

relieve Contractor of responsibility for any deviation from the requirements of the Contract Documents.

3. Affix stamp and initials or signature, and indicate requirements for revisions and resubmittal, if any.
4. Return submittals to Contractor for distribution, or for resubmission.

J. Distribution:

1. Distribute reproductions of Shop Drawings and copies of Product Data which have been reviewed by the Engineer and do not require revisions.
 - a. Job site file.
 - b. Record Documents file.
 - c. Other affected contractors.
 - d. Subcontractors.
 - e. Supplier or Fabricator.
2. Distribute samples which have been approved by the Engineer as directed by the Engineer.
3. Shop Drawings, product data, and samples used for field installation shall bear the review stamp of the Engineer.

1.5 SCHEDULE OF VALUES

- A. Follow the table of contents of this Project Manual as the format for listing component items.
 1. Identify each line item with the number and title of the respective major section of the specifications.
- B. For each major line item list sub-values of major products or operations under the item.
- C. For the various portions of the Work:
 1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 2. For items on which progress payments will be requested for stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with taxes paid.
 - b. The total installed value.
 3. Submit a sub-schedule for each separate stage of work, building or area.
- D. The sum of all values listed in the schedule shall equal the total Contract Sum.
- E. Itemize separate line item cost for each of following general cost items:
 1. Performance and Payment Bonds.
 2. Field supervision and layout.
 3. Temporary facilities and controls.

4. Contractor's fee.
- F. Submit quantities of designated materials. List quantities of materials specified under unit price allowances.
- G. Initial Submittal:
 1. Submit initial schedule at least 15 days prior to first application for payment for review by the Engineer.
 2. Upon request of Engineer, support values with data which will substantiate their correctness.
- H. Resubmittal:
 1. After review by Engineer, revise and resubmit schedule as necessary.
 2. Resubmit revised schedule monthly in same manner.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 40 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform specified testing of work and materials at the Project Site.
 - 1. Contractor shall cooperate with the laboratory to facilitate the execution of its required services.
- B. Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform specified services and testing of work and materials at the point of manufacture or fabrication.

1.2 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities:
- B. Respective sections of specifications: Certification of products.
- C. Each specification section listed: Laboratory test required, and standards for testing.

1.3 QUALIFICATION OF CONTRACTOR'S LABORATORY

- A. Meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories.
- B. Meet basic requirements of ASTM E329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction."
- C. Authorized to operate in the State of Texas.
- D. Submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during the most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- E. Testing Equipment:
 - 1. Calibrated at reasonable intervals by devices of accuracy traceable to either:
 - a. National Bureau of Standards.
 - b. Accepted values of natural physical constants.

1.4 LABORATORY DUTIES

- A. Cooperate with Engineer and Contractor; provide qualified personnel after due notice from Contractor.
- B. Perform specified inspections, sampling and testing of materials and methods of construction:
 - 1. Comply with specified standards.
 - 2. Ascertain compliance of materials with requirements of Contract Documents.
- C. Promptly notify Engineer and Contractor of observed irregularities or deficiencies of work or products.
- D. Promptly submit written report of each test and inspection; one copy each to Engineer and Owner. Three copies each to Contractor, and one copy to Record Documents File. Each report shall include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing laboratory name, address and telephone number.
 - 4. Name and signature of laboratory inspector.
 - 5. Date and time of sampling or inspection.
 - 6. Record of temperature and weather conditions.
 - 7. Date of test.
 - 8. Identification of product and specification section.
 - 9. Location of sample or test in the Project.
 - 10. Type of inspection or test.
 - 11. Results of tests and compliance with Contract Documents.
 - 12. Interpretation of test results, when requested by Engineer.
- E. Perform additional tests as required by Engineer or the Owner.

1.5 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Perform any duties of the Contractor.
 - 4. Stop the Work.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to Work, to manufacturer's operations.
- B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.
- D. Furnish copies of Products test reports as required.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.
- F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
- G. Make arrangements with laboratory and pay for services to perform additional inspections, sampling and testing required:
 - 1. For the Contractor's convenience.
 - 2. When initial tests indicate Work does not comply with Contract Documents.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 50 00**CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Furnish, install and maintain temporary utilities required for construction, remove on completion of Work.
- B. Provide temporary personnel traffic and materials handling equipment and facilities required for construction, remove at completion of construction.
- C. Provide construction aids, inspection aids and equipment required to facilitate execution of the Work.
- D. Provide and maintain lighted barriers for the protection of personnel and materials in accordance with the Drawings and requirements of applicable codes and regulations.
- E. Provide and maintain temporary storage facility on-site for the storage of salvaged products to be reused in the Work of this Contract.
- F. Remove construction facilities and temporary controls at completion of project. Restore site to original condition.
- G. Provide and maintain temporary construction partitions for proper phasing of work. Remove as required by phasing at end of Contract.

1.2 RELATED REQUIREMENTS

- A. Section 01 01 00: Summary of Work.
- B. Section 01 04 50: Cutting and patching.
- C. Section 09 90 00: Painting.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with National Electric Code.
- B. Comply with Federal, State and local codes and regulations and with utility company requirements.

PART 2 - GENERAL

2.1 MATERIALS, GENERAL

- A. Materials may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.
- B. Provide warning signs to help prevent damage and injury.
- C. Should it become necessary to remove safety items it shall be the Contractors responsibility to replace the item immediately, in conformance with applicable regulations.
- D. Wood materials used in barricades and barriers within the building and in material storage areas shall be fire-retardant.

2.2 TEMPORARY ELECTRICITY AND LIGHTING

- A. Owner is to pay for temporary power used during construction as available in the existing building. Contractor is to verify the voltage/amperage and available circuitry of the existing building electrical system. The Contractor shall provide and pay for all power required for construction activities not available in the existing building. Contractor is to arrange with utility company and pay for tap to provide service required for power and lighting of any and all construction trailers (if any).
- B. Contractor is to install circuit and branch wiring as required at Contractor's expense, with area distribution boxes located so that power and lighting is available throughout the construction by the use of construction-type power cords.
- C. Provide adequate artificial lighting for all areas of work when natural light is not adequate for work, and for areas accessible to the public.

2.3 TEMPORARY HEAT AND VENTILATION

- A. Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature or humidity.
- B. Provide adequate forced ventilation of enclosed areas for curing of installed materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors or gases.
- C. Portable heaters shall be standard approved units complete with controls.

- D. Pay all costs of installation, maintenance, operation and removal, and for fuel consumed.
- E. Open flame heating equipment is not permissible under any circumstances.

2.4 TEMPORARY WATER

- A. Owner will pay for temporary water used for construction purposes as is available in the existing building. Contractor is to verify availability, quantity and type of water in the existing building, and to provide and pay for any additional water service or requirements for construction activities not available in the existing building.
- B. Install branch piping with taps located so that water is available throughout the construction by the use of hoses. Protect piping and fittings against freezing.

2.5 TEMPORARY TELEPHONE SERVICE

- A. Arrange with local telephone service company and pay for installation to provide direct line telephone service at construction site for use of personnel and employees.
- B. Pay all costs for installation, maintenance and removal, and service charges for local calls. Toll charges shall be paid by the party who places the call.

2.6 TEMPORARY SANITARY FACILITIES

- A. Contractor's employees are to use existing restroom within existing building that is designated by the Owner for the Contractor's use. Contractor is to clean and maintain this restroom and restore it to original condition upon completion of the project.

2.7 TEMPORARY FIRE PROTECTION

- A. Take necessary precautions in welding or cutting operations to keep work area free of combustible materials. Do not use welding equipment around flammable liquids or vapors.

2.8 TEMPORARY SIGNAGE

- A. Informational Signs:
 - 1. Painted signs with painted lettering, or standard products.
 - 2. Size of signs and lettering to be as required by regulatory agencies or as appropriate to usage.
 - 3. Colors to be as required by applicable regulatory agencies, or otherwise of uniform colors throughout job as selected by Owner's Representative.
 - 4. Erect informational signs at locations necessary to provide required information.

B. Quality Assurance:

1. Sign painter with professional experience in type of work required.
2. Finishes and painting adequate to resist weathering and fading for scheduled construction period.
3. Maintain temporary signs and supports in neat, clean condition; repair damages to structure, framing and sign.
4. Relocate informational signs as required by progress of work.
5. Repair any damage to permanent structures or finishes caused by placement or removal of temporary signage.

2.9 SCAFFOLDING

- A. Provide scaffolding, ramps, runways, platforms, guardrails, stairs and ladders as required by job conditions.

2.10 LIFTING AND HOISTING

- A. Provide hoists, cranes or other lifts as required for material handling.
- B. Contractor shall be responsible for determining need, providing appropriate equipment, coordinating installation and location with Engineer and Owner, and maintaining properly throughout use.

2.11 CONSTRUCTION BARRIERS

- A. Provide construction barrier around material storage and construction areas to prevent unauthorized access.

2.12 DEBRIS CONTROL

- A. Maintain areas under Contractor's control free of unnecessary debris.
- B. Initiate and maintain a specific program to prevent accumulation of debris at construction site, storage and parking areas or along roads and haul routes.
 1. Provide containers for deposit of debris.
 2. Prohibit overloading of trucks to prevent spillage on access and haul routes.
 3. Provide periodic inspection of traffic areas to enforce requirements.
- C. Schedule periodic collection and disposal of debris as indicated. Provide additional collections and disposal of debris whenever periodic schedule is inadequate to prevent accumulation. All debris is to be removed from the site and base and properly disposed of.

2.13 POLLUTION CONTROL

- A. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by discharge of noxious substances from construction operations.
- B. Provide equipment and personnel, perform emergency measures required to contain any spillage, and to remove contaminated soil or liquids. Excavate and dispose of contaminated earth off site and replace with suitable compacted fill and topsoil.
- C. Take special measures to prevent harmful substances from entering public waters. Prevent disposal of wastes, effluence, chemicals or other substances adjacent to streams or in sanitary or storm sewers.
- D. Provide systems for control of atmospheric pollutants. Prevent toxic concentrations of chemicals. Prevent harmful dispersal of pollutants into atmosphere.

2.14 TEMPORARY FACILITIES

- A. Construction (If Required):
 - 1. Structurally sound, weathertight, with floors above grade.
 - 2. Insulated space.
 - 3. Portable office may be used.
 - 4. Provide necessary HVAC, lighting, plumbing and sewer.
- B. Storage Sheds: As required to serve the needs of the stored items. Sheds shall be constructed to protect the products stored within. Products that could be damaged by environmental conditions shall be appropriately protected by the Contractor and shall be replaced if damaged by storage conditions provided by Contractor.

2.15 DRINKING WATER

- A. Furnish potable water for all personnel connected with Work, water as available in the existing building may be used.
- B. Pipe or transport to keep clean and fresh.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with applicable requirements specified in Division 22 & 23 – Plumbing & Mechanical, and in Division 26 - Electrical.
- B. Maintain and operate systems to assure continuous service.
- C. Modify and extend systems as work progress requires.

3.2 PREPARATION

- A. Review site conditions and factors which affect construction procedures and construction facilities, including adjacent properties and public facilities which may be affected by execution of the Work.

3.3 INSTALLATION

- A. Comply with applicable requirements of each Specification Section.
- B. Maintain and operate systems to assure continuous service. Modify and extend systems as work progress requires.
- C. Install facilities of neat and reasonable, uniform appearance, structurally adequate for required purposes. Maintain during entire construction period.
- D. Prior to start of Work at project site, install enclosure fence with locked entrance gates.
- E. Construct or locate construction offices and sheds on proper foundation, with utility connections, provide steps and landing at entrances.
- F. Locate a thermometer in a convenient location, out of direct sunlight.
- G. Locate construction offices and sheds as directed by Owner.

3.4 MAINTENANCE

- A. Provide cleaning and maintenance of construction office, sheds, furnishings, and equipment as required.

3.5 REMOVAL

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Completely remove barricades when construction has progressed to point that they are no longer required, and when approved by Owner's representative or Engineer.
- D. Remove construction office and sheds including foundations and contents at completion of the project.
- E. Grade site to required elevation and clean the area.
- F. Replace any landscaping damaged by Contractor's operations

END OF SECTION

SECTION 01 60 00**MATERIALS AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- A. General requirements of each specification section of the Project Manual.

1.2 RELATED REQUIREMENTS

- A. Section 01 30 00: Submittals.
- B. Section 01 70 00: Contract Closeout.

1.3 MATERIAL AND EQUIPMENT INCORPORATED INTO WORK

- A. Comply with applicable specifications and standards.
- B. Comply with size, make, type and quality specified or as specifically accepted in writing by Engineer.
- C. Design, fabricate, assemble and install products in accordance with engineering and shop practices normal to trade.
- D. Manufacture like parts of duplicate units to standard interchangeable sizes and gauges. Two or more items of same kind shall be identical by same manufacturer.
- E. Products shall be suitable for intended purpose.
- F. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically accepted in writing.
- G. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.4 QUALITY ASSURANCE

- A. Where materials or equipment are specified by trade or brand name, it is not intended to omit equivalent products of another manufacturer, except where specifically noted.
- B. Materials specified are to define standard of quality or performance and to establish basis for evaluation of proposals.

1.5 PRODUCTS LIST

- A. Within 15 days after award of Contract, submit to Engineer five copies of complete list of major Products which are proposed for installation.
- B. Tabulate Products by Specification Section number and title.
- C. For products specified only by reference standards, list for each such Product:
 - 1. Name and address of manufacturer.
 - 2. Trade name.
 - 3. Model or catalogue designation.
 - 4. Manufacturer's data:
 - a. Reference standards.
 - b. Performance test data.
- D. Engineer will reply promptly in writing stating whether there is reasonable objection to listed items. Failure to object to a listed item shall not constitute a waiver of the requirements of Contract Documents.

1.6 PRODUCT OPTIONS

- A. For Products specified only by reference standard, select Product meeting that standard, by any manufacturer.
- B. For Products specified by naming several Products or manufacturers, select any one of products and manufacturers named which complies with Specifications.
- C. For Products specified by naming one or more Products or manufacturers and stating "or equal", submit a request as for substitutions, for any Product or manufacturer which is not specifically named.
- D. For Products specified by naming only one Product and manufacturer, there is no option and no substitution will be allowed.

1.7 MANUFACTURER'S INSTRUCTIONS

- A. When Contract Documents require that installation of work shall comply with manufacturers printed instructions, obtain and distribute copies of instructions to parties involved in installation, including two copies to Engineer, prior to commencing work.
- B. Maintain one set of complete instructions at job site during installation and until complete.
- C. Maintain copies for Project Record Documents.

- D. Handle, install, connect, clean, condition and adjust products in strict accord with manufacturer's instructions and in conformity with specified requirements.
- E. Should job conditions or specified requirements conflict with manufacturer's instructions, notify Engineer in writing for further instructions. Do not proceed with work without clear instructions.
- F. Perform Work in accordance with manufacturer's instructions. Do not omit preparatory steps of installation procedures unless specifically modified or exempted by Contract Documents.

1.8 SUBSTITUTIONS

- A. Within a period of 30 days after award of Contract, Engineer will consider formal requests from the Contractor for substitution of Products in place of those specified.
 - 1. After end of that period, requests will be considered only in case of Product no longer manufactured.
- B. Submit separate request for each substitution. Support each request with:
 - 1. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature; identify:
 - 1) Product description.
 - 2) Reference standards.
 - 3) Performance and test data.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and date of each installation.
 - 2. Itemized comparison of the proposed substitution with product specified; List significant variations.
 - 3. Data relating to changes in construction schedule.
 - 4. Any effect of substitution on separate contracts.
 - 5. List of changes required in other work or Products.
 - 6. Accurate cost data comparing proposed substitution with product specified.
 - a. Amount of any net change to Contract Sum.
 - 7. Designation of required license fees or royalties.
 - 8. Designation of availability of maintenance services, sources of replacement materials.
- C. Substitutions will not be considered for acceptance when:

1. They are indicated or implied on shop drawings or product data submittals without a formal request from Contractor.
 2. They are requested directly by a subcontractor or supplier.
 3. Acceptance will require substantial revision of Contract Documents.
 4. Additional cost to Owner.
- D. Substitute products shall not be ordered or installed without written acceptance of Engineer.
- E. Engineer will determine acceptability of proposed substitutions.
- F. If proposed substitution is not accepted by Engineer, provide specified product or material.

1.9 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with work and conditions at site. Avoid congesting traffic.
- B. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
- C. Immediately upon delivery, inspect shipments to assure compliance with requirements of Contract Documents and accepted submittals and that products are properly protected and undamaged.
- D. Promptly remove unsatisfactory materials from site.
- E. Furnish equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.10 STORAGE

- A. Store materials subject to damage from exposure to weather in weathertight storage facilities of suitable size with floors raised above ground. Materials not subject to weather damage may be stored on blocks off ground.
- B. Store fabricated products in accordance with manufacturer's instructions, seals and labels intact and legible. Store products subject to damage by elements in weathertight enclosures. Maintain temperature and humidity within ranges required by manufacturer's instructions.
- C. Cover materials which are subject to deterioration with breathable, impervious sheet covering providing adequate ventilation to avoid condensation.
- D. Arrange storage in manner to permit easy access for inspections.

- E. Protect metal from damage, dirt or dampness. Furnish flat, solid support for sheet products during storage.
- F. Make periodic inspections of stored materials to verify that products are maintained under specified conditions and are free from damage or deterioration.
- G. Do not use materials in work which have deteriorated, become damaged or are otherwise unfit for use.
- H. Store paints in assigned room or area kept under lock and key.
- I. Remove oil, rags and other combustible materials daily and take precautions to prevent fire hazards.
- J. Do not load structure during construction by storing materials with load greater than structure is calculated to support safely.

1.11 PROTECTION

- A. Furnish protection against weather. Cover building openings to protect interior of building from weather.
- B. Maintain work, materials, apparatus and fixtures free from damage.
- C. Protect items having factory finish to prevent damage to finish and equipment.
- D. At end of day's work, cover new work likely to be damaged or otherwise protect as necessary.
- E. After installation, secure substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
- F. Remove protection when no longer needed. Upon completion of work, remove storage facilities from site.

1.12 CONTRACTOR'S REPRESENTATION

- A. In making formal request for substitution Contractor represents that:
 - 1. He has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.
 - 2. He will provide same warranties or bonds for substitution as for product specified.
 - 3. He will coordinate installation of accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.
 - 4. He waives claims for additional costs caused by substitution which may subsequently become apparent.
 - 5. Cost data is complete and includes related costs under his Contract, but not:
 - a. Costs under separate contracts.

- b. Engineer's costs for redesign or revision of Contract Documents.
- 6. Material will remain available as a standard for a minimum of five (5) years.

1.13 ENGINEER DUTIES

- A. Engineer will determine acceptability of proposed substitutions.
- B. Engineer will review requests for substitutions with reasonable promptness and notify Contractor in writing of decision to accept or reject proposed substitution.
- C. Review of Engineer, acceptance or failure to take exceptions to substitutions or other review documents, shall not relieve Contractor of his responsibility for item actually meeting performance or other requirements of Contract Documents.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 70 00**CONTRACT CLOSEOUT****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the Work.
- B. Execute cleaning, during progress of Work, and at completion of the Work, as required by General Conditions.
- C. Maintain at site for Owner one Record Set copy of following:
 - 1. Contract Drawings.
 - 2. Contract Project Manual.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to Contract.
 - 5. Engineer issued Field Orders or other written instructions or clarifications.
 - 6. Accepted Shop Drawings, Product Data and Samples.
 - 7. Field Test Reports.
- D. Compile Product Data and related information appropriate for Owner's maintenance and operation of products and equipment furnished under Contract.
- E. Instruct Owner's personnel in maintenance of products and in operation of equipment and systems.
- F. Compile specified warranties.
- G. Review submittals to verify compliance with Contract Documents.

1.2 RELATED SECTIONS

- A. Conditions of the Contract: Fiscal provisions, legal submittals and additional administrative requirements.
- B. Section 01 01 00 - Summary of Work.
- C. Section 01 30 00 - Submittals.
- D. Respective Sections of Specifications: Closeout Submittals Required of Trades.

1.3 SUBSTANTIAL COMPLETION

- A. When Contractor considers Work is substantially complete, he shall submit to Engineer:
 - 1. Written certification that Work, or designated portion thereof, is substantially complete.
 - 2. List of items to be completed or corrected.
- B. Within reasonable time after receipt of such certificate, Engineer will make examination to determine status of completion.
- C. Should Engineer determine that Work is not substantially complete:
 - 1. Engineer will promptly notify Contractor in writing, stating reasons.
 - 2. Contractor shall remedy deficiencies in Work, and send a second written notice of substantial completion to Engineer.
 - 3. Engineer will re-examine Work.
- D. When Engineer concurs that Work is substantially complete, he will:
 - 1. Prepare Certificate of Substantial Completion on AIA Form G704, accompanied by Contractor's list of items to be completed or corrected, as verified and amended by Engineer.
 - 2. Submit Certificate to Owner and Contractor for written acceptance of responsibilities assigned in Certificate.
- E. After Work is substantially complete, Contractor shall:
 - 1. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
 - 2. Obtain Certificate of Occupancy.
 - 3. Complete work listed for completion or correction within designated form.
 - 4. Perform final cleaning.

1.4 FINAL INSPECTION

- A. When Contractor considers Work complete, he shall submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Work has been examined for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Equipment and systems have been tested in presence of Owner's representative and are operational.
 - 5. Work is completed and ready for final examination.
- B. Engineer will make examination to verify status of completion with reasonable promptness after receipt of such certification.
- C. Should Engineer consider that Work is incomplete or defective:

1. Engineer will promptly notify Contractor in writing, listing incomplete or defective work.
 2. Contractor shall take immediate steps to remedy stated deficiencies, and send second written certification to Engineer that Work is complete.
 3. Engineer will re-examine Work.
- D. When Engineer finds that Work is acceptable under Contract Documents, he shall request Contractor to make closeout submittals.

1.5 REINSPECTION FEES

- A. Should Engineer perform re-examinations due to failure of Work to comply with claims of status of completion made by Contractor:
1. Owner will compensate Engineer for such additional services.
 2. Owner will deduct amount of such compensation from final payment to Contractor.

1.6 CLEANING DISPOSAL REQUIREMENTS

- A. Hazards Control:
1. Store volatile wastes in covered metal containers.
 2. Remove containers from premises daily.
 3. Prevent accumulation of wastes which create hazardous conditions.
 4. Provide adequate ventilation during use of volatile or noxious substances.
- B. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws:
1. Do not burn or bury rubbish and waste materials on Project site.
 2. Do not dispose of wastes into streams or waterways.
 3. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains.

1.7 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
1. Provide files and racks for storage of documents.
 2. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents and samples in accordance with CSI Masterformat.
- C. Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and samples available at all times for examination by Engineer.

- E. Incomplete or out of order documents and samples will be grounds for not approving application for payment.
- F. Provide felt tip marking pens for recording information in color code designated by Engineer.
- G. Label each document "PROJECT RECORD" in neat large printed letters.
- H. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
- I. Maintain clean, undamaged set of mylar Contract Drawings and Shop Drawings as Record Drawings.
 - 1. Mark set to show actual installation where installation varies substantially from Work as originally shown.
 - 2. Obtain from Engineer and pay for reproduction costs of reproducible mylar sepias and blue line prints for keeping accurate records during construction. Each subcontractor shall post, on the project record drawings, any changes occurring during the pay period, prior to submission of application for payment. Failure to maintain such records shall constitute cause for denial of a progress payment. Drawings will be reviewed during progress meetings. Upon completion of the project the Contractor shall transfer all conditions and marks to a final set of 3 mil. mylars furnished by the Owner.
 - 3. Record Drawings shall be created on 3-mil sepia mylar reproductions made at Contractor's expense from either Engineer's original drawings with seals and logos removed (architectural, structural, and MEP) or from Contractor's shop electronic drawings. Additionally, provide as-builts in AutoCadd 2020 or higher format on CD with printed as-builts.
- J. Contractor shall retain competent drafting services, as necessary, for transfer of "mark-up notations" from information recorded during construction.
- K. Legibly mark in color code designated by Engineer to record actual construction on designated Record Drawing prints:
 - 1. Depths of various elements of foundation in relation to finish first floor datum.
 - 2. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
 - 4. Field changes of dimension and detail.
 - 5. Changes made by Field Order or by Change Order.
 - 6. Details not on original contract drawings.
 - 7. Record information on a daily basis, or as often as necessary.
 - 8. References to related shop drawings and modifications.
 - 9. Mark whichever drawing is most capable of showing conditions fully and accurately.

10. Where shop drawings are used, record cross-reference at corresponding location on Contract Drawings.
 11. Give particular attention to concealed elements that would be difficult to measure and record at later date.
 12. Mark new information that is important to Owner, but was not shown on Contract Drawings or Shop Drawings.
 13. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates, and other identification on cover of each set.
- L. Contractor provide 1 set of reproducible mylars and 2 sets of bluelines of Record Drawings. Reproduction costs will be paid by Owner through Engineer.
- M. Legibly mark each Specification Section to record Addenda items:
1. Manufacturer, trade name, catalogue number, and Supplier of each Product and item of equipment actually installed.
 2. Changes made by Field Order or by Change Order.

1.8 OPERATING AND MAINTENANCE DATA

- A. Form of Submittals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - a. Assemble data in durable 3-ring binders, indexed and tabbed for each separate product or piece of operating equipment.
 - b. Provide 3 copies of each manual type to Owner.
- B. Content of Manuals:
1. Provide neatly typewritten table of contents for each volume, arranged in systematic order.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of volume.
 - c. List, with each product, name, address and telephone number of subcontractor or installer and 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 only those sheets which are pertinent to specific product.
 - b. Annotate each sheet to clearly identify specific product or part installed and data applicable to installation.

3. Drawings:
 - a. Supplement Product Data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems and 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. Provide written text, as required to supplement Product Data for particular installation, organized in consistent format and in logical sequence of instructions for each procedure.
5. Provide copy of each warranty, bond and service contract issued.

C. Manual for Equipment and Systems:

1. Submit five copies of complete manuals in final form.
2. 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, shutdown 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.
 - d. Servicing and lubrication schedule.
 - 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.
 - h. As-installed control diagrams by controls manufacturer.
 - i. Each subcontractor's coordination drawings including as-installed color coded piping diagrams.
 - j. Charts of valve tag numbers, with location and function of each valve.

- k. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 - l. Other data as required under pertinent sections of specifications.
- 3. Content, for each electric and electronic system, as appropriate:
 - a. Description of system 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. Circuit directories of panelboards.
 - 1) Electrical service.
 - 2) Controls.
 - 3) Communications.
 - c. As-installed color coded wiring diagrams.
 - d. Operating procedures:
 - 1) Routine and normal operating instructions.
 - 2) Sequences required.
 - 3) Special operating instructions.
 - e. Maintenance procedures:
 - 1) Routine operations.
 - 2) Guide to "trouble-shooting".
 - 3) Disassembly, repair and reassembly.
 - 4) Adjustment and checking.
 - f. Manufacturer's printed operating and maintenance instructions.
 - g. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 - h. Other data as required under pertinent sections of specifications.
- 4. Additional requirements for operating and maintenance data as included in respective Sections of Specifications.
- 5. Provide complete information for products and equipment specified in:
 - a. Division 22: Plumbing Systems.
 - b. Division 23: Mechanical Systems.
 - c. Division 26: Electrical Systems.

1.9 WARRANTIES AND BONDS

A. Submittal Requirements:

1. Assemble warranties and service and maintenance contracts, executed by each of respective manufacturers, suppliers, and subcontractors.
2. Table of Contents: Neatly typed, in orderly sequence.
3. Provide complete information for each item.
 - a. Product or work item.
 - b. Firm, with name of principal, address and telephone number.
 - c. Scope.
 - d. Date of beginning of each warranty or service and maintenance contract.
 - e. Duration of Warranty or service maintenance contract.
 - f. Provide information for Owner's personnel:
 - 1) Proper procedure in case of failure.
 - 2) Instances which might affect validity of warranty.
 - g. Contractor, name of responsible principal, address and telephone number.

B. Form of Submittals:

1. Prepare in duplicate packets.
2. Format:
 - a. Size: 8-1/2" x 11", punch sheets for standard 3-ring binder, fold larger sheets to fit into binders.
 - b. Identify each packet with typed or printed cover:
 - 1) Title: "WARRANTIES AND BONDS".
 - 2) Title of Project.
 - 3) Name of Contractor.
3. Binders: Commercial quality, 3-ring, with durable and cleanable plastic covers.
4. Provide 3 complete copies of warranty and bond submittal in final form.

C. Time of Submittals:

1. Make submittals within 10 days after Date of Substantial Completion, prior to final request for payment.
2. For items of work, where acceptance is delayed materially beyond Date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

D. Emergency Repairs: Owner reserves right to make emergency repairs as required to keep equipment or materials in operation or to prevent damage to persons or property without voiding Contractor's warranty or bond, or relieving Contractor of his responsibilities during contract, warranty or warranty periods.

1.10 ATTIC STOCK

- A. Provide attic stock of paint. Engineer will review for compliance with contract requirements. Contractor to submit letter of transmittal for each type of stock. Refer to section for amount.

1.11 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER

- A. Evidence of compliance with requirements of governing authorities:
 - 1. Certificate of Occupancy.
 - 2. Certificates of Inspection: Mechanical and Electrical systems as required by respective sections.
- B. Project Record Documents.
- C. Operating and Maintenance Data, Instructions to Owner's Personnel:
 - 1. Submit one copy of completed data in final form 30 days prior to demonstration of equipment.
 - 2. Copy will be returned accepted or with comments for revisions.
- D. Warranties and Bonds.
- E. Certificate of Insurance for Products and Completed Operations.

1.12 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

- A. Contractor's Affidavit of Payment of Debts and Claims: AIA G706.
- B. Contractor's Affidavit of Release of Liens: AIA G706A with following:
 - 1. Consent of Surety to Final Payment: AIA G707.
 - 2. Contractor's Release or Waiver of Liens.
 - 3. Separate releases of waivers of liens from subcontractors, suppliers and others with lien rights against property of Owner, together with list of those parties.
- C. All submittals shall be duly executed before delivery to Owner.

1.13 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit final statement of accounting to Engineer.
- B. Statement shall reflect all adjustments to Contract Sum:
 - 1. Original Contract Sum.
 - 2. Additions and deductions resulting from:

- a. Previous Change Orders.
 - b. Allowances.
 - c. Unit Prices.
 - d. Deductions for uncorrected Work.
 - e. Penalties and Bonuses.
 - f. Deductions for liquidated damages.
 - g. Deductions for re-examination payments.
 - h. Other adjustments.
- 3. Total Contract Sum, as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- C. Engineer will prepare final Change Order, reflecting approved adjustments to Contract Sum which were not previously made by Change Orders.

1.14 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in operation, adjustment and maintenance of operating equipment and systems. Operating and maintenance manual shall constitute basis of instruction.
- B. Review contents of manual with Owner's personnel in full detail to explain all aspects of operations and maintenance.
- C. Amount of time to be devoted to instructions shall be reasonable and consistent with size and complexity of equipment.

1.15 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit final Application for Payment in accordance with procedures and requirements stated in Conditions of Contract.

1.16 POST-CONSTRUCTION INSPECTION

- A. Prior to expiration of one year from Date of Substantial Completion, Owner will make visual inspection of Project in company of Contractor to determine whether further correction of Work is required in accordance with provisions of Contract.
- B. Owner will promptly notify Contractor, in writing, of any observed deficiencies.
- C. Contractor will contact Owner to arrange time and establish schedule for correction of deficiencies.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 73 00**OPERATION AND MAINTENANCE DATA****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Administrative and procedural requirements the preparation and submittal for operating and maintenance manuals including the following:
 - 1. Operating and maintenance manuals for building systems or equipment.
 - 2. Instruction manual covering the care, preservation and maintenance of architectural products and finishes.
 - 3. Instruction of Owner's operating personnel in operation and maintenance of building systems and equipment.

1.2 FORM OF SUBMITTALS

- A. Prepare instructional manuals and data bound in commercial quality 3-ring binders:
 - 1. Organize with index tabs according to sequence of Specification Sections.
 - 2. Identify each volume with type or printed title as instructed by Architect.

1.3 CONTENT OF MANUALS

- A. Arrange typewritten table of contents for each volume, in systematic order:
 - 1. List of each product required to be included with name, address, and telephone number of:
 - a. Subcontractor or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Local source of supply for parts and replacement.
 - 2. Identifying each product by product name and other identifying symbols.
- B. Product Data:
 - 1. Include only those sheets which are pertinent to specific product with product clearly identified.
 - 2. Delete references to inapplicable information.
 - 3. Annotate each sheet to clearly identify specific product or part installed, and data applicable to installation.
- C. Drawings:
 - 1. Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems and control and flow diagrams.

2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
- D. Written Text: As required to supplement product data for particular installation to provide logical sequence of instructions for each procedure, organized in a consistent format and in logical sequence of instructions for each procedure.
- E. Recommended Spare Parts: Furnish a list of recommended spare parts for each equipment item that will be needed to support that item of equipment for a 12 month period. Spare parts list shall contain the following information:
 1. Parts Descriptions.
 2. Manufacturer's Part Number.
 3. Shelf Life.
 4. Recommended Quantity.
 5. Unit Price.
 6. Name and address of the part manufacturer.
 7. Name and address of a local supplier for the part.

1.4 EQUIPMENT AND SYSTEMS MANUAL REQUIREMENTS

- A. Submit three copies of completed manuals in final form.
- B. Content, for each unit of equipment and system, as appropriate:
 1. Description of unit and component parts.
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 2. Operating procedures:
 - a. Start-up, break-in, routine and normal operating instructions.
 - b. Regulation, control, stopping, shutdown and emergency instructions.
 - c. Summer and winter operating instructions.
 - d. Special operating instructions.
 3. Maintenance Procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting".
 - c. Disassembly, repair and reassembly.
 - d. Alignment, adjusting and checking.
 4. Servicing and lubrication schedule, including list of lubricants required.
 5. Manufacturer's printed operating and maintenance instructions.
 6. Description of sequence of operation by control manufacturer.

7. Original manufacturer's parts list, price lists, illustrations, assembly drawings and diagrams required for maintenance, predicted life of parts subject to wear and items recommended to be stocked as spare parts.
 8. As-installed control diagrams by controls manufacturer.
 9. Each subcontractor's coordination drawings including as-installed color coded piping diagrams.
 10. Charts of valve tag numbers, with location and function of each valve.
 11. Water treatment procedures and tests.
 12. Final balancing reports for mechanical systems.
 13. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 14. Other data as required under pertinent sections of specifications.
- C. Content, for each electric and electronic system, as appropriate:
1. Description of system and component parts.
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 2. Circuit directories of panelboards.
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
 3. As-installed color coded wiring diagrams.
 4. Operating procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.
 5. Maintenance procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting".
 - c. Disassembly, repair and reassembly.
 - d. Adjustment and checking.
 6. Manufacturer's printed operating and maintenance instructions.
 7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 8. Other data as required under pertinent sections of specifications.
- D. Include warnings of detrimental maintenance practices.
- E. Prepare and include additional data when need for such data becomes apparent during instruction of Owner's personnel or as required under pertinent Specification Section.

- F. Refer to individual Sections of Project Manual for additional requirements for operating and maintenance data.
- G. Provide complete information for products and equipment specified in:
 - 1. Division 22: Plumbing Systems.
 - 2. Division 23: Mechanical Systems.
 - 3. Division 26: Electrical Systems.

1.5 ARCHITECTURAL PRODUCTS MANUAL REQUIREMENTS

- A. Submit three copies of complete manual in final form.
- B. Refer to individual Sections of Project Manual for submittal requirements.
- C. Content: Manufacturer's data, giving full information on products, catalog numbers, sizes, and composition; and finish designations.
- D. Information required for re-ordering.
- E. Instructions for care and maintenance.
 - 1. Manufacturer's recommended lubricants.
 - 2. Manufacturer's recommendations for types of cleaning agents and methods.
 - 3. Cautions against cleaning agents and methods which are detrimental to product.
 - 4. Recommended maintenance and cleaning schedule.
- F. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

1.6 SUBMITTAL SCHEDULE

- A. Submit one copy of completed data in final form 30 days prior to demonstrations of equipment.
- B. Copy will be returned approved or with comments for revisions.
- C. Submit specified number of copies of approved data in final form within 10 days prior to equipment demonstrations and prior to final inspection or acceptance.

1.7 INSTRUCTIONS OF OWNER'S PERSONNEL

- A. Prior to final inspection, instruct the Owner's personnel in operation, adjustment, and maintenance of products equipment and systems. Provide instruction at mutually agreed upon times.
 - 1. For equipment that requires seasonal operation, provide similar instruction during other seasons.

2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 09 90 00**PAINTING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Work includes painting and finishing of interior and exterior exposed items and surfaces scheduled for finish, including surface preparation, priming and painting of finishing. Work is in addition to shop-priming and surface treatment under other Sections.
- B. Provide labor, materials, tools, ladders, scaffolding and other equipment necessary for completion of Work.
- C. Examine specifications for other trades and become thoroughly familiar with other provisions for painting. Surfaces left unfinished by other Sections shall be painted or finished under this Section, unless otherwise indicated.
- D. Painting shall mean coating systems materials, primers, emulsions, enamels, sealers and fillers, whether used as prime, intermediate or finish coats.

1.2 REFERENCE STANDARDS

- A. ASTM E84: Surface Burning Characteristics of Building Materials.
- B. FS TT-C-535: Two Coat Epoxy Coatings for Interior Use.
- C. FS TT-C-550: Chemical Resistance.
- D. FS TT-F-1098: Surface Fillers for Porous Surfaces.
- E. FS TT-P-29: Interior Latex Base Paint.

1.3 SUBMITTALS

- A. Product data:
 - 1. Submit manufacturer's technical information including paint label analysis and application instructions for each material proposed for use.
 - 2. Submit product performance data printed on manufacturer's technical data sheets.
- B. Samples:
 - 1. Prepare samples, of each color selected, on same materials to which respective finishes are required to be applied.

2. Prepare stained wood samples on type and quality of wood specified for use on project.
3. Make samples not less than 12" x 12".
- C. Schedule: Submit painting schedule including manufacturer's product name and substrate proposed for painting.
- D. Certificates: Furnish manufacturer's certificates indicating that materials comply with Specification requirements.
- E. Test Samples:
 1. When requested by Architect, obtain test samples from material stored at Project site or source of supply.
 2. Contractor is to retain all paint cans and lids on site until authorized to discard by Architect.
- F. Closeout submittal: Prepare samples of actual colors applied in accordance with requirements of Section 01700.

1.4 QUALITY ASSURANCE

- A. Paint materials manufacturer:
 1. Provide materials in brand and quality specified. No claims by paint applicator to unsuitability or unavailability of materials specified will be considered unless claim is submitted in writing with proposal to Contractor.
 2. Paints, varnishes, enamels, lacquers, stains, fillers and similar materials must be delivered in original containers with unbroken seals and labels intact. Retain containers with labels until reviewed by Architect.
- B. Applicator qualifications:
 1. Employ skilled mechanics to ensure highest quality workmanship. Materials to be applied by craftsmen experienced in use of specific product involved.
 2. Submit documentation of following minimum qualifications for paint applicator:
 - a. Minimum five years commercial painting experience.
 - b. Minimum three successful projects of similar scope and complexity.
 - c. List of references for completed projects.
- C. Include on label of each container:
 1. Manufacturer's name.
 2. Manufacturer's stock number.
 3. Type of paint.
 4. Color.
 5. Instructions for reducing, where applicable.
 6. Label analysis.

D. Interface:

1. Provide finish coats which are compatible with prime paints used.
2. Review other sections of Specifications in which prime paints are provided to ensure compatibility of total coatings system for various substrates.
3. Upon request from other trades, furnish information on characteristics of finish materials proposed for use to ensure compatible prime coats are used.
4. Provide barrier coats over incompatible primers or remove and reprime as required.

E. Regulatory requirements: Contractor and applicator shall comply with applicable codes, regulations, ordinances and laws regarding use and application of painting systems and volatile organic compounds (VOC's).**1.5 DELIVERY, STORAGE AND HANDLING**

- A. Deliver paint materials in sealed original labelled containers, bearing manufacturer's name, type of paint, brand name, color designation and instructions for mixing and/or reducing.
- B. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45 degrees F. in well ventilated area.
- C. Take precautionary measures to prevent fire hazards and spontaneous combustion. Soiled or used rags, waste and trash must be removed from building daily.

1.6 ENVIRONMENTAL CONDITIONS

- A. Comply with manufacturer's recommendations for environmental conditions under which systems can be applied.
- B. Do not apply finish in areas where dust is being generated.
- C. Apply water-base paints only when temperature of surface to be painted and surrounding air temperatures are between 50 degrees F. and 90 degrees F.
- D. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F. and 90 degrees F.
- E. Do not apply paint in snow, rain, fog, mist or when relative humidity exceeds 85%, or to damp or wet surfaces.
- F. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.
- G. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 50 degrees F. for 24 hours before, during and 48 hours after application of finishes.

- H. Provide minimum 25 foot candles of lighting on surfaces to be finished.
- I. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture contents of surfaces are below following maximums:
 - 1. Veneer plaster and gypsum wallboard: 12%.
 - 2. Masonry, concrete and concrete block: 12%.
 - 3. Interior located wood: 15%.

1.7 PROTECTION

- A. Adequately protect other surfaces from paint and damage. Repair damage as a result of inadequate or unsuitable protection.
- B. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.
- C. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items to be carefully stored, cleaned and replaced on completion of work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.

PART 2 - PRODUCT

2.1 MANUFACTURERS

- A. Acceptable manufacturers:
 - 1. Kelly-Moore.

2.2 MATERIALS

- A. Provide best quality grade of paint regularly manufactured by manufacturer.
- B. Materials selected for coating systems for each type surface shall be product of single Manufacturer.
- C. Paint materials to be ready-mixed except field catalyzed coatings. Pigments fully ground maintaining soft paste consistency, capable of being readily and uniformly dispersed to complete homogeneous mixture.
- D. Paint accessory materials (linseed oil, shellac, turpentine and other materials not specifically indicated herein but required to achieve finishes specified) to be of best and highest quality and grade and be approved by paint manufacturer.

2.3 COLORS AND FINISHES

- A. Prior to beginning work, District will furnish color chips of surfaces to be painted selected from Contractor submittals.
- B. Use representative colors when preparing samples for review.
- C. Final acceptance of colors will be from samples applied on job.
- D. Acceptable products: Paint system numbers specified in this Section represent acceptable paint system products manufactured by Pratt & Lambert or Tnemac Company, Inc., and establish acceptable standard for paint systems.

2.4 MIXING AND TINTING

- A. Deliver paints ready-mixed to job site.
- B. Accomplish job mixing and job tinting only when acceptable to Architect. Use only thinners approved by paint manufacturer and use only within recommended limits.
- C. Mix only in mixing pails placed in suitably sized nonferrous or oxide resistant metal pans.
- D. Use tinting colors recommended by manufacturer for specific type of finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine surfaces scheduled to be painted prior to commencement of work.
 - 1. Report in writing to Architect any surface condition that cannot be put in proper condition by cleaning, sanding and puttying operations that may potentially affect proper application.
 - 2. Do not commence until such defects have been corrected.
- B. Do not proceed with finishing until surface is acceptable. Application of paint or finish to surface constitutes acceptance of surface.

3.2 GENERAL PREPARATION

- A. Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not to be painted.
- B. Furnish sufficient drop cloths, shields and protective equipment to prevent spray and droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.

- C. Place cotton waste, cloths and material which may constitute fire hazard in closed metal containers and remove daily from site.
- D. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions for each particular substrate condition.
- E. Mildew, efflorescence and foreign material shall be removed from surfaces by appropriate methods.
- F. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning processes will not fall onto wet, newly-painted surfaces.
- G. Remove hardware, hardware accessories, machined surfaces, plates, and other items not to be painted, or provide protection prior to surface preparation and painting operations.
- H. Do not paint moving parts of operating units, mechanical and electrical parts including valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts, and sprinkler heads unless otherwise noted. Provide covering and tape in place during spray paint operations.
- I. Sand and featheredge abraded or damaged areas of shop coats of paint before touch-up painting.

3.3 SURFACE PREPARATION

- A. Ferrous metal surfaces:
 - 1. Prepare unprimed surface in accordance with recommendations or directions of metal manufacturer or rust-inhibitive primer.
 - 2. Clean primed surfaces as recommended by primer manufacturer.
 - 3. Feather edges of sound paint by grinding if necessary.
- B. Repainting Previously Coated Surfaces:
 - 1. Remove all surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, efflorescence and sealers.
 - 2. Existing glossy surfaces of paint films should be thoroughly washed with abrasive cleaner to clean and dull surface, or wash thoroughly and sand.
 - 3. Remove sanding dust.
 - 4. Spot prime bare spots with appropriate primer for new finish.
 - 5. When applying new coatings to existing painted surface, check for compatibility by applying 3 square feet of test patch of new coating over prepared and cleaned existing surface. Allow to dry and verify adhesion.

3.4 PAINT APPLICATION

A. General requirements:

1. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.
2. Apply paint with suitable brushes, rollers or spraying equipment.
3. Rate of application shall not exceed rate recommended by paint manufacturer for surface involved.
4. Keep brushes, rollers and spraying equipment clean, dry, free from contaminants and suitable for required finish.
5. Comply with recommendation of product manufacturer for drying time between successive coats.
6. Vary slightly color of successive coats.
7. Sand and dust between each coat to remove defects visible from distance of 5'-0".
8. Provide light sand texture finish coats, free of brush marks, streaks, laps, or pile up of paints and skipped or missed areas.
9. Leave parts of moldings and trim clear and true to details with no undue amount of paint in corners or depressions.
10. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.
11. Refinish whole wall where portion of finish has been damaged or is not acceptable.
12. Latex paint may be spot retouched if acceptable to Architect.
13. Runs on faces not permitted.
14. Provide temporary signs required to protect wet finishes.

B. Examination:

1. Do not apply additional coats until completed coat has been reviewed by Architect.
2. Only reviewed coats of paint will be considered in determining number of coats applied.

3.5 FIELD QUALITY CONTROL

- A. Applicator shall apply materials in accordance with manufacturer's recommendations and to minimum dry film thickness specified.
- B. Applicator shall initiate and maintain for duration of Project field quality control program to ensure application in conformance with Project requirements.

3.6 CLEANING

- A. Touch up and restore finish where damaged.
- B. Remove spilled, splashed or splattered paint from surfaces.
- C. Do not mark surface finish of item being cleaned.
- D. Leave storage space clean and in condition required for equivalent spaces in Project.

3.7 MAINTENANCE STOCK

- A. Provide five unopened gallon cans of each type and color paint used.
- B. Each can to be tightly closed and clearly labeled to contents.
- C. Maintenance stock shall be delivered to Owner's Maintenance Building at 220 South 2nd Ave., Midlothian, Texas 76065 at a time scheduled with Owner. Midlothian I.S.D. representative must be present to accept and sign for stock, indicating on transmittal form location of stock for reference in Project Closeout documents (refer to 01 70 00).

3.8 PAINTING SCHEDULE

A. Ferrous Metal:	
Type	Alkyd Enamel.
Finish	Per Owner.
Location	Exterior Exposed.
System:	
Touch-Up	Touch up abraded surfaces of shop coat with same primer.
Primer	One coat Tnamec Series 10-99 (DFT 2.0-2.5 mils). (Omit on shop-primed surfaces).
2nd, 3rd Coats	Two coats Tnemec Series 23 (Min. DFT 2.0 Mils each coat).
B. Plaster or Gypsum:	
Type	Latex.
Finish	Match existing.
Location	Interior exposed locations, as indicated on drawings, vertical and horizontal surfaces.
System:	
1st, 2nd Coats	Two coats Pratt & Lambert Latex House and Trim Finish. (Min. DFT 1.2 Mils each coat).

END OF SECTION

SECTION 22 05 00**COMMON WORK RESULTS FOR PLUMBING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SCOPE OF WORK

- A. All Division 22 sections of these specifications shall include all labor and material to complete the entire mechanical systems as specified and shown on the Drawings.
- B. All work shown and specified shall be completely installed and connected by mechanics properly qualified to perform the work required. All work shall be left in a satisfactory operating condition as determined by the Owner and Owner's Representative.
- C. Provide all services and perform all operations required in connection with, or properly incidental to, the construction of complete and fully operating systems with all accessories as herein specified and shown on the Drawings.
- D. Refer to "Conditions of Work" in Division 1

1.3 GENERAL

- A. The accompanying Drawings show diagrammatically the sizes and location of the various equipment items and the sizes of the major interconnecting piping and without showing exact details as to elevations, offsets, control lines, and other installation details. The Contractor shall carefully lay out his work to conform to the site conditions, to avoid obstructions and provide proper grading of lines. Exact locations of outlets, apparatus, and connections thereto shall be determined by reference to the Drawings, reviewed Shop Drawings, including equipment drawings, and rough-in drawings, by measurements at the building, and in cooperation with work specified in other sections of these specifications. Minor relocations necessitated by the conditions at the site or directed by the Engineer shall be made without any additional cost to the Owner.

- B. These specifications and the accompanying Drawings are intended to describe and illustrate systems which will not interfere with the structures, which will fit into available spaces, and which will insure complete and satisfactorily operating installations. Contractor shall coordinate the proper fitting of all material and apparatus into the building and shall prepare larger scale installation drawings for all critical areas, areas with limited working clearances, and areas of significant congestion requiring a higher level of coordination illustrating the installation of work specified in Division 22 in relation to all other portions of work specified in other Sections of these Specifications. Interferences with other portions of work, or the building structure, shall be corrected before any work proceeds. Should changes become necessary on account of the failure of the Contractor to comply with these stipulations, Contractor shall make all necessary changes at no expense to the Owner.
- C. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted on the Drawings.
- D. It is the intent of the Contract Documents to provide an installation complete and operational in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section, or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems and required to complete the installation.
- E. Contractor sets forth that all personnel have the necessary technical training and ability; and that all work specified in this Division will be installed to the best standard of each trade, and will be complete and in good working order. If any of the requirements of the Drawings and specifications are impossible to perform, or if the installation when made in accordance with such requirements will not perform satisfactorily, report same to the Engineer promptly after discovery of the discrepancy.
- F. No extra compensation will be allowed for extra work or changes caused by failure to comply with the above requirements.

1.4 EXAMINATION OF THE SITE

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

1.5 CUTTING AND PATCHING

- A. Excessive cutting of the building structure, walls, floors, ceilings, roof, etc., will not be permitted. No structural member shall be notched or cut unless specifically shown on the Drawings, or unless such cutting is authorized by the Engineer.
- B. Provide for all holes or openings of proper size and shape as may be necessary for the proper installation of work specified in Division 22, consulting with the Engineer regarding proper locations and sizes.
- C. Where deemed necessary, and after consulting with the Engineer, perform all cutting and patching required for the installation of piping, etc. This shall include the cutting of concrete floors, concrete and tile floors, walls, ceilings, roofs, etc. It shall also include patching them as required to restore work to match existing finishes, following installation, testing, backfilling, insulation, etc.
- D. Holes through concrete shall be drilled with "Mole", "Core-It", or other diamond point hole saw.
- E. Refer to Division 01, Cutting and Patching.

1.6 CODE REQUIREMENTS

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

Contractor shall obtain all permits, inspections, and approvals as required by all authorities having jurisdiction. Fees and costs incidental to these permits, inspections, and approvals must be assumed and paid by the Contractor.

1.7 RECORD DRAWINGS

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

1.8 RECORDS AND INSTRUCTIONS FOR OWNER

- A. Accumulate during the job's progress the following sets, in triplicate, in accordance with the provisions of Division 01, Execution and Close-Out Requirements:
 - 1. Warranties and guarantees and manufacturer's directions on equipment and material covered by the Contractor.
 - 2. Equipment and fixture brochures, wiring diagrams, and control diagrams.
 - 3. Copies of reviewed Shop Drawings, and material and equipment submittals. Copies of rejected submittals and Shop Drawings are not to be provided.
 - 4. Operating instructions for heating and other plumbing systems. Operating instructions shall include recommended maintenance and seasonal change-over procedures.
 - 5. Other data and drawings required during construction.
 - 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
 - 7. Valve tag charts and diagrams specified elsewhere herein.
 - 8. "As-Built" Record Drawings shall be provided in electronic format on a USB Drive (provide two (2) copies) in a PDF or DWG format as determined by the Owner.
 - 9. Provide copies of all City Inspection Certificates of Approval.
 - 10. Provide Contractor's Certification Statement that all equipment furnished and all work performed is in compliance with all applicable codes referenced in these specifications, or those which are currently in effect.
- B. Provide not less than one (1) day of operating instructions per building, during the adjustment and testing period, to the Owner's operating personnel in order to familiarize them with the proper care and operation of all equipment.

- C. All of the above data should be submitted to the Engineer for approval at such time as the Contractor asks for his last payment request, just prior to his final payment request. In no case will any portion of retainage be released until these documents are submitted and accepted.
- D. Refer to related portions of Division 1 for Project Close-Out requirements, Operation and Maintenance Data, Warranties, and other related certificates.

1.9 SHOP DRAWINGS AND SUBMITTALS

- A. Contractor shall submit to the Engineer shop drawings, product submittals, and catalog data on all piping, equipment, and materials designated on the Drawings and specified herein. Electronic Pdf copies of each shall be submitted.
- B. Contractor shall submit full product data shop drawings and shall prepare and submit 1/4" = 1'-0" scale plumbing piping shop drawings. Contractor shall fully coordinate all piping shop drawings with sheet metal shop drawings and other trades. Failure to submit shop drawings in a timely manner, as required to keep pace with the construction and work of all other trades, will result in delays, and possible stoppage, of payment to the contractor. Additionally, no work may proceed until such shop drawings are submitted, reviewed, and found to be acceptable by the engineer.
- C. Each submittal will be reviewed for compliance with general requirements of design and arrangement only; it is not a contract document and acknowledgment of compliance does not relieve the Contractor from responsibilities for performance of the work in compliance with all provisions and requirements of the Contract Documents. Job measurements and the coordination of all dimensions for proper fit of all parts of the work and performance of all equipment supplied to meet specification requirements are, and remain, specific responsibilities of the Contractor.
- D. Shop Drawings shall be furnished by the Contractor for the work involved after receiving approval on the make and type of material and in sufficient time so that no delay or changes will be caused. This is done in order to facilitate progress on the job, and failure on the part of the Contractor to comply shall render him liable to stand the expense of any and all delays, changes in construction, etc., occasioned by his failure to provide the necessary detailed drawings. Also, if the Contractor fails to comply with this provision, the Engineer reserves the right to go directly to the manufacturer he selects and secure any details he might deem necessary; and, should there be any charges in connection with this, they shall be borne by the Contractor.
- E. Shop Drawings submitted shall not consist of manufacturers' catalogues or tear sheets therefrom that contain no indication of the exact item offered. Rather, the submission on individual items shall designate the exact item offered and accessories as specified.

- F. Shop Drawings are not intended to cover detailed quantitative lists of valves, devices, fixtures, and similar items, as the Drawings and specifications illustrate those items; and it is the Contractor's responsibility to procure the proper quantities required to comply with the established requirements.
- G. Shop Drawings prepared to illustrate how equipment, piping, etc., can be fitted into available spaces will be examined under the assumption that the Contractor has verified the conditions shown. Review by the Engineer shall not relieve the Contractor of responsibility in the event the material cannot be installed as shown on those Shop Drawings.
- H. Various material submissions of such items as plumbing fixtures, drains, and other related items or accessories shall be assembled in brochures or in other suitable package form and shall not be submitted in a multiplicity of loose sheets. Cover sheets for each item submitted shall have sufficient bare space to allow for shop drawing review stamps.
- I. Contractor shall process his submitted data to insure that it conforms to the requirements of the Drawings and specifications, and there are no omissions and/or duplications.
- J. Shop Drawings and Submittals shall be accompanied by certification from the Contractor, and firm preparing such, that Shop Drawings have been checked for, and are in compliance with, the Contract Documents.
- K. All Submittals and Shop Drawings shall have been submitted for review by the Engineer and Engineer within 90 days after Contract Award Date.

1.10 PENETRATIONS THROUGH FIRE-RATED ASSEMBLIES

- A. Seal voids around pipes penetrating fire-rated assemblies and partitions using fire-stopping materials and methods.

1.11 DRAWINGS

- A. Drawings show diagrammatically the locations of the various pipes, fixtures, and equipment, and the method of connecting and controlling them. It is not intended to show every connection in detail and all fittings required for a complete system. The systems shall include, but are not limited to, the items shown on the drawings. Exact locations of these items shall be determined by reference to the general plans and measurements at the building, and in full cooperation with work specified in other Divisions of these specifications; and, in all cases, shall be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable change in the location of any of this work without additional cost to the Owner.

- B. Should any changes be deemed necessary in items shown on the Contract Drawings, the shop drawings, descriptions, and the reason for the proposed changes shall be submitted to the Engineer for approval.
- C. Exceptions and inconsistencies in plans and specifications shall be brought to the Engineer's attention prior to bids being submitted; otherwise, the Contractor shall be responsible for the cost of any and all changes and additions that may be necessary to accommodate the installation of any particular apparatus.
- D. Lay out all work maintaining all lines, grades, and dimensions according to these Drawings with due consideration for the work of others. Verify all dimensions at the site prior to any fabrication or installation. Should any conflict develop or installation be found impractical, the Engineer shall be notified before any installation or fabrication, and the existing conditions shall be investigated and proper changes effected without any additional cost.
- E. Titles of Sections and Paragraphs in these specifications are introduced merely for convenience and are not to be construed as a correct or complete segregation or tabulation of the various units of materials and work. The Engineer does not assume any responsibility, either direct or implied, for omissions or duplications by the Contractor due to real or alleged error in the arrangement of matter in the Contract Documents.

1.12 CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

- A. Equipment supplied as portions of work specified under other Divisions of these specifications shall be furnished with proper roughing-in diagrams and shall be installed as a part of Division 22.
- B. Furnish materials and labor required for the connection of this equipment.
- C. Contractor shall ascertain that all equipment so specified is included as part of this work.

1.13 COOPERATION

- A. Coordinate all work indicated in Division 22 with work specified in other Divisions to assure proper and adequate interface with other portions of the work.
- B. Maintain contact and be familiar with the progress of the general construction and the timely installation of sleeves and inserts, etc., before concrete is placed. Install the required systems in their several stages, at the proper time to expedite the work and avoid unnecessary delays in the progress of other portions of the work.

- C. Should any questions arise between work specified in Division 22 with respect to other portions of work specified in other Divisions of the Specifications, reference shall be made to the Engineer for instructions.

1.14 MATERIALS AND EQUIPMENT

- A. All materials and equipment purchased shall be new. No used or reconditioned equipment will be allowed.
- B. All piping only material shall be manufactured in the United States and/or shall comply with the North America Free Trade Agreement, NAFTA.**
- C. Substitutions: Products of same functions, performance and design will only be considered if in full accordance with the requirements of Section 01 60 00, Product Requirements. The products of other manufacturers will be acceptable; only if, in the opinion of the Engineer, the substitute material is of a quality as good or better than the material specified, and will serve with equal efficiency, maintainability, and dependability, the purpose for which the items specified were intended.
- D. Listed Manufacturers:
 1. Manufacturers listed in a product or system specification are those manufacturers considered capable of manufacturing products conforming to the specification requirements, and are listed therein to establish a standard.
 2. The "listing" of a manufacturer does not imply "acceptance" or "approval" of any standard product of that manufacturer.
 3. Products offered by listed manufacturers shall be equal to, or superior in all respects to, that specified by named products; and shall meet or exceed specification requirements.
 4. The description of specific qualities takes precedence over the reference standards and the description of qualities and reference standards together take precedence over the named product of listed manufacturers.
- E. Product Options:
 1. Products specified only by Reference Standards or by Description only means that any product meeting those standards or descriptions, by any manufacturer, will be considered.
 2. Products specified by naming several products or manufacturers means that only the manufacturers named will be considered.
 3. Products specified by naming only one product and manufacturer means that no option exists unless a substitution is accepted. Submit a request for substitution for any product or manufacturer not specifically named.

4. Products specified by Description, Reference Standard, and naming several products or manufacturers means that any product and manufacturer named meeting those descriptions and standards will be considered. Submit a request for substitution for any product or manufacturer not specifically named.

F. Limitations or Substitutions:

1. During Proposal Period, Instructions to Proposers, in Division 1, will govern times for submitting requests for substitutions under requirements specified in this Section.
 2. No later than ten (10) days prior to the proposal date, Contractor shall notify the Engineer in writing of any desired substitutions of products in place of those specified. These requests will be considered; and, if a favorable response is determined, this will be documented in the form of an Addenda.
 3. Substitutions will not be considered when indicated or implied on Shop Drawings or product data submittals without separate formal request, when requested directly by subcontractor or supplier, or when acceptance will require substantial revision of Contract Documents.
 4. Substitute products shall not be ordered or installed without written acceptance.
 5. Only one request for substitution for each product will be considered. If substitution is not accepted, Contractor shall provide specified product.
 6. Engineer will determine acceptability of any and all substitutions.
- G. It is fully the Contractor's responsibility to assemble and submit sufficient technical information to fully illustrate that the material or equipment proposed for substitution is equal or superior, as the Engineer is under no obligation to perform the service for the Contractor. The proposal shall be accompanied by manufacturer's engineering data, specification sheet, and a sample, if practical or if requested or specified. In no event shall a proposal for substitution be cause for delay of work. This shall include a detailed comparison to each product specification paragraph.
- H. Should a substitution be accepted under the above provisions, and should the substitution prove defective or otherwise unsatisfactory for the intended service, within the warranty period, the Contractor shall replace the substitution with the equipment or material specified, and on which the specifications required him to base his proposal.
- I. No substitutions will be considered contingent upon pending certification and rating agency approvals. Such certifications and ratings shall be in effect at the time of bidding.

1.15 EQUIPMENT SIZES AND REQUIREMENTS

- A. Space allocations in machinery and mechanical equipment spaces are based on equipment scheduled in each case. Should the Contractor request a substitution for equipment of another make that requires more space in any critical dimension, the Contractor shall submit, together with other submittal data on the equipment, prints of

drawings indicating how the equipment may be installed, indicating room for servicing and revisions in piping or ducting and any other details necessary for the Engineer to form a judgement as to the suitability of the substitute material, as to performance, suitability for the space and other variables.

- B. Duties of certain equipment items, horsepower of driving motors and electrical characteristics are scheduled for equipment items of a particular make in each case. Should requests for a substitute material be accepted which has other requirements that would involve allied equipment or other portions of work, the Contractor shall be responsible for all modifications required at no change in contract price. As examples:
 - 1. If an accepted pump motor has a brake horsepower requirement above the motor horsepower scheduled, the Contractor shall be responsible for providing a larger motor and heavier drive and any change in size of the protective device, conduit run and conductors serving that motor. The latter shall be extended through an individual branch protective device and branch circuit on through the panel, feeder, feeder protective device, etc.
 - 2. If accepted, water heaters having a different power voltage, phase or breaker size than those on which the heater were based, the Contractor shall be responsible for adjusting electrical service work accordingly.
- C. Structural steel members are indicated to provide supports for certain specific sizes and weights of equipment. Should a substitution request involve other equipment, the spacing of the supports shall be varied to suite the equipment. Should the weight or size of a proposed substituted item of equipment require additional supporting steel members, the Contractor shall include documentation of the additional supports in the request for substitution and install them at no change in contract price if the substitution is accepted.
- D. Various large apparatus to be installed may require that the apparatus be installed prior to the installation of portions of structural, walls, or door frames. Coordinate the installation of these items to insure that no demolition of general construction is necessary for equipment installation or that the apparatus does not have to be disassembled for installation.

1.16 STORAGE AND PROTECTION OF MATERIALS

- A. Store and protect materials and equipment as specified in Section 01 60 00, Product Requirements.
- B. Contractor shall provide storage space for protection and storage of his materials and assume complete responsibility for all losses due to any cause whatsoever. All storage shall be within the property lines of the building site, and as directed by the Engineer. In no case, shall storage interfere with traffic conditions in any public or project thoroughfare.

- C. All work and material shall be protected at all times. Contractor shall make good any damage caused, either directly or indirectly, by his workmen. He shall be responsible for safe handling of all mechanical equipment and shall replace, without charge, all items damaged prior to acceptance by the Owner.
- D. On site storage shall not be inside the building during construction progress, but shall be in approved trailers or as specifically approved otherwise by the Engineer. Storage inside the building shall only be allowed when so allowed by the Engineer.

1.17 FOUNDATIONS

- A. Provide equipment foundations associated with the work specified in Division 22.
- B. All top corners and edges of all foundations shall be neatly chamfered at a one inch (1") high 45 degree angle.
- C. Foundation bolts shall be placed in the forms when the concrete is poured. Allow one inch (1") below the equipment bases for alignment, leveling, and grouting with non-shrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary.
- D. After removal of the forms, the surface of the foundation shall be rubbed until smooth.
- E. Unless otherwise noted, foundations shall be four inches (4") thick for plumbing equipment, unless specifically noted otherwise on the Drawings.
- F. Provide housekeeping pads and foundations for every item of floor mounted equipment specified in Division 22 specifications. Pads shall extend a minimum of two inches (2") in each direction beyond the equipment size.

1.18 WIRING

- A. Unless otherwise noted, all wiring for motors, starters, and equipment is specified in Division 26.
- B. Wiring of temperature controls shall be performed in accordance with the requirements of Division 26 but shall be performed as outlined in other sections of these specifications.
- C. All power for control circuits required for the Temperature Control System shall be provided and installed where indicated on the Division 26 Drawings, but shall otherwise be provided as indicated in other sections of these specifications.

- D. Each supplier of equipment requiring control shall have wiring diagrams furnished with submittals. This shall be used to determine conduit layouts required to complete the electrical portions of the instrumentation and control systems.
- E. All motors furnished as a portion of work specified in Division 22 shall be wired as specified in Division 26.
- F. Except where combination starter-disconnects are specified elsewhere herein or in Division 26, all motors shall be provided with safety disconnect switches in accordance with the National Electrical Code as specified in Division 26.
- G. Furnish all necessary wiring diagrams for equipment specified in Division 22, as a part of equipment submittals, for installation under other sections of these specifications.

1.19 EQUIPMENT STANDARDS

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

1.20 CLEAN UP

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

1.21 FINAL CONSTRUCTION REVIEW

- A. Schedule: Upon completion of the work specified in Division 22, there shall be a final construction review of the completed plumbing systems installations. Prior to this walk-thru, all work specified in this Division shall have been completed, tested, adjusted, and

balanced in its final operating condition and the preliminary test report shall have been submitted to and approved by the Engineer.

- B. Personnel: A qualified person representing the Contractor must be present at this final construction review to demonstrate the system and prove the performance of the equipment.
- C. Building plumbing systems shall have been in operation for a minimum of 15 days and Test and Balance work shall be substantially complete prior to this review.
- D. Exceptions to the aforementioned requirements will be considered on a case-by-case basis dependent on the size and type of project, as well as construction schedule limitations.

1.22 CERTIFICATIONS

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

1.23 GUARANTEE

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

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

END OF SECTION

SECTION 22 11 23**NATURAL GAS PIPING SYSTEM****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with Division 22 Sections, as applicable. Refer to other Divisions for coordination of work with other trades, as required.
- C. Comply with Local Governing Gas Codes, and the requirements of the Authorities Having Jurisdiction.

1.2 SYSTEM DESCRIPTION

- A. Provide a complete natural gas piping system as indicated herein and as illustrated on the contract drawings.
- B. Make connections to water heaters, HVAC equipment, kitchen equipment or other devices as specified here or as shown on the drawings.
- C. Provide gas cocks, pressure regulators, dirt legs, valves and unions or other devices as indicated and as required by the local authorities having jurisdiction.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Indicate on submittal piping material and joining method for each system and for the various sizes of piping systems to be installed. This shall be in tabular form in one location.
- C. Product Data:
 - 1. Pipe.
 - 2. Fittings.
 - 3. Joining methods.
 - 4. Valves.
 - 5. Clean Gas pressure regulators.
 - 6. Vents.
- D. Certification: Submit certification that completed system complies with test requirements of municipality, State, and other public authorities having jurisdiction over system.

- E. Provide closeout documents as required in Division 1.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in following order of precedence:
 1. Codes, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction over installation, inspection, and testing, including local codes.
 2. Provisions specified in this Section.
 3. Applicable provisions of standards of National Fire Protection Association (NFPA).
 4. Applicable provisions of standards of American Gas Association (AGA).
 5. International Plumbing Code and International Fuel Gas Code.
 6. Local Gas Utility Requirements.
- B. Installer shall have been doing related work as described herein for a minimum of 5 years.

PART 2 - PRODUCTS

2.1 MASTER METER

- A. Contractor shall coordinate revised gas service requirements with the Local Natural Gas Utility Company to insure the timely provision of this service to keep up with the project requirements. Coordinate exact pipe routing, size, installation, and system pressure requirements with utility company. Contractor shall coordinate with and pay all costs to the Utility Company for all new gas piping from the off-site gas main trunk connection up to the property line, extended onto the site up to and including the gas meter installation at the proposed location. Contractor shall install gas piping from the gas meter up to the building entry point. This system shall be provided with the service pressure noted with isolation valves, test ports, and regulation components to adjust the downstream pressure to that indicated.
- B. Contractor shall furnish to the local gas utility company a detailed itemized list of all gas fired equipment including required operating supply pressure and MBTU input requirement of each piece of equipment.

2.2 ABOVE GROUND PIPE AND FITTINGS

- A. Pipe: ASTM A53, Grade A or B, seamless, Schedule 40, standard weight black steel.
 1. 2 Inches and Smaller: Threaded and coupled.
 2. 2-1/2 Inches and Larger: Butt welded joints
 3. All gas piping in sleeves shall have welded joints, regardless of size.

- B. Fittings, 2 Inches and Smaller: ASTM A197, 150 LB black malleable iron, screwed joint. Piping system with pressure of 2 psig or greater shall have socket welded joints for all sizes.
- C. Fittings, 2-1/2 Inches and Larger: ASTM A234, WPB standard weight, weld joint fittings.
- D. Unions, 2 Inches and Smaller: ASTM A197, 150 LB, black malleable iron, screwed joint, brass to iron ground joint.
- E. Flanges:
 - 1. Use for 2-1/2 Inches and larger pipe.
 - 2. ASTM A181, Grade 1, 150 LB, flat faced, weld neck.
 - 3. Gaskets:
 - a. Acceptable manufacturers:
 - 1) Manville.
 - 2) Cranite.
 - b. 150 LB, 1/16 Inch full-faced, punched sheet, 650 Deg.F. rating suitable for gas service.
 - c. Bolting: ASTM A307, Grade B, heavy hex head machine bolt with heavy hex nuts.

2.3 VALVES

- A. Acceptable Manufacturers:
 - 1. SMG Global
 - 2. Milwaukee
 - 3. Hammond
 - 4. McDonald.
- B. Valves: 125 LB iron cocks, flat head, non-lubricated plug with resilient double seal, screwed ends or flanged, for natural gas service.
- C. Acceptable Product: "Series 400", Key Port valve by SMG Global with RS49 (HYCAR) plug seals, U.L. listed for natural gas shut-off.

2.4 GAS PRESSURE REGULATORS

- A. Acceptable Manufacturers:
 - 1. Rockwell/Equimeter.
 - 2. Fisher.
 - 3. Sensus
 - 4. Itron

B. Regulators:

1. Adjustable type, with automatic loading.
2. Provide with automatic pressure relief.
3. Provide means for removing and renewing valve.
4. Adjust for outlet pressure required.
5. Outlet pressure shall not vary more than 1/2 inch water column from setting point at connected load capacity for regulator.

C. Pressure Relief: Diaphragm operated, spring loaded type with vent for relief of excess pressure on low pressure side of each main service regulator.

D. All equipment shall be furnished with final regulator.

E. Regulators shall have bugproof screened vent cap installed in vent tapping.

F. When regulators are installed inside the building and venting of the regulator is required, extend the vent full size to the outside and terminate vent with a gooseneck with a bugproof screen.

G. Acceptable Product: Rockwell Model 143, 243 or 121 as determined by inlet and outlet pressure, pipe size and CFH capacity.

H. Provide secondary regulators at individual equipment connections where required to deliver manufacturer's recommended delivery pressure to equipment. Where regulator are installed in the building, provide an individual regulator vent to the exterior of the building and terminate open sight 12" above the roof with gooseneck and bug screen.

2.5 GAS PIPE ROOF SUPPORTS:

A. Pipe supports shall have stainless steel adjustable height hard cast rubber roller w/ nylon bushing pipe supports with stainless steel pad for all roof top utility lines. Refer to manufacturer's recommendations for spacing and appropriate pipe support size of pipe. Provide, as a minimum supports as follows:

1. Within 3'-0" of all equipment connections
2. Within 2'-0" of each change in direction, elbow & tee.
3. Not more than every 10'-0" on centers beyond those indicated above.

B. Provide Mapa model MX-5RA or equal by Erico or Miro

C. Provide with Traffic Pad, Mapa model MWP1016.

2.6 VENT CAPS

- A. Caps shall be weatherproof with bugproof screened vent.
- B. Caps shall be double outlet vent cap, slip-on type with set screw or threaded, with aluminum body and 40 mesh stainless wire cloth as manufactured by Morrison Bros. Co., OPW or Universal.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Cap or plug pipe openings during installation.
- B. Cover and protect piping, fixtures and equipment against dirt, water, weather, and chemical or mechanical injury.
- C. Run Piping Concealed and Sleeved in Finished Rooms unless Indicated Otherwise:
 - 1. Terminate lower end of vertical supply piping near burners or equipment connections.
 - 2. Terminate with tee, nipple, and cap to serve as dirt trap.
 - 3. Where gas burning kitchen equipment is located adjacent to other gas burning kitchen equipment, provide manifold for battery.
 - 4. Connect each end of a manifold to gas distribution system to maintain uniform gas pressure at each piece of equipment, two (2) point service.
 - 5. All final equipment connections shall consist of a union and shut-off valve.
- D. Threaded Joints:
 - 1. Taper threads and cut evenly; make with graphite and oil.
 - 2. After cutting and before threading, ream pipe to remove burrs.
 - 3. Use appropriate pipe joint thread compound.
 - 4. Caulking of threaded joints after joining to stop or prevent leaks will not be permitted.
- E. Welded Joints:
 - 1. Fusion-weld in accordance with ANSI B31.8, make changes in direction of piping with welding fittings only.
 - 2. Mitering or notching pipe to form elbows and tees will not be permitted except for sleeves as indicated elsewhere herein.
 - 3. Make branch connections with welding tees or forged welding branch outlets except for sleeves as indicated elsewhere herein.
- F. Beveling:
 - 1. Make field and shop bevels by mechanical means or flame cutting.
 - 2. Where beveling is done by flame cutting, clean surfaces of scale and oxidation prior to welding.

G. Alignment:

1. Before welding, align component parts to be welded so no strain is placed on weld when finally positioned.
2. Set flanges and branches true.
3. Maintain alignment during welding operation.

H. Make final connection to equipment using rigid pipe and fittings.

I. Place fire stop where pipes pass through fire walls, fire partitions, or floors.

J. Sleeves:

1. Install continuous pipe sleeve around gas piping above ceilings, in vertical chases, and at all concealed piping within the building.
2. Seal all sleeves airtight inside the building except where noted, and allowed by Authorities Having Jurisdiction, to terminate in ventilated space.
3. Vent all sleeves to the outside. Terminate sleeve to prevent entrance of water and insects.
4. Size and install gas pipe sleeves to permit replacement of gas piping without damage to building structure.
5. Terminate gas sleeve vents a minimum of eight inches (8") above the roof with specified vent cap. All exposed vent piping on roof or above grade shall be Schedule 40 galvanized steel pipe.
6. Vent to have free area equal to the net free area between the sleeve and the largest gas pipe contained therein.
7. All gas piping in sleeves shall have welded joints regardless of pipe size.
8. Where the end sealing is capable of withstanding the full pressure of the gas pipe the vented sleeve shall be designed for the same pressure as the pipe.

K. Piping on roof:

1. Piping shall be supported on roof supports furnished and installed under Division 22. Refer to documents for installation requirements. Spacing not to exceed 10'-0" on center and within 3'-0" of each equipment connection or branch pipe.
2. Offset pipes to be 8" minimum above the roof at all expansion joints, roof penetrations, perimeter gravel stops/fascia and vertically flashed surfaces.
3. Unless noted otherwise, bottom of pipe shall be minimum of 4" above roof or roof ballast.
4. Do not secure piping to supports unless detailed otherwise.
5. Exposed piping shall be coated with red primer and a minimum of two coats of paint. Preparation of piping and painting shall comply with other applicable sections in Division I.
6. Pipe installer shall determine exact layout of piping and locate all required supports.

3.2 FIELD QUALITY CONTROL

- A. Set up in accessible position, where directed, test pump and mercury gauge connected to permanent gas piping.
- B. Protect pump and gauge and keep in working order until after final inspection.
- C. Remove as directed.
- D. Before appliances are connected, piping systems shall withstand a test pressure of 150 percent of the maximum working pressure or 30 PSIG, whichever is greater, for a period of not less than one (1) hour without showing a drop in pressure.
- E. Pressure calibrated instruments shall read in increments of not greater than 0.1 LB when measured with mercury manometer or slope gauge.
- F. Pressurize system, then isolate source of pressure before pressure tests are made.
- G. Test gas piping with dry air only.
- H. If test fails, repair all leaks and retest until the test passes.

END OF SECTION

SECTION 23 00 00**HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) WORK****PART 1 - GENERAL****1.1 DESCRIPTION OF WORK**

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

1.2 RELATED DOCUMENTATION

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

1.3 DESCRIPTION OF HVAC DEMOLITION WORK

- A. Contractor shall remove several items of materials and equipment under this Section of the Specifications. Equipment and materials to be removed shall be as indicated and noted on the Drawings and as required to facilitate the new installations.

- B. Generally, modifications to, replacing of, or making new connections into existing service lines shall be accomplished only during the times directed by the Owner's Representative.

PART 2 - EXECUTION

NOT USED

PART 3 - EXECUTION

3.1 INSTRUCTION OF OWNER'S PERSONNEL

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

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

3.2 TEMPORARY WORKING ACCESS

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

3.3 DISRUPTION OF EXISTING FUNCTIONS

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

- D. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior written approval and shall include the following information in the form of a memorandum submitted by the Contractor to the Owner's Representative for approval by the Owner:

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

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

3.4 MODIFICATIONS AND RELOCATIONS

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

3.5 SCHEDULE OF WORK

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

3.6 SALVAGE, DEMOLITION, AND RELOCATION

- A. It shall be the responsibility of the Contractor to remove and store those items of existing equipment as indicated on the Drawings to be removed. All items of equipment or fixtures removed shall be protected from damage insofar as is practical.
- B. Mechanical items to be removed, salvaged, or relocated shall be removed by the respective trade who would normally be responsible to install new work similar to that to be removed. This shall include whatever selective demolition is necessary to avoid damaging other work of other trades. Each trade shall be responsible for their respective demolition. However, all trades shall keep informed as to the project schedule as it relates to the Demolition Scope of Work.

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

3.7 CLEAN UP

- A. Remove all debris, rubbish, and materials resulting from cutting, demolition, or patching operations from the work area on a daily basis.
- B. Where such work generates dust and debris take all precautions necessary to prevent dust and debris from accumulating in or on other mechanical and electrical equipment. This may require adding temporary filter media over ventilation air openings of certain types of equipment.
- C. At the conclusion of this work clean all building materials, mechanical equipment and electrical equipment so that all items are dust free and operating properly. Where dust causes damage to equipment the Contractor shall make repairs to this equipment at no cost to the Owner.

- D. Transport all demolished materials and equipment indicated above in approved containers and legally dispose of all debris off site in a manner approved by the Engineer and Owner.

END OF SECTION

SECTION 23 05 00**COMMON WORK RESULTS FOR HVAC****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SCOPE OF WORK

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

1.3 GENERAL

- A. The accompanying Drawings show diagrammatically the sizes and location of the various equipment items and the sizes of the major interconnecting piping and ductwork, without showing exact details as to elevations, offsets, control lines, and other installation details. The Contractor shall carefully lay out his work to conform to the site conditions, to avoid obstructions and provide proper grading of lines. Exact locations of outlets, apparatus, and connections thereto shall be determined by reference to the Drawings, reviewed Shop Drawings, including equipment drawings, and rough-in drawings, by measurements at the building, and in cooperation with work specified in other sections of these specifications. Minor relocations necessitated by the conditions at the site or directed by the Engineer shall be made without any additional cost to the Owner.

- B. These specifications and the accompanying Drawings are intended to describe and illustrate systems which will not interfere with the structures, which will fit into available spaces, and which will insure complete and satisfactorily operating installations. Contractor shall coordinate the proper fitting of all material and apparatus into the building and shall prepare larger scale installation drawings for all critical areas, areas with limited working clearances, and areas of significant congestion requiring a higher level of coordination illustrating the installation of work specified in Division 23 in relation to all other portions of work specified in other Sections of these Specifications. Interferences with other portions of work, or the building structure, shall be corrected before any work proceeds. Should changes become necessary on account of the failure of the Contractor to comply with these stipulations, Contractor shall make all necessary changes at no expense to the Owner.
- C. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted on the Drawings.
- D. It is the intent of the Contract Documents to provide an installation complete and operational in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section, or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems and required to complete the installation.
- E. Contractor sets forth that all personnel have the necessary technical training and ability; and that all work specified in this Division will be installed to the best standard of each trade, and will be complete and in good working order. If any of the requirements of the Drawings and specifications are impossible to perform, or if the installation when made in accordance with such requirements will not perform satisfactorily, report same to the Engineer promptly after discovery of the discrepancy.
- F. No extra compensation will be allowed for extra work or changes caused by failure to comply with the above requirements.

1.4 EXAMINATION OF THE SITE

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

- C. All site visits shall be coordinated and scheduled with the Owner.

1.5 CUTTING AND PATCHING

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

1.6 CODE REQUIREMENTS

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

- C. Contractor shall obtain all permits, inspections, and approvals as required by all authorities having jurisdiction. Fees and costs incidental to these permits, inspections, and approvals must be assumed and paid by the Contractor.

1.7 RECORD DRAWINGS

- A. Contractor shall, during the execution of work, maintain a complete set of "Record Drawings" upon which all locations of equipment, ductwork, piping, and all deviations and changes in the work shall be neatly recorded for use in producing "As Builts" at Project Close- Out. This shall include the incorporation of all Supplemental Drawings issued during the Construction Period.
- B. All "Record Drawings" shall be reviewed monthly during the Construction Period, along with the monthly Pay Application Request.
- C. Refer to Section 01 07 00, Contract Close-Out.

1.8 RECORDS AND INSTRUCTIONS FOR OWNER

- A. Accumulate during the job's progress the following sets, in triplicate, in accordance with the provisions of Section 01 70 00 & 01 73 00:
 - 1. Warranties and guarantees and manufacturer's directions on equipment and material covered by the Contractor.
 - 2. Equipment and fixture brochures, wiring diagrams, and control diagrams.
 - 3. Copies of reviewed Shop Drawings, and material and equipment submittals. Copies of rejected submittals and Shop Drawings are not to be provided.
 - 4. Operating instructions for heating and cooling and other mechanical systems. Operating instructions shall include recommended maintenance and seasonal change-over procedures.
 - 5. Other data and drawings required during construction.
 - 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
 - 7. Valve tag charts and diagrams specified elsewhere herein.
 - 8. "As-Built" Record Drawings shall be provided in electronic format on a USB Drive (provide two (2) copies) in a PDF or DWG format as determined by the Owner.
 - 9. Provide copies of all City Inspection Certificates of Approval.
 - 10. Provide Contractor's Certification Statement that all equipment furnished and all work performed is in compliance with all applicable codes referenced in these specifications, or those which are currently in effect.
- B. Provide not less than one (1) days of operating instructions, during the adjustment and testing period, to the Owner's operating personnel in order to familiarize them with the proper care and operation of all equipment.

- C. All of the above data should be submitted to the Engineer for approval at such time as the Contractor asks for his last payment request, just prior to his final payment request. In no case will any portion of retainage be released until these documents are submitted and accepted.
- D. Refer to related portions of Division 1 for Project Close-Out requirements, Operation and Maintenance Data, Warranties, and other related certificates.

1.9 SHOP DRAWINGS AND SUBMITTALS

- A. Contractor shall submit to the Engineer shop drawings, product submittals, and catalog data on all ductwork, equipment, and materials designated on the Drawings and specified herein. A minimum of three (3) copies of each shall be submitted or submittal shall be transmitted electronically. Additional copies will be required when indicated by the Engineer and as required for project coordination.
- B. Each submittal will be reviewed for compliance with general requirements of design and arrangement only; it is not a contract document and acknowledgement of compliance does not relieve the Contractor from responsibilities for performance of the work in compliance with all provisions and requirements of the Contract Documents. Job measurements and the coordination of all dimensions for proper fit of all parts of the work and performance of all equipment supplied to meet specification requirements are, and remain, specific responsibilities of the Contractor.
- C. Shop Drawings shall be furnished by the Contractor for the work involved after receiving approval on the make and type of material and in sufficient time so that no delay or changes will be caused. This is done in order to facilitate progress on the job, and failure on the part of the Contractor to comply shall render him liable to stand the expense of any and all delays, changes in construction, etc., occasioned by his failure to provide the necessary detailed drawings. Also, if the Contractor fails to comply with this provision, the Engineer reserves the right to go directly to the manufacturer he selects and secure any details he might deem necessary; and, should there be any charges in connection with this, they shall be borne by the Contractor.
- D. Shop Drawings submitted shall not consist of manufacturers' catalogues or tear sheets therefrom that contain no indication of the exact item offered. Rather, the submission on individual items shall designate the exact item offered and accessories as specified.
- E. Shop Drawings are not intended to cover detailed quantitative lists of heating specialties, valves, air distribution devices, fixtures, and similar items, as the Drawings and specifications illustrate those items; and it is the Contractor's responsibility to procure the proper quantities required to comply with the established requirements.

- F. Shop Drawings prepared to illustrate how equipment, piping, ducts, etc., can be fitted into available spaces will be examined under the assumption that the Contractor has verified the conditions shown. Review by the Engineer shall not relieve the Contractor of responsibility in the event the material cannot be installed as shown on those Shop Drawings.
- G. Various material submissions of such items as air devices, plumbing fixtures, drains, and other related items or accessories shall be assembled in brochures or in other suitable package form and shall not be submitted in a multiplicity of loose sheets. Cover sheets for each item submitted shall have sufficient bare space to allow for shop drawing review stamps.
- H. Contractor shall process his submitted data to insure that it conforms to the requirements of the Drawings and specifications, and there are no omissions and/or duplications.
- I. Shop Drawings and Submittals shall be accompanied by certification from the Contractor, and firm preparing such, that Shop Drawings have been checked for, and are in compliance with, the Contract Documents.
- J. All Submittals and Shop Drawings shall have been submitted for review by the Engineer and Engineer within 90 days after Contract Award Date.

1.10 PENETRATIONS THROUGH FIRE-RATED ASSEMBLIES

- A. Seal voids around ducts and pipes penetrating fire-rated assemblies and partitions using fire-stopping materials and methods.

1.11 DRAWINGS

- A. Drawings show diagrammatically the locations of the various pipes, ductwork, fixtures, and equipment, and the method of connecting and controlling them. It is not intended to show every connection in detail and all fittings required for a complete system. The systems shall include, but are not limited to, the items shown on the drawings. Exact locations of these items shall be determined by reference to the general plans and measurements at the building, and in full cooperation with work specified in other Divisions of these specifications; and, in all cases, shall be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable change in the location of any of this work without additional cost to the Owner.
- B. Should any changes be deemed necessary in items shown on the Contract Drawings, the shop drawings, descriptions, and the reason for the proposed changes shall be submitted to the Engineer for approval.

- C. Exceptions and inconsistencies in plans and specifications shall be brought to the Engineer's attention prior to bids being submitted; otherwise, the Contractor shall be responsible for the cost of any and all changes and additions that may be necessary to accommodate the installation of any particular apparatus.
- D. Lay out all work maintaining all lines, grades, and dimensions according to these Drawings with due consideration for the work of others. Verify all dimensions at the site prior to any fabrication or installation. Should any conflict develop or installation be found impractical, the Engineer shall be notified before any installation or fabrication, and the existing conditions shall be investigated and proper changes effected without any additional cost.
- E. Titles of Sections and Paragraphs in these specifications are introduced merely for convenience and are not to be construed as a correct or complete segregation or tabulation of the various units of materials and work. The Engineer does not assume any responsibility, either direct or implied, for omissions or duplications by the Contractor due to real or alleged error in the arrangement of matter in the Contract Documents.

1.12 CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

- A. Equipment supplied as portions of work specified under other Divisions of these specifications shall be furnished with proper roughing-in diagrams and shall be installed as a part of Division 23.
- B. Furnish materials and labor required for the connection of this equipment.
- C. Contractor shall ascertain that all equipment so specified is included as part of this work.

1.13 COOPERATION

- A. Coordinate all work indicated in Division 23 with work specified in other Divisions to assure proper and adequate interface with other portions of the work.
- B. Maintain contact and be familiar with the progress of the general construction and the timely installation of sleeves and inserts, etc., before concrete is placed. Install the required systems in their several stages, at the proper time to expedite the work and avoid unnecessary delays in the progress of other portions of the work.
- C. Should any questions arise between work specified in Division 23 with respect to other portions of work specified in other Divisions of the Specifications, reference shall be made to the Engineer for instructions.

1.14 MATERIALS AND EQUIPMENT

- A. All materials and equipment purchased shall be new. No used or reconditioned equipment will be allowed.
- B. Substitutions: Products of same functions, performance and design will only be considered if in full accordance with the requirements of Section 01 60 00, Material and Equipment. The products of other manufacturers will be acceptable; only if, in the opinion of the Engineer, the substitute material is of a quality as good or better than the material specified, and will serve with equal efficiency, maintainability, and dependability, the purpose for which the items specified were intended.
- C. Listed Manufacturers:
 - 1. Manufacturers listed in a product or system specification are those manufacturers considered capable of manufacturing products conforming to the specification requirements, and are listed therein to establish a standard.
 - 2. The "listing" of a manufacturer does not imply "acceptance" or "approval" of any standard product of that manufacturer.
 - 3. Products offered by listed manufacturers shall be equal to, or superior in all respects to, that specified by named products; and shall meet or exceed specification requirements.
 - 4. The description of specific qualities takes precedence over the reference standards and the description of qualities and reference standards together take precedence over the named product of listed manufacturers.
- D. Product Options:
 - 1. Products specified only by Reference Standards or by Description only means that any product meeting those standards or descriptions, by any manufacturer, will be considered.
 - 2. Products specified by naming several products or manufacturers means that only the manufacturers named will be considered.
 - 3. Products specified by naming only one product and manufacturer means that no option exists unless a substitution is accepted. Submit a request for substitution for any product or manufacturer not specifically named.
 - 4. Products specified by Description, Reference Standard, and naming several products or manufacturers means that any product and manufacturer named meeting those descriptions and standards will be considered. Submit a request for substitution for any product or manufacturer not specifically named.
- E. Limitations or Substitutions:
 - 1. During Bidding Period, Instructions to Bidders, in Division 1, will govern times for submitting requests for substitutions under requirements specified in this Section.
 - 2. No later than ten (10) days prior to the bid date, Contractor shall notify the Engineer in writing of any desired substitutions of products in place of those

- specified. These requests will be considered; and, if a favorable response is determined, this will be documented in the form of an Addenda.
3. Substitutions will not be considered when indicated or implied on Shop Drawings or product data submittals without separate formal request, when requested directly by subcontractor or supplier, or when acceptance will require substantial revision of Contract Documents.
 4. Substitute products shall not be ordered or installed without written acceptance.
 5. Only one request for substitution for each product will be considered. If substitution is not accepted, Contractor shall provide specified product.
 6. Engineer will determine acceptability of any and all substitutions.
- F. It is fully the Contractor's responsibility to assemble and submit sufficient technical information to fully illustrate that the material or equipment proposed for substitution is equal or superior, as the Engineer is under no obligation to perform the service for the Contractor. The proposal shall be accompanied by manufacturer's engineering data, specification sheet, and a sample, if practical or if requested or specified. In no event shall a proposal for substitution be cause for delay of work. This shall include a detailed comparison to each product specification paragraph.
- G. Should a substitution be accepted under the above provisions, and should the substitution prove defective or otherwise unsatisfactory for the intended service, within the warranty period, the Contractor shall replace the substitution with the equipment or material specified, and on which the specifications required him to base his proposal.
- H. No substitutions will be considered contingent upon pending certification and rating agency approvals. Such certifications and ratings shall be in effect at the time of bidding.

1.15 EQUIPMENT SIZES AND REQUIREMENTS

- A. Space allocations in machinery and mechanical equipment spaces are based on equipment scheduled in each case. Should the Contractor request a substitution for equipment of another make that requires more space in any critical dimension, the Contractor shall submit, together with other submittal data on the equipment, prints of drawings indicating how the equipment may be installed, indicating room for servicing and revisions in piping or ducting and any other details necessary for the Engineer to form a judgement as to the suitability of the substitute material, as to performance, suitability for the space and other variables.
- B. Duties of certain equipment items, horsepower of driving motors and electrical characteristics are scheduled for equipment items of a particular make in each case. Should requests for a substitute material be accepted which has other requirements that would involve allied equipment or other portions of work, the Contractor shall be responsible for all modifications required at no change in contract price. As examples:

1. If an accepted A/C Unit has a brake horsepower requirement above the motor horsepower scheduled, the Contractor shall be responsible for providing a larger motor and heavier drive and any change in size of the protective device, conduit run and conductors serving that motor. The latter shall be extended through an individual branch protective device and branch circuit on through the panel, feeder, feeder protective device, etc.
 2. If accepted, heat exchangers, coils, etc., having greater pressure drops than those on which pumping heads were based, the Contractor shall be responsible for selecting proper pumps and drives and adjusting electrical service work accordingly.
- C. Structural steel members are indicated to provide supports for certain specific sizes and weights of equipment. Should a substitution request involve other equipment, the spacing of the supports shall be varied to suite the equipment. Should the weight or size of a proposed substituted item of equipment require additional supporting steel members, the Contractor shall include documentation of the additional supports in the request for substitution and install them at no change in contract price if the substitution is accepted.
- D. Various large apparatus to be installed may require that the apparatus be installed prior to the installation of portions of structural, walls, or door frames. Coordinate the installation of these items to insure that no demolition of general construction is necessary for equipment installation or that the apparatus does not have to be disassembled for installation.

1.16 STORAGE AND PROTECTION OF MATERIALS

- A. Store and protect materials and equipment as specified in Section 01 60 00, Material and Equipment.
- B. Contractor shall provide storage space for protection and storage of his materials and assume complete responsibility for all losses due to any cause whatsoever. All storage shall be within the property lines of the building site, and as directed by the Engineer. In no case, shall storage interfere with traffic conditions in any public or project thoroughfare.
- C. All work and material shall be protected at all times. Contractor shall make good any damage caused, either directly or indirectly, by his workmen. He shall be responsible for safe handling of all mechanical equipment and shall replace, without charge, all items damaged prior to acceptance by the Owner.
- D. On site storage shall not be inside the building during construction progress, but shall be in approved trailers or as specifically approved otherwise by the Engineer. Storage inside the building shall only be allowed when so allowed by the Engineer.

1.17 FOUNDATIONS

- A. Provide equipment foundations associated with the work specified in Division 23.
- B. All top corners and edges of all foundations shall be neatly chambered at a one inch (1") high 45 degree angle.
- C. Foundation bolts shall be placed in the forms when the concrete is poured. Allow one inch (1") below the equipment bases for alignment, leveling, and grouting with non-shrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary.
- D. After removal of the forms, the surface of the foundation shall be rubbed until smooth.
- E. Unless otherwise noted, foundations shall be four inches (4") thick elsewhere for low pressure rated air handling units and other mechanical equipment, unless specifically noted otherwise on the Drawings.
- F. Provide housekeeping pads and foundations for every item of floor mounted equipment specified in Division 23 specifications. Pads shall be a minimum of 4 inches thick extend a minimum of two inches (2") in each direction beyond the equipment size.

1.18 EXCAVATION AND BACKFILLING

- A. Contractor shall do all necessary excavating and backfilling for the installation of his work. Trenches for underground conduits shall be excavated to required depths with bell holes provided as necessary to insure uniform bearing. Care shall be taken not to excavate below depth, and any excavation below depth shall be refilled with sand or gravel firmly compacted. Where rock or hard objects are encountered, they shall be excavated to a grade six inches (6") below the lowermost part of the piping and refilled to grade as specified. After the piping has been installed and reviewed by Engineer and local building authorities, trenches shall be backfilled to grade with approved materials, well tamped or puddled compactly in place. Where streets, sidewalks, etc., are disturbed, cut, or damaged by this work, the expense of repairing same in a manner approved by Engineer shall be a part of this contract.
- B. Contractor shall bear sole responsibility for design and execution of acceptable trenching and shoring procedures, in accordance with State of Texas Regulations. On trench excavations in excess of five feet (5') in depth, Contractor shall pay a qualified engineer to prepare detailed Drawings and specifications directing Contractor in the safe execution of trenching and shoring. It is understood that trench safety systems constitute a means and method of construction for which the Engineer and Owner are

not responsible. Accordingly, such documents when prepared, shall be separately issued by Contractor's Consultant, independent of project contract Documents.

1.19 WIRING

- A. Unless otherwise noted, all wiring for motors, starters, and equipment is specified in Division 26.
- B. Wiring of temperature controls shall be performed in accordance with the requirements of Division 26 but shall be performed as outlined in other sections of these specifications.
- C. All power for control circuits required for the Temperature Control System shall be provided and installed where indicated on the Division 26 Drawings, but shall otherwise be provided as indicated in other sections of these specifications.
- D. Each supplier of equipment requiring control shall have wiring diagrams furnished with submittals. This shall be used to determine conduit layouts required to complete the electrical portions of the instrumentation and control systems.
- E. All motors furnished as a portion of work specified in Division 23 shall be wired as specified in Division 26.
- F. Except where combination starter-disconnects are specified elsewhere herein or in Division 26, all motors shall be provided with safety disconnect switches in accordance with the National Electrical Code as specified in Division 26.
- G. Furnish all necessary wiring diagrams for equipment specified in Division 23, as a part of equipment submittals, for installation under other sections of these specifications.

1.20 EQUIPMENT STANDARDS

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

1.21 CLEAN UP

- A. Contractor shall be responsible for cleaning up after and during all work performed under this Division of the Specifications.

- B. Contractor shall, on a daily basis, remove construction trash and debris accumulation to minimize the entrance of dust, dirt, and debris in piping, ductwork, and mechanical equipment.
- C. At the completion of construction, just prior to Substantial Completion and sustained operation of equipment, thoroughly clean the inside of piping, ductwork, and equipment.
- D. Refer to Division 1.

1.22 FINAL CONSTRUCTION REVIEW

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

1.23 CERTIFICATIONS

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

1.24 GUARANTEE

- A. The guarantee provision of this specification requires prompt replacement of all defective workmanship and materials occurring within one year of final job acceptance, Substantial Completion, or as defined by Extended Warranty Contracts. This includes all work required to remove and replace the defective item and to make all necessary

adjustments to restore the entire installation to its original specified operating condition and finish at the time of acceptance.

- B. The Contractor shall also guarantee that the performance of all equipment furnished and installed under this Division of the Specifications shall be at least equal to the performance as called for in the specifications and as stated in the equipment submittals. Should there be indication that the equipment and installation is not producing the intended conditions, the Contractor shall make further tests as the Owner's Representative may direct to demonstrate that the equipment installed meets the specifications and is delivering the capacity specified or called for on the Drawings.
- C. If there is any indication that the equipment does not meet the specified quantities, the Contractor shall, at his expense, institute a program to demonstrate the adequacy of the installation. This program shall include all necessary testing and testing equipment. Should the Contractor not have the equipment or technical skill to perform the tests, it shall be his responsibility to employ recognized experts to perform the tests and shall provide certified laboratory tests, certified factory reports and work sheets, or other certified data to support results of any tests required.

END OF SECTION

SECTION 23 05 13**COMMON MOTOR REQUIREMENTS FOR HVAC****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

1.2 SYSTEM DESCRIPTION

- A. Provide motors for all mechanical equipment furnished under Division 23, as indicated herein and as illustrated on the Contract Drawings.
- B. All motors shall be of the same manufacture for like pieces of equipment; i.e., air handling units shall have motors of the same manufacturer. Pumps shall have motors of the same manufacturer, but both types of equipment are not required to have the same motor manufacturer.
- C. The following equipment with 3 phase 1 horsepower motors or larger shall be provided with NEMA Premium efficiency motors as specified herein:
 - 1. Roof Top Units.
 - 2. Large Exhaust Fans.
- D. Three phase, horizontal, NEMA frame induction motors served by AC Adjustable Frequency Motor Controllers shall be designed to meet the intent of NEMA MG1, Part 31, Section 31.40.4.2 regarding voltage spikes without exception.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 23 and 23 05 00.
- B. Indicate on submittal the motors proposed for each system of equipment to be installed. This shall be in tabular form in one location for each type of equipment submitted. The lack of this information will be grounds for rejection of equipment submittals.
- C. Product Data shall be furnished which shall include:
 - 1. Motor Manufacturer.
 - 2. Motor Type; Open Drip Proof, Totally Enclosed (Fan Cooled or Air Over).
 - 3. Model of Manufacturer.

4. Motor Horsepower.
 5. Motor RPM.
 6. NEMA Motor Efficiency at 25%, 50%, 75%, and 100% of Full Load Rating for motors served by variable frequency drives; 100% only for constant speed motors 1 HP and larger.
 7. Power Factor at 25%, 50%, 75%, and 100% of Full Load Rating for motors served by variable frequency drives; 100% only for constant speed motors 1 HP and larger.
 8. Service Factor.
- D. Certification: Provide manufacturer's literature indicating NEMA premium motor efficiency as tested in accordance with IEEE Standard 112, Test Method B. Provide documentation to verify motors served by variable frequency drives meet NEMA MG1, Part 30 for 6-step drives and Part 31 for PWM drives.
- E. Provide closeout documents as required in Division 1.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 ELECTRICAL MOTORS, GENERAL

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

- D. Unless otherwise noted, fractional motors rated at 1/2 horsepower and less shall be single phase, the motors rated at larger than 1/2 horsepower shall be three phase. Single phase motors shall be arranged for across-the-line starting.
- E. Single phase motors shall be capacitor start, induction run type, and shall be furnished with motor controller with pilot light where scheduled or indicated. Refer to Section 23 05 14.
- F. All motors shall be of the same manufacturer on similar equipment furnished by the same manufacturer, unless they are an integral part of the piece of equipment to which they are attached, such as a chiller. Air Handling Units shall have motors of the same manufacture and pumps shall have motors of the same manufacture; but, pumps and air handling units are not required to have motors of the same manufacturer.
- G. Three phase motors shall generally have the following characteristics:
 - 1. All copper windings.
 - 2. Type K, NEMA Design "B".
 - 3. Normal Starting Torque.
 - 4. Class B insulation.
 - 5. Continuous Duty Rated.
 - 6. 40 Deg.C. ambient rated.
 - 7. Minimum 1.15 Service factor on motors 1 horsepower and larger; 1.25 service factor on motors 3/4 horsepower and smaller.
 - 8. 1800 RPM unless scheduled otherwise.
 - 9. Oversize steel conduit boxes.
 - 10. Greasable bearings.
 - 11. Stainless steel or aluminum motor nameplates for standard motor information.
 - 12. Cold rolled steel 1045 shaft.
 - 13. Steel frame and splash cover.
- H. Where other sections of specifications do not call for premium efficiency motors this section shall apply to motor requirements. Where premium efficiency motors are required in the other Sections of these Specifications refer to Article 2.2 herein.
- I. Motor manufacturers shall be Reliance, Baldor, General Electric, A.O. Smith or U.S. Motors. Other manufacturers will not be considered.

2.2 PREMIUM EFFICIENCY ELECTRICAL MOTORS

- A. All premium efficiency electrical motors furnished under any of the several sections of these specifications shall be of a recognized manufacturer, be of adequate capacity for the loads involved, and wound for the electrical characteristics indicated on the Drawings and specified herein. Verify all job site voltages and power source available before submitting, ordering and installing any motor or related controls.

- B. Motors shall conform to the standards of manufacture and performance of the National Electrical Manufacturer's Association (NEMA) as shown in their latest publication.
- C. Motors shall be furnished with an open-frame, unless otherwise noted, or required by the NEC for the service conditions encountered. Motors exposed to weather shall be the totally enclosed type suitable for installation in ambient conditions for exposure to the sun, heat, and rain. Provide explosion proof motors where indicated and as required for the hazard in which to be installed.
- D. All NEMA Premium efficiency motors shall be three phase.
- E. Except as otherwise specified NEMA Premium efficiency motors shall be drip-proof, squirrel cage, premium efficiency type as manufactured by A. O. Smith (E Plus III), Baldor (Super E), Reliance (Duty Master XE), General Electric (Energy Saver), or U.S. Motors Premium Efficiency NEMA Design B, induction type rated for constant duty with 40 Deg.C. ambient temperature rise. The motors shall have the following characteristics:
 - 1. 1800 RPM unless scheduled otherwise.
 - 2. 1.15 Service Factor.
 - 3. Rigid base.
 - 4. Serialized and certified.
 - 5. Stainless steel nameplate.
 - 6. Class B insulated.
 - 7. 60 Hertz.
 - 8. High power factor.
 - 9. Ball Bearings.
- F. Totally enclosed motors and motors served by variable frequency drives shall be Class F insulated.
- G. Minimum Nominal motor efficiencies at 1800 RPM, 208V or 460V, 4 pole (as noted on drawings), full-load, per IEEE Standard 112, test method B, as defined by NEMA MG1-12.53, a and b, shall be as follows, along with minimum power factor:

MOTOR HP	NOMINAL EFFICIENCY		POWER FACTOR	
	TEFC	ODP	TEFC	ODP
1	85.5	85.5	84.0	84.0
1.5	86.5	86.5	85.7	85.7
2	86.5	86.5	85.7	85.7
3	89.5	89.5	85.5	85.5
5	90.2	89.5	88.0	88.0
7.5	91.0	91.0	82.0	82.0
10	91.7	91.7	82.0	82.0
15	92.4	93.0	86.0	83.5
20	93.0	93.0	86.5	84.5
25	93.0	93.6	87.5	87.0
30	93.6	94.1	88.5	87.0
40	94.1	94.1	89.0	87.0

- H. Furnish submittal data on all NEMA Premium efficiency motors furnished to include motor efficiencies as rated in accordance with IEEE Standard 112, Test Method B.
- I. All motors shall be of the same manufacturer on similar equipment furnished by the same manufacturer, unless they are an integral part of the piece of equipment to which they are attached, such as a chiller. Air Handling Units shall have motors of the same manufacture' and pumps shall have motors of the same manufacture; but, pumps and air handling units are not required to have motors of the same manufacturer.
- J. Each premium efficiency motor shall be warranted for a minimum of three (3) years.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Motors shall typically be furnished by the manufacturer of the equipment which the motor will serve.
- B. Motors shall be factory installed in the equipment and be mounted on equipment bases, wired to a terminal box, connected to the mechanical device to be rotated, and factory run tested.
- C. When project schedules will not allow the above due to excessive lead time requirements, the Contractor shall do one of the following all at no additional cost:

1. Locally procure the specified motors, while meeting all of the above requirements, and field install the motors on the equipment in accordance with the manufacturer's installation instructions.
 2. Accept factory installed standard efficiency motors and replace with high efficiency motors as noted above.
- D. Motors disconnects will be furnished and installed under Division 26, unless integral with, or specified to be a part of, the equipment as indicated elsewhere in other sections of these Specifications. The wiring to the motor and installation of the motor controller, if not specified to be integral with the equipment, as furnished under other sections of these specifications, shall also be installed under Division 26.
- E. Interlock and control voltage wiring shall be installed as outlined in other Sections of these Specifications.

END OF SECTION

SECTION 23 05 14**COMMON MOTOR STARTER REQUIREMENTS FOR HVAC EQUIPMENT****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

1.2 SYSTEM DESCRIPTION

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

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in following order of precedence:

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

PART 2 - PRODUCTS

2.1 MOTOR STARTERS

- A. Except as specified otherwise, a starter providing overload protection shall be furnished with each motor provided in Division 23, under this section of the specifications, unless:
1. Starters are provided in Division 26 as part of a motor control center, or
 2. Starters are furnished under Division 26 as a combination motor starter-disconnect.
 3. Disconnects on fractional horsepower motors are not substitutes for a motor controller (starter). However, a motor controller on these size motors may substitute for a disconnect only where the required location for both is in the same location.
 4. Unit heater and ceiling fan fractional horsepower, motors, 1/8 HP or smaller, with inherent thermal overload protection are not required to have motor starters.
- B. Each starter furnished herein shall have a NEMA horsepower capacity rating within the required limits of the motor which it serves.
- C. Unless otherwise indicated, starters mounted indoors shall be furnished with NEMA Type 1 enclosures, and those exposed to the weather shall be furnished with NEMA Type 3 enclosures.
- D. Each three phase starter shall be provided with three thermal overload protection relays, one in each phase, be of the full voltage, across-the-line, non-reversing, single or two-speed, magnetic controller type. Overload relays shall be reset from outside the starter enclosure by means of an insulated bar or button.
- E. Starters shall have auxiliary contacts as required to comply with provision for electrical interlocks as defined hereinafter. Provide a minimum of one (1) normally open (N.O.) and one (1) normally closed (N.C.) auxiliary contacts with each three (3) phase starter. Where used, the secondary side of the control transformer shall be grounded and the

other side shall be fused. Where starters are interlocked, the starter holding coils shall be of one voltage. Where starter line voltages are different and above 120 volts to ground, provide control voltage transformers in the starters that are interlocked. The control systems installer shall supply all electrical power supply and transformers as needed to serve control circuit requirements for temperature controls. Control voltage in each starter shall be not more than 120 volts to ground, with an individual control transformer provided in each interlocked starter. Control safety circuits shall de-energize the respective motors served via holding coils in the respective starter.

- F. Manual starters for fractional horsepower single phase motors shall be on-off, or snap action switch type combined with thermal overload device. The switch shall be so constructed that it cannot be held closed under a sustained motor overload. This shall be equal to an Allen Bradley No. 600-TAX216, toggle switch with neon pilot light and NEMA 1 enclosure unless indicated otherwise for severe duty.
- G. Provide starter covers with Hand-Off-Auto Switch and pilot light where equipment is interlocked or remotely controlled. Provide starter covers with Start-Stop buttons and neon pilot lights where equipment is locally controlled.
- H. The Hand-Off-Auto Switches shall be so wired that, when in automatic position, the control of their motors is transferred to the control system as outlined elsewhere herein; and, when in hand position, they themselves assume control of their motors irrespective of the remainder of the equipment, although the temperature control sequences shall operate the same while in either the "Hand" or "Auto" position. Safety devices will not be bypassed when in "Hand" position.
- I. Coordinate the purchase of all starting equipment, insofar as practical, such that all starting equipment on the project shall be of the same manufacturer.
- J. Starters shall be a regularly manufactured product to meet the intent of all requirements specified herein.
- K. Acceptable starters and controllers shall be manufactured by
 - 1. Allen-Bradley.
 - 2. General Electric.
 - 3. Eaton.
 - 4. Square D.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All starters furnished under this section of the Specifications shall be installed under Division 26 of the specifications.

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

END OF SECTION

SECTION 23 05 48**VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

1.2 SYSTEM DESCRIPTION

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

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

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

1.5 PRODUCT HANDLING

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

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 APPLICATIONS

- A. Isolating material shall be selected in each case in accordance with the manufacturer's recommendations and the latter shall be prepared to demonstrate, upon request of the Architect, the isolation effectiveness of the material which has been installed upon his recommendation.
- B. Isolators shall be so selected that when all the items in each of the mechanical rooms are in simultaneous operation, the vibration transmission to the building at the lowest disturbing frequency shall be limited to a maximum of 10% for a mechanical equipment room floor that is on the ground and 5% for all other building surfaces, including those in fan rooms, from all the equipment when the various items are in harmony.
- C. Isolators for supporting Fans suspended from the construction above on rod hangers, not internally isolated, shall be of the open spring type with housings and noise washers, lock washers, nuts, etc. Isolators shall be similar to Amber Booth type BSW-1 or 2 or KDXW-1 or 2 with a minimum 1 inch deflection for fans and 2 inch deflection for air handling units. For fans and heat pump units less than 1000 CFM in capacity they may be isolated with rubber-in-shear isolating grommets in lieu of spring isolators.
- D. For all curb mounted fans, roof top units, and condensing units use two inch (2") wide x 3/8" thick neoprene isolation strips to be in continuous contact at all curb to equipment contact areas.

2.3 MANUFACTURER

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

PART 3 - EXECUTION**3.1 PERFORMANCE OF ISOLATORS**

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

END OF SECTION

SECTION 23 05 53**IDENTIFICATION FOR HVAC EQUIPMENT AND PIPING****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

1.2 SYSTEM DESCRIPTION

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

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions in accordance with Section 23 05 00.
- B. Shop Drawings:
 - 1. Submit a list of all piping systems to be identified, color of background to be used, legend or wording to be displayed for each system, and the intended location of all markers to be displayed.
 - 2. Submit a list of equipment to receive identification tags, cut sheets and proof copies of tags which indicate location of tag and wording to be engraved thereon.

1.5 PRODUCT HANDLING

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

PART 2 - PRODUCTS

2.1 PIPING IDENTIFICATION SYSTEM

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

2.2 EQUIPMENT IDENTIFICATION

- A. This Contractor shall provide identification plates similar and equal to Seton Name Plates, Style 15671(M4564).
- B. Name plates shall be a minimum of 1/16" thick flexible multi-layered acrylic and be 1" X 3" in size with beveled edges. The surface shall be a black satin with a white core for lettering. Other color combinations may be used for specific systems where warranted. Each plate shall be drilled with two mounting holes sized for 3/8" No. 3 round head nickel plated steel screws. Lettering shall be a minimum of 3/16" high and lettering shall be cut through the black surface to the white core and be "Gothic Normal". Only name plates equal to those specified will be considered. No punched plastic tape or engraved aluminum plates are acceptable. Stick-on only plates are not acceptable.
- C. Provide and install identification plates on the cover of all starters or disconnects or combination starter-disconnects, where not mounted directly on the equipment,

delivered by the mechanical system installer to the electrical systems installer and on each piece of Mechanical Equipment to include but not necessarily limited to:

1. Split DX A/C or Heat Pump Units.
 2. Make-Up Air Fans.
 3. Condensing Units.
 4. Roof Top A/C Units.
 5. Exhaust Fans.
- D. Name plates for air handling units and roof top units shall have complete words describing equipment type, use and service. As an example, air handlers shall be designated "AHU-H-X" to designate the equipment as an air handler, building being served, and mechanical room where located. Name plate shall also include CFM of unit, and areas of building being served. Use multiple or larger name plates as required to fulfill this requirement.

Example:

AHU-H-A2

11,000 CFM

Serves: Second and Third Floors Area A

RTU-H-B311

1,750 CFM

Serves: Science H-B311

2.3 EQUIPMENT LOCATION IDENTIFICATION

- A. All equipment located above a ceiling shall be provided with an identification tag located directly below it. In areas with drop ceiling, tags shall be riveted to closest metal ceiling angle.
- B. Location tag shall be Phenolic type material that is abrasion, heat, stain, and chemical resistant. Constructed of multi-layered acrylic, 3-ply, 1/16" thick with a low glare satin finish. Tags shall have pre-drilled holes on each end to accept a standard rivet size.
- C. Color of tag shall be red background with white lettering.

PART 3 - EXECUTION

3.1 PIPE MARKER INSTALLATION

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

3.2 IDENTIFICATION TAG INSTALLATION

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

END OF SECTION

SECTION 23 05 93**TESTING, ADJUSTING, AND BALANCING (TAB) FOR HVAC****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. This Section shall be related to the General Provisions of the contract, including General and supplementary conditions.
- B. Refer to Section 23 050 for General Provisions.

1.2 SCOPE OF WORK

- A. The work included in this Section consists of the furnishing of all labor, instruments, tools and services required in connection with the Testing, Adjusting and Balancing (TAB) of the Heating, Ventilating and Air Conditioning (HVAC) systems as described in the mechanical specifications and shown on the mechanical Drawings, or reasonably implied therefrom, to include the overall commissioning of systems and subsystems such as verification of operation of each control device and all equipment sequences of operation.
- B. TAB of the HVAC systems will be performed by an impartial Technical Firm who is a member of the Associated Air Balance Council (AABC) and whose operations are limited only to the field of professional TAB work. Owner shall select the TAB firm at an early stage of the project and notify the Contractor of TAB firm that shall be employed. TAB services shall be paid for directly by Owner. TAB firm to submit proposal to Owner at same time main proposal is due, refer to Proposal Form 00 30 00. TAB firm shall provide pricing where noted on proposal form. TAB services shall be performed by one of the following pre-qualified TAB Firms:
 - 1. Engineered Air Balance (EAB)
 - 2. Delta T
 - 3. Air Balancing Company (ABC).
- C. TAB Firm is responsible to and shall submit all reports directly to the Engineer and as requested to the Owner.
- D. TAB services shall result in the optimum temperature, humidity, airflow, ventilation rates, and noise levels in the conditioned spaces of the building.

- E. The following basic components of the HVAC systems shall be tested, adjusted and balanced:
 - 1. Air distribution systems.
 - 2. Air moving equipment.
 - 3. Cooling systems.
 - 4. Heating systems.
 - 5. Control systems verification to include end devices, control sequences of operation and energy management system control and monitoring point verification.
- F. Document Review
 - 1. The TAB Firm shall be responsible for reviewing the HVAC Drawings and specifications relating to the TAB services for proper arrangement and adequate provisions of devices for testing, adjusting and balancing.
 - 2. TAB Firm shall review HVAC manufacturer's submittal data relative to balanceability.
 - 3. TAB Firm shall review submitted HVAC automatic temperature control sequences for conformity to the specifications.
- G. Three (3) hard bound copies and three (3) .PDF file copies saved onto USB Drive of final report shall be submitted to the owner, or representative thereof, indicating a summary of actual operating data and any abnormal operating conditions. The report will contain all required information as described within this specification.

1.3 SERVICES OF CONTRACTOR

- A. Contractor shall start up and test all materials and equipment which normally require testing. All piping, ductwork, etc., shall be tested to meet code requirements or the specification requirements, whichever is the more stringent. All equipment shall operate a sufficient length of time at the Contractor's expense to prove to the Architect, Engineer, and Owner that the equipment is free from mechanical defects, runs smoothly and quietly and performs satisfactorily to meet the requirements set forth in the Mechanical Drawings and Specifications.
- B. In order that all HVAC systems can be properly tested, adjusted and balanced, the Contractor shall operate the HVAC systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB, and shall further operate and pay all costs of operation during the TAB period. Operating expenses to be paid for by the Contractor (not TAB firm) will include, but not necessarily be limited to, the following:
 - 1. Utility costs; electrical, gas, etc., as applicable.
 - 2. Personnel costs to start, operate and stop all HVAC equipment.
 - 3. All start-up labor and materials costs.
 - 4. All maintenance costs.

- C. The drawings and specifications have indicated valves, dampers and miscellaneous adjustment devices for the purpose of testing, adjusting and balancing the HVAC systems to obtain optimum operating conditions. It will be the responsibility of the Contractor to install these devices in a manner that will leave them fully accessible and readily adjustable to include access to allow recording of all motor and fan nameplate data. The TAB firm shall be consulted if there is a questionable arrangement of a control or adjustable device. Should any such device not be readily accessible, the Contractor shall provide access as required by the TAB firm.
- D. Contractor shall provide and coordinate the services of qualified, responsible sub-contractors, suppliers, and personnel as required to correct, repair or replace any and all deficient items or conditions found before and during the TAB period.
- E. As a part of this Project Contract, the Contractor shall make any changes in the sheaves, belts, motors, and dampers, or the addition of dampers as required, to correctly balance the HVAC systems as required by the TAB firm at no additional cost.
- F. Provide sufficient time in Project Contract completion schedule to permit the completion of TAB services prior to Owner occupancy of the project.
- G. Contractor shall furnish without charge to the TAB Firm:
 - 1. One set of mechanical specifications.
 - 2. All pertinent change orders and Addenda.
 - 3. Two complete sets of mechanical plans with latest revisions.
 - 4. "As-installed" drawings.
 - 5. Approved control diagrams.
 - 6. Approved manufacturer's submittals for all HVAC equipment.
- H. Have all HVAC systems complete and in operational readiness prior to notifying the TAB Firm that the project is ready for TAB services. So certify in writing to the Engineer, and Owner that such a condition exists. Complete operational readiness prior to commencement of TAB Services shall include the following:
 - 1. Construction status of building shall permit the closing of doors and windows, ceilings installed, etc., to permit the obtaining of projected actual operating conditions.
 - 2. Air Distribution Systems:
 - a. Verify installation for conformity to design of all supply, return and exhaust ducts. Document and certify that all duct leakage tests as required by the mechanical specifications have been performed and the test results are within specified limits (provide copies of leakage test results). TAB firm shall be notified of the time when all leakage tests are to be conducted to allow them to witness as needed.

- b. Verify that all volume dampers, smoke dampers and fire dampers are properly located, functional and open; verify that properly located, sized, and labeled access doors are installed in ducts and in general construction (ceilings, walls, furrings, etc.).
- c. Verify that outside air and relief air dampers provide tight closure, open fully and operate smoothly and freely (Roof Top, and Split DX A/C units).
- d. Verify that all supply, return, exhaust and transfer air diffusers, grilles and registers are installed as indicated on the mechanical Drawings.
- e. Verify that all heating coils, cooling coils, filter sections, access doors, etc., have been blanked and sealed to eliminate the bypass of air around the coils, filters, etc. or leakage of air into or out of the unit.
- f. Install clean filters at each air handling unit or filter grille, and maintain these filters for the complete period that the subject system is being tested, adjusted, and balanced. Refer to Section 23 3000.
- g. Verify that all (supply and exhaust) fans are operational including proper fan rotation, operates free from vibrations, belts are properly aligned, and belt tension is proper.
- h. Verify that all motor starter overload heater elements are of proper size and rating; nameplate amperage to be within the range of the heater element size.
- i. Make a record of actual motor amperage and voltage, per phase, and verify that they do not exceed nameplate ratings.
- j. Verify specified vibration isolation accessories are correctly installed and adjusted.
- k. Insure that all fan drive components, motors, belts, sheaves, and fan wheels are all accessible to allow for servicing and verification of name plate data, sizes, and model and serial numbers, as applicable.

I. Automatic Controls:

- 1. Verify that all control components are installed in accordance with project requirements and are functional as intended by these specifications, including all electrical interlocks, damper and valve sequences, air and water temperature resets, duct smoke detectors, high limit pressure sensors, freezestats, safeties, etc.
- 2. Verify that all controlling instruments are calibrated and set for designed operating conditions with the exception of room thermostats which shall be calibrated at the completion of TAB services with cooperation between TAB Firm and controls system installer.
- 3. Automatic temperature control and/or energy management system installer shall thoroughly check all controls, sensors operators, sequences of operation, etc. before notifying the TAB agency that the automatic temperature controls and energy management system are operational. Automatic temperature control and/or energy management system installer shall provide technical support (technicians

and necessary hardware and software) to the TAB agency to allow for a complete check out of these systems.

4. The controls system installer shall also provide trending reports with the specific points and trend intervals, as requested by the TAB firm or engineer, when abnormal conditions are experienced.
5. The scope of the TAB work as defined herein is indicated in order that the contractor will be apprized of his responsibility regarding the coordination and assistance required to complete the project requirements for final TAB. The TAB Firm will be responsible to the Engineer, and Owner for the satisfactory execution of the TAB services.

1.4 SERVICES OF THE TAB FIRM

A. TAB Firm Qualifications:

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

B. TAB Firm Responsibilities:

1. Liaison: The TAB personnel on the job shall act as liaison between the Architect, Engineer, Owner and Contractor.
2. Inspect the installation of mechanical piping systems, sheet metal work, temperature controls and other component parts of the HVAC systems during the early construction stages, and at other appropriate stages, for the purpose of reviewing that part of the work relating to proper arrangement and adequate provisions for TAB.
3. When performing inspection services prepare a punch list to be copied to the Engineer and Contractor noting observed deficiencies that would prevent adequate access to equipment and components installed or missing that would prevent the TAB Services from being carried out successfully.
4. Witness the duct static pressure test performed on duct systems required to be pressure tested (primarily limited to the any grease exhaust ductwork testing) to

verify proper testing procedures are followed and documented. Include time for witnessing test performed. Should the initial testing be unsatisfactory, then witnessing of the retest will be required. Document tests witnessed in writing.

C. TAB Firm Services:

1. TAB personnel shall, upon completion of the installation and start-up of the mechanical equipment systems, test, adjust and balance the HVAC systems to provide optimum temperature, airflow and noise conditions in the conditioned spaces in the building while the HVAC equipment is operating efficiently.
2. The Firm shall be responsible for testing, adjusting, balancing and logging actual data on all air distribution and air moving equipment, fans, heating and cooling equipment and the operating conditions of all motors, etc. as indicated in this specification.
 - a. Air Distribution Devices:
 - 1) Preset all volume dampers in the 100% open position.
 - 2) Determine and verify proper air pattern deflection devices have been installed.
 - 3) Verify size and types of all air devices installed, versus, the sizes and types indicated on the Drawings.
 - 4) Read out all air distribution devices served by their source (Split DX A/C Unit or Heat Pump Unit, Roof Top A/C Heat Pump Unit, Supply Fan, Exhaust Fan, etc.)
 - 5) Balance all air distribution devices proportional to design CFM.
 - 6) Adjust source to design CFM.
 - 7) Verify that all air distribution devices are within plus or minus 10% of design (and all proportional to one another on each system).
 - b. Supply/Exhaust Fans:
 - 1) Verify correct fan rotation.
 - 2) If belt driven, verify proper belt tension and that fan and motor sheaves are properly aligned.
 - 3) Verify that all safeties and interlocks are operational.
 - 4) Verify correct size and rating of motor overload protection.
 - 5) Verify fan motor is not overloaded; amperage readings do not exceed nameplate rating, for each phase, as applicable.
 - 6) Determine total air quantities of system served by the respective fan. Air quantities to be determined by duct traverse if duct configuration permits and air velocity is 800 to 1000 feet per minute or greater. If the duct main is not suitable for traverse then traverse branch ducts as required to total air flows supplied by the system.

- 7) If air volume is less than design and motor capacity is available, adjust fan to design CFM. If new sheave or sheaves and belts are required, data will be submitted to Contractor.
 - 8) Witness positive pressure duct leakage tests performed by the contractor on large exhaust systems to minimize duct leakage in these systems.
 - 9) Balance air distribution system (see Air Distribution Devices).
- c. Fire, Fire-Smoke, and Smoke Dampers:
- 1) Verify operation of all fire-smoke and smoke dampers only by witnessing the Contractor fully opening and closing these dampers.
 - 2) Verify each fire, fire-smoke, and smoke damper is located where indicated on the Drawings and tagged or identified with a permanent fire resistant tag or stencil (at access door location).
 - 3) Verify that each fire, fire-smoke, and smoke damper is provided with a suitably sized and located access door to allow full testing and observation of damper operation. Verify each duct access damper has suitable access through general construction features.
 - 4) Witness the Contractor testing each fire-smoke and smoke damper which shall be manually released, allowed to fully close, verifying it has a tight fit when closed, and then verify it does not bind when opening or closing.
 - 5) Witness each fire-smoke and smoke damper being fully opened by the Contractor and the fusible links on the fire damper portion of fire-smoke dampers being reset by the Contractor to include other related devices on smoke-fire dampers.
 - 6) Verify that all fire dampers are fully opened.
 - 7) Identify all dampers requiring repair or having a faulty installation.
 - 8) Write down pertinent information on damper testing tags to verify dates tested and initials of tester to confirm a successful test was conducted.
- d. Rooftop Air Conditioning Units (RTU):
- 1) Verify that the outside, return and relief air dampers are operational and move freely.
 - 2) Verify that filters are clean at the time of testing.
 - 3) Verify correct evaporator and return or relief air (as applicable) fan rotation.
 - 4) If belt driven, verify proper belt tension and that fan and motor sheaves are properly aligned. If direct drive, verify that motor is multi-speed motor and adjust speed setting for air balance purposes.

- 5) Verify that all equipment safeties are operational, as applicable, (low and high pressure limit switches, freeze state, high static pressure, anti-recycle timer, etc.)
- 6) Verify correct size and rating of motor overload protection for each supply, return and relief fan motor.
- 7) Verify each fan motor above is not overloaded; amperage readings do not exceed motor nameplate rating.
- 8) Determine total supply and return air. Air quantities to be determined by duct traverse if duct configuration permits and air velocity is 800-1000 feet per minute or greater.
- 9) Balance air distribution system (see Air Distribution Devices).
- 10) If air volume is less than design and motor capacity is available, adjust fan or fans, to obtain supply and return design CFM quantities to within $\pm 10\%$ of design. If new sheave or sheaves and belts are required, data will be submitted to Contractor for change out. For direct drive fans, adjust fan speed setting. After adjustments are made, retest units to determine final air balance quantities.
- 11) If applicable, determine the required static pressure and submit the static pressure control set point to control contractor for setting. Final set point shall not be arbitrary, but shall be based on the minimum value to obtain design air flows at 100% operation.
- 12) Test and adjust the minimum outside air up to any maximum values scheduled, for demand controlled ventilation, and return air CFM relationship to design.
- 13) Verify all temperature control devices are set and calibrated at design set points.

e. Cooling and Heating Coils:

- 1) Verify that all coils and heat exchangers are installed properly.
 - 2) Verify that all cooling and heating coils have filters installed upstream of coils.
 - 3) Verify no simultaneous cooling and heating occurs at any piece of equipment except during a humidity control sequence.
 - 4) Verify operation of all safety devices.
 - 5) Record entering and leaving air dry bulb temperatures, as applicable, to determine actual air temperature drop or rise as compared to the design value for all equipment tested. Additionally, for cooling coils, record the entering and leaving wet bulb temperatures for each component.
3. During the balancing process, all abnormalities or malfunctions of equipment or components discovered by the TAB personnel, will be reported promptly to the Engineer, Owner and Contractor so that the condition can be corrected expediently.

4. The temperature controls will be verified for calibration and proper relationship between control devices. The Contractor will be advised of any instruments out of calibration so that the Automatic Temperature Controls (ATC) contractor can recalibrate, using data supplied by the TAB Firm as required.
5. Thoroughly test the Energy Management System (EMS), as applicable. The testing of the Energy Management System shall include all HVAC controls, sensors, operators, sequences, etc. The tests shall include verification that commands introduced at the EMS console actually occur and temperatures, pressures, etc. indicated at the EMS console correlate with the actual reading at the sensing point. The ATC and EMS contractor shall provide technical support to the TAB Firm for a complete check out of the HVAC temperature controls and the Energy Management System. The EMS workstation console and field direct digital control panel displays of measured variables such as temperature, relative humidity, and pressure shall have the displayed values offset through software to be within 0.3 Deg.F. of the temperature, 5.0 percent for relative humidity, 20 parts per million (ppm) for carbon dioxide, 10 parts per million (ppm) for carbon monoxide and 0.01% for pressure of the actual variables measured in the field, with recently calibrated test equipment, at the sensor locations.
6. After testing, adjusting and balancing to the design conditions, if comfort conditions are not being maintained, the air conditioning system shall be rebalanced within the limitations of the equipment installed to obtain comfort conditions. If comfort conditions cannot be obtained, a report will be submitted giving specific data regarding the trouble area.
7. Make not less than three (3) inspections within ninety (90) days after occupancy of the building, and make adjustments if required, to insure that satisfactory conditions are being maintained throughout. Inspections are to be coordinated with Architect, Engineer, and Owner; and shall be documented with a supplemental report containing data and information, as required, after each visit, to document in writing that such visit took place and to note any unusual operating conditions.
8. Make an inspection during the opposite season from that in which the initial adjustments were made and at that time make any necessary modifications to the initial adjustments required to produce optimum operation of the systemic components to produce the proper conditions in each conditioned space. The opposite season inspection shall be coordinated with the Architect/Engineer and Owner. This inspection shall be documented with a supplemental report containing any pertinent data and information regarding readings and adjustments made.

1.5 TAB REPORT

- A. TAB report shall incorporate all performance data for the HVAC systems. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operating personnel.
- B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must be made on site by the permanently employed technicians or engineers of the TAB Firm.

C. TAB report shall include but not be limited to the following:

1. Index.
2. Preface: A general discussion of the system, an outline of normal and ventilation modes of operation, any unusual operating conditions and any deficiencies not corrected as of the time the report was written.
3. Instrumentation List: A list of instruments used by type, model, range and calibration date. All instruments must be calibrated within six (6) months prior to the starting date of TAB services.
4. Air Distribution Devices (Supply, Exhaust, Return, and Relief Air type where Balance Dampers are Used):
 - a. Manufacturer, model and size.
 - b. Location.
 - c. Design and actual CFM (cooling and heating).
 - d. Air distribution devices, where a velocity indicating instrument is used to determine CFM; provide the required and actual velocity in FPM (when an air flow hood is used to determine CFM, only CFM is required to be recorded.)
5. Supply/Exhaust Fans:
 - a. Manufacturer, model and size; include neck size where different than the designated device size.
 - b. Location (Room name and number, above ceiling, roof mounted, etc.).
 - c. Design and actual CFM.
 - d. Design and actual fan RPM.
 - e. Design and actual static pressure (leaving minus entering).
 - f. Motor nameplate data.
 - g. Motor starter data and motor overload protection (heater) sizes and rating.
 - h. Actual motor amperage and voltage (all phases).

6. Fire Dampers:
 - a. Fill out a tag (provided by the Contractor) at each damper with a set of the tester's initials and the date that the damper was tested and operation verified, as witnessed by the TAB firm, as being acceptable.
 - b. Tags shall have additional spaces for future testing/verification.
7. Coils and Heat Exchangers:
 - a. Manufacturer, model, size and serial number where available.
 - b. Design and actual CFM.
 - c. Design and actual entering and leaving air static pressures.
 - d. Design and actual entering air dry bulb temperatures. Provide design and actual entering air wet bulb temperatures for each cooling coil.
 - e. Design and actual leaving air dry bulb temperatures. Provide design and actual leaving air wet bulb temperatures for each cooling coil.
 - f. Actual outside air temperature, dry and wet bulb, during testing.
8. Rooftop Air Conditioning Units:
 - a. Manufacturer, model, size and serial number.
 - b. Design and actual CFM (Supply, Return and Outside Air).
 - c. Design and actual Evaporator Fan RPM.
 - d. Static air pressure entering and leaving filters, coils, heaters, control dampers, and evaporator fan.
 - e. Evaporator, Return and Relief Air (as applicable) motor nameplate data.
 - f. Evaporator, Return and Relief Air (as applicable) fan motor starter data and motor overload protection heater sizes and rating (for each phase).
 - g. Actual evaporator motor amperage and voltage (all phases).
 - h. Filters; type, manufacturer, model, MERV rating, thickness, sizes, quantities of each size, actual static pressure drop across filters and condition (new, clean, dirty, loaded, wet, etc.).
 - i. Total unit Nameplate data (Volts, Amps, and overcurrent protection required).
 - j. Actual Unit volts and amps, for each phase, and actual overcurrent protection device rating, with the unit operating in full cooling.
 - k. Actual outside air temperature, dry and wet bulb (or relative humidity) during testing.
 - l. Condenser coil entering and leaving air dry bulb temperatures at full cooling.
- D. Instructions to Operating Personnel: TAB Firm shall instruct the operating personnel regarding the following:
 1. Systems Operation.
 2. Unusual Operating Conditions
 3. System Troubleshooting Procedures.

- E. Guarantee: Provide extended warranty of twelve (12) months after occupancy during which time the Engineer and/or Owner may, at his discretion, request check of the balance of any HVAC equipment. Provide TAB technicians to assist as required in making such tests. When any device is found not balanced in accordance with the mechanical plans and specifications, that HVAC system shall be completely re-balanced as directed by the Engineer and/or Owner at the TAB Firm's expense.

END OF SECTION

SECTION 23 07 00**INSULATION****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

1.2 SYSTEM DESCRIPTION

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

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions to allow review of Materials and Methods to ensure complete compliance with specifications.

- B. Shop Drawings: Submit materials to be used and method of application for each system in tabular form. General statements not specifically identifying means or methods to be used shall be cause for rejection. Include descriptive data and cut sheets on each type of insulation material, sealing method, adhesives used, insert types, shield sizes, and PVC or aluminum jacketing as specified.

1.5 PRODUCT HANDLING

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

PART 2 - PRODUCTS

2.1 PIPING AND EQUIPMENT INSULATION MATERIALS

- A. Condensate Drains, Drains and Miscellaneous Lines:
 - 1. The drain from each Roof-Top AC Unit condensate drain pan and all refrigerant suction piping shall be insulated with foamed plastic, below roof, Armacell Armaflex or Aeroflex Aerocell slipped on while the piping is being fabricated, and with all joints, butt type, sealed using an adhesive recommended by the manufacturer of the plastic. The insulation shall be continuous from the drain opening in the Air Handling equipment condensate pan (when located inside the building) or from the roof penetration when located on the roof, to the point of discharge with an open sight air gap over a drain. All formed plastic insulation shall meet ASTM E-84 requirements. Provide 1/ 2" thick insulation on condensate drains and 1-1/2" thick insulation on refrigerant suction piping. For all "Armaflex" type insulation installed outdoors apply two (2) coats of NOMACO K-Flex R-374, or Foster 30-64, or approved equal, protective coating (ultra-violet rays), white in color.
- B. Refrigerant Lines Exposed to the Outdoors:
 - 1. Insulate as described in A.1 above.
 - 2. Cover with an 0.016 inch thick aluminum with locked seams and banded joints made watertight. Jacketing shall be equivalent to Childers Aluminum roll jacketing conforming to ASTM B-209, with smooth mill finish.
 - 3. Cover mechanical couplings and fittings with prefabricated aluminum jacketed fitting covers with factory applied moisture barriers to thickness to match that on piping and band in place. Fitting covers shall be equivalent to Childers ELL-JACS., Tee-Jacs, Flange-JACS, and Valve-JACS. Seal ends to prevent moisture penetration and to make completely weatherproof.

2.2 DUCTWORK INSULATION MATERIALS

A. Duct Insulation - External:

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

B. Duct Insulation - Internal:

1. Internal duct insulation, liner, shall be in thicknesses as indicated herein, and be as specified in Specification Section 23 30 00. Duct liner shall be one inch (1") thick on all return, transfer, and relief air ducts, and on portions of general exhaust air ductwork systems as specified elsewhere herein. Internal duct insulation on all conditioned, cooled or heated, supply, all outside air ductwork systems and all mixed air plenums shall be 1-1/2" thick duct liner.
2. All duct liner shall be made of glass fiber coated with a bonded mat on the air stream side of the insulation. Coating shall be neoprene based meeting the requirements of NFPA-90A and U.L. Standard 723. Insulation shall not be less than 1.5 lbs. per cu.ft. density, and have a K-value of 0.28 per ASTM-C-177 at a mean temperature of 75 Deg.F.
3. All insulation systems shall meet the requirements of the 2015 version of the International Energy Conservation Code, which requires a minimum installed R-

value of 6.0 for conditioned, cooled or heated, supply and all outside air system ductwork and mixed air plenums when located inside buildings or spaces. Increase insulation thickness as required to comply.

4. Fire Hazard Classification of installed duct insulation systems shall meet the requirements of ASTM-E-84; Flame Spread of 25, or less; Smoke Developed and Fuel Contributed of 50, or less.
5. All insulation systems, adhesives, mastics, sealants, and tapes shall be U.L. rated for the application.
6. All duct liner shall be suitable for the air velocities to be encountered in each system, and shall generally be suitable for velocities of up to 6000 FPM.
7. Acceptable duct lining manufacturers shall be:
 - a. Certainteed.
 - b. Knauf.
 - c. Owens Corning.
 - d. Johns Manville.

C. Duct Insulation - Outdoors

1. Insulate as noted for internal insulation.
2. Provide an additional one inch (1") thick external rigid fiberglass board.
3. Finally, cover with 0.016" aluminum with locked seams and banded joints made water tight. Jacketing shall be equivalent to Childers Aluminum roll jacketing confirming o ASTM B-209 with smooth mill finish.

PART 3 - EXECUTION

3.1 GENERAL

- A. Apply insulation and pipe covering after all of the piping system to be insulated has been pressure tested, found to be completely tight (without leaks), and accepted as such. All insulated T-handles, blow-down valves, extended handles and caps should be installed prior to commencing with insulation. Verify that control, isolation, and balancing valves and any other piping specialty where a valve stem or test port extends beyond the normal pipe insulation thickness to be installed is installed pointed upward vertically. Thoroughly clean and dry all surfaces prior to being covered.
- B. All insulation shall be continuous through wall and ceiling openings and sleeves. Use exterior duct wrap insulation on the outside of smoke and fire damper sleeves. Create a secondary sleeve around the primary sleeve to allow a complete insulation system as allowed by the local authority having jurisdiction.
- C. All insulation and accessories shall have composite (insulation, jacket and adhesive used to adhere the jacket to the insulation) fire and smoke hazard ratings as tested under procedure ASTM E-84, NFPA 255, and UL 723 not exceeding:

Flame Spread	25
Smoke Developed	50
Fuel Contributed	50

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

- J. All insulation materials and jacketing shall exhibit the following characteristics:
1. Water sorption, per ASTM C 1104, shall be less than 0.02%.
 2. Linear shrinkage, per ASTM C 356, shall be negligible.
 3. Stress corrosion, per ASTM C 795, shall not cause corrosion.
 4. Corrosiveness, per ASTM C 665, shall not be any greater than sterile cotton.
 5. Resistance to fungi, mold and mildew and bacteria, per ASTM C 665, shall be rated as not promoting growth of fungi and bacteria. Inhibitors shall be added to specified products to meet these requirements.

3.2 DUCTWORK

- A. Duct Insulation - Internal: Provide sound absorbing and thermal insulation to the interior surface of the following duct systems: Line the first 10 foot from the unit of all rectangular low pressure supply (except kitchen make-up air ducts), return, relief, transfer, and outside air ducts and supply, mixed, and return air plenums, unless noted, otherwise on the drawings. Additionally, line the first 10 feet of general exhaust ducts, except grease, fume, exhaust systems, on both sides of in-line fans and for the first 10'-0" from the fan curb toward the occupied space for roof mounted fans. All lined ductwork shall be increased in size to maintain the clear inside (air stream) dimensions designated on the Drawings.
1. Duct liner shall be applied in accordance with the manufacturer's recommendations, with the coated, or mat-faced, surface located away from the metal (exposed to air stream). It shall be adhered to the metal with Foster 85-10 or 85-15 adhesive applied to the entire inner surface of the duct. The liner shall be further secured to the duct with Graham Insulating Pins and Clips or other metal clips of the type which do not protrude through the duct. Those clips shall be installed on not greater than 12" centers both ways. All seams and openings in the liner shall be carefully sealed with adhesive.
 2. Paint all joints in liner and butter the edges of sections where sections of ductwork will be joined using Foster No. 30-35, or equivalent adhesive.
 3. Where damper rods occur, suitable metal bushings shall be provided on each end of the damper rod inside the duct, to provide clearance between the damper blade and the lining.
 4. Refer to Section 23 30 00, HVAC Air Distribution.
 5. Due to the 2018 version of the International Energy Conservation Code, conditioned air, heated or cooled air (includes outside air intake ductwork), ductwork insulation located inside the building envelope shall have a minimum installed R-value of 6.0. For lined ductwork, this shall be accomplished by using 1-1/2" thick duct liner. Coordinate insulation requirements with other Sections of these Specifications.

B. Duct Insulation - External:

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

3.3 SHIELDS AND INSERTS

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

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

END OF SECTION

SECTION 23 08 00**MECHANICAL SYSTEMS COMMISSIONING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify that Systems and Operations and Maintenance (O&M) documentation is complete.
 - 4. Verify that the Owner's operating personnel are adequately trained in the O&M of these systems.
- B. The systems to be commissioned include: rooftop AC units, exhaust fans, and all related controls.
- C. Commissioning requires the participation of Division 23 and 26 system installers to ensure that all systems are operating in a manner consistent with the Contract Documents. Division 23 installers shall be familiar with all parts of the commissioning plan issued by the Commissioning Authority (C.A.) and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- D. Commissioning Team members shall consist of the Commissioning Authority (C.A.), the designated representative of the Owner, the General Contractor (GC, CM or Contractor), the architect and design engineers (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the Testing, Adjusting, and Balancing (TAB) representative, the Controls Contractor (CC), and any other installing subcontractors or suppliers of equipment pertinent to the complete installation of Division 23 and 26 Systems intended to be Commissioned. The Owner's

representative for operations and maintenance shall also be a member of the commissioning team.

1.3 COMMISSIONING AUTHORITY

- A. The commissioning authority or agency shall be selected and employed by the building owner. The commissioning agent shall be a licensed professional engineer in the State where the work will be performed, and shall be experienced in the commissioning of mechanical and electrical systems of the type installed in this project. Experience in the construction process, direct digital control systems, Testing, Adjusting, and Balancing; and ASHRAE Guideline 1.1-2007 is mandatory. The commissioning agent shall not be associated with or employed by a mechanical contractor, or equipment supplier.

Commissioning shall be paid for and provided by the District. District shall select the commissioning authority at an early stage of the project and notify the Contractor of the C.A. that shall be employed. Commissioning firm to submit proposal to Owner at same time main proposal is due, refer to Proposal Form 00 30 00. Commissioning firm shall provide pricing where noted on proposal form. Commissioning services shall be performed by one of the following pre-qualified Commissioning Firms:

1. Engineered Air Balance (EAB)
2. Delta T
3. Air Balancing Company (ABC).
4. Farnsworth.

1.4 COMMISSIONING PLAN

- A. Commissioning Plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CA will provide the plan, which will continue to evolve and expand as the project progresses. The project *Specifications* shall take precedence over the *Commissioning Plan*.
- B. Commissioning Process includes a narrative that provides a brief overview of the typical commissioning tasks during construction and the general order in which they will occur.
1. Commissioning during construction begins with a scoping meeting conducted by the CA where the commissioning process is reviewed with the commissioning team members.
 2. Additional meetings will be required throughout the active construction phase, as scheduled by the CA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 3. Equipment documentation is submitted to the CA during normal submittals, including detailed start-up procedures.

4. The CA works with the pertinent subcontractors in developing startup plans and startup documentation formats, including prefunctional checklists to be completed, during the startup process.
5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.
6. The Subcontractors, under their own direction, execute and document the prefunctional checklists and perform startup and initial checkout. The CA documents that the checklists and startup were completed according to the approved plans. This may include the CA witnessing start-up of selected equipment.
7. The Subcontractors develop proposed specific equipment and system functional performance test (FPT) procedures. The CA will review these procedures and develop the official FPT procedures to be incorporated into the project.
8. The procedures are executed by the Subcontractors, under the direction of, and documented by the CA.
9. Items of non-compliance in material, installation or setup are corrected at the Subcontractor's expense and the system is then retested.
10. The CA reviews the O&M documentation for completeness.
11. Commissioning is intended to be completed before Substantial Completion.
12. The CA reviews, pre-approves and coordinates the training provided by the Subs and verifies that it was completed.
13. Deferred testing is conducted, as specified or as required.

1.5 RESPONSIBILITIES

A. General Contractor (GC):

1. Facilitate the coordination of the commissioning work as outlined by the CA, and with the assistance of the CA, ensure that all commissioning activities are being scheduled into the master construction schedule.
2. Include all costs of commissioning, as outlined herein and elsewhere, in the total contract price.
3. Furnish one (1) copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to equipment to be commissioned to the CA.
4. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and complete training.
5. Ensure that all subcontractors execute their commissioning responsibilities according to the Contract Documents and schedule.
6. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Commissioning process.
7. Coordinate the training to be provided to the Owner's personnel.
8. Prepare O&M manuals and systems manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to "as-built" conditions.
9. Warranty Period:

- a. Ensure that Subcontractors execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
- b. Ensure that Subcontractors correct deficiencies and make necessary adjustments to O&M manuals and “as-built” drawings for applicable issues identified in any seasonal testing.

B. Mechanical and Controls Systems Installers:

- 1. Commissioning responsibilities applicable to each of the mechanical and controls (systems installers) of Division 23 are as follows (all references apply to commissioned equipment only):
 - a. Construction and Acceptance Phases:
 - 1) Include the cost of commissioning in the contract price.
 - 2) In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, Systems and O&M data and training.
 - 3) Attend a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
 - 4) Contractors shall provide the CA with normal cut sheets and shop drawing submittals of all equipment to be commissioned.
 - 5) Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures.
 - a) Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
 - b) The Commissioning Agent may request further documentation necessary for the commissioning process.
 - 6) Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review and approval.
 - 7) Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

- 8) Preparing proposed specific functional performance test procedures for submission to and consideration of the CA. The CA will use these submittals to prepare finalized test procedures. Subcontractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests, as applicable.
 - 9) Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CA for all commissioned equipment. Submit to CA for review and approval prior to startup.
 - 10) During the startup and initial checkout process, execute the mechanical-related portions of the prefunctional checklists for all commissioned equipment.
 - 11) Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
 - 12) Address current A/E punch list items before functional testing. Air TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air related systems.
 - 13) Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
 - 14) Perform functional performance testing under the direction of the CA for specified equipment. Assist the CA in interpreting the monitoring data, as necessary.
 - 15) Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, and A/E and retest the equipment.
 - 16) Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to "as-built" conditions.
 - 17) Prepare redline "as-built" drawings for all drawings and final "as-builts" for contractor-generated coordination drawings.
 - 18) Provide training of the Owner's operating personnel as specified.
 - 19) Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- b. Warranty Period:
- 1) Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.

- 2) Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

C. Mechanical (Systems Installer) Contractor:

1. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:
 - a. Provide startup for all HVAC equipment, except for the building automation control system.
 - b. Assist and cooperate with the TAB contractor and CA by:
 - 1) Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - 2) Including cost of sheaves and belts that may be required by TAB.
 - 3) Providing temperature and pressure taps in piping and equipment according to the Construction Documents for TAB and commissioning testing. Verify locations for taps with the CA before installation.
 - c. Prepare a schedule for Division 23 equipment start-up and TAB start and completion for use by the CA. Update the schedule as appropriate.
 - d. Be proactive in seeing that commissioning processes are executed and that the CA has the scheduling information needed to efficiently execute the commissioning process.

D. Controls (Systems Installer) Contractor (CC):

1. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:
 - a. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
 - 1) An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
 - 2) All interactions and interlocks with other systems.
 - 3) Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
 - 4) Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).

- 5) Start-up sequences.
 - 6) Warm-up mode sequences.
 - 7) Normal operating mode sequences.
 - 8) Unoccupied mode sequences.
 - 9) Shutdown sequences.
 - 10) Capacity control sequences and equipment staging.
 - 11) Temperature and pressure control: setbacks, setups, resets, etc.
 - 12) Detailed sequences for all control strategies, e.g., optimum start/stop, staging, optimization, demand limiting, etc.
 - 13) Effects of power or equipment failure with all standby component functions.
 - 14) Sequences for all alarms and emergency shut downs.
 - 15) Seasonal operational differences and recommendations.
 - 16) Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - 17) All sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.
- b. Control Drawings Submittals shall include:
- 1) Control drawings shall have a key to all abbreviations.
 - 2) Control drawings shall contain graphic schematic depictions of each system and each component.
 - 3) Schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - 4) Provide a full points list with at least the following included for each point:
 - a) Controlled system.
 - b) Point abbreviation.
 - c) Point description.
 - d) Display unit.
 - e) Control point or setpoint (Yes / No).
 - f) Monitoring point (Yes / No).
 - g) Intermediate point (Yes / No).
 - h) Calculated point (Yes / No).
 - i) Key:
 - (1) Point Description: DB temp, airflow, etc.

- (2) Control or Setpoint: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)
 - (3) Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).
 - (4) Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
 - (5) Calculated Point: “Virtual” point generated from calculations of other point values.
- 5) Controls Contractor shall keep the CA informed of all changes to this list during programming and setup.
- c. An updated “as-built” version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
- d. Assist and cooperate with the TAB contractor in the following manner:
 - 1) Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 - 2) Have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CA prior to TAB.
 - 3) Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
- e. Assist and cooperate with the CA in the following manner:
 - 1) Execute the functional testing of the controls system as specified for the controls contractor.
 - 2) Assist in the functional testing of all equipment specified.
- f. Controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing, according to the process. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:
 - 1) System name.
 - 2) List of devices.

- 3) Step-by-step procedures for testing each controller after installation, including:
 - a) Process of verifying proper hardware and wiring installation.
 - b) Process of downloading programs to local controllers and verifying that they are addressed correctly.
 - c) Process of performing operational checks of each controlled component.
 - d) Plan and process for calibrating valve and damper actuators and all sensors.
 - e) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
 - 4) A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has “passed” and is operating within the contract parameters.
 - 5) A description of the instrumentation required for testing.
 - 6) Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the CA and TAB contractor for this determination.
 - g. Provide a signed and dated certification to the CA and CM or GC upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.
 - h. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as specified.
 - i. List and clearly identify on the “as-built” duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).
- E. TAB Contractor. The duties of the TAB contractor, in addition to those listed above are:
1. Submit the outline of the TAB plan and approach for each system and component to the CA prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.
 2. Submitted plan will include:
 - a. Reviewed the construction documents and the systems to sufficiently understand the design intent for each system.

- b. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Detailed step-by-step procedures for TAB work for each system and issue.
 - d. Plan for formal deficiency reports (scope, frequency and distribution) and final report.
 - 3. Submit reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CA as required.
 - 4. Communicate to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB, which affect the control system setup and operation.
 - 5. Provide a draft TAB report to the CA. The report should follow the latest reporting recommendations by AABC.
 - 6. Provide the CA with any requested data, gathered, but not shown on the draft reports.
 - 7. Provide final TAB reports in the number required.
- F. Equipment Suppliers:
- 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 - 2. Assist in equipment testing per agreements with Subs.
 - 3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone data logging equipment that may be used by the CA.
 - 4. Provide information requested by CA regarding equipment sequence of operation and testing procedures.
 - 5. Review test procedures for equipment installed by factory representatives.
- G. Commissioning Agent (CA):
- 1. The CA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CA may assist with problem-solving non-conformance items or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CA is to develop and coordinate the execution of a testing plan, observe and document performance so that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. Contractor and all subcontractors shall provide all tools or the use of tools to start, checkout and functionally test equipment and systems, to include any specified or required testing equipment needed to conduct these tests.
 - 2. Construction Phase:
 - a. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all

necessary parties, frequently updated timelines and schedules and technical expertise.

- b. Coordinate the commissioning work and, with the GC, ensure that commissioning activities are being scheduled into the master schedule.
- c. Revise, as necessary, *Commissioning Plan—Construction Phase*.
- d. Plan and conduct a commissioning scoping meeting.
- e. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.
- f. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
- g. Review normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, along with A/E reviews.
- h. Assist in the development of prefunctional tests and checklists.
- i. Assist in the development of an enhanced start-up and initial systems checkout plan with Subcontractors.
- j. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
- k. Witness all or part of the HVAC piping test and flushing procedure, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify Owners project manager of any deficiencies in results or procedures.
- l. Witness all or part of any ductwork testing and cleaning procedures, if required, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's project manager of any deficiencies in results or procedures.
- m. Approve prefunctional tests and checklist completion by reviewing prefunctional checklist reports and by selected site observation and spot-checking.
- n. Approve systems startup by reviewing start-up reports and by selected site observation.
- o. With necessary assistance and review from installing contractors, review the functional performance test procedures for equipment and systems. This may include energy management control system trending, or manual functional testing.

- p. Analyze any functional performance trend logs and monitoring data to verify performance.
 - q. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.
 - r. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
 - s. Oversee and approve the training of the Owner's operating personnel.
 - t. Compile and maintain a commissioning record and building systems book(s).
 - u. Review and approve the preparation of the O&M and Systems manuals.
 - v. Provide a final commissioning report.
3. Warranty Period:
- a. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
 - b. Return to the site at 10 months into the 12-month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

1.6 SCHEDULING

- A. The CA will work with the GC according to established protocols to schedule the commissioning activities. The CA will provide sufficient notice to the CM and GC for scheduling commissioning activities.
- B. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the applicable Division 23 or 26 contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing

equipment for the HVAC system and controls system in Division 23, except for equipment specific to and used by the TAB firm in their commissioning responsibilities.

- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents, shall be included in the Base Bid price of the Contractor and be left on site.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in 23 05 93. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year and a resolution of + or - 0.5°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed to the test equipment or certificates of calibration shall be readily available with a copy being furnished to the C.A. for their records.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Scoping Meeting. Within 90 days of commencement of construction, the CA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the GC. Information gathered from this meeting will allow the CA to revise the *Commissioning Plan* to its "final" version, which will also be distributed to all parties.
- B. Miscellaneous Meetings will be planned and conducted by the CA as required as the construction phase progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subcontractors. The CA will plan these meetings and will minimize unnecessary time being spent by Subcontractors, or any other member of the Commissioning Team.

3.2 REPORTING

- A. CA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- B. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

- C. A final summary report by the CA will be provided focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report. Prefunctional checklists, functional tests and monitoring reports will be part of the final report, and the entire report will be included in the O&M manuals.

3.3 SUBMITTALS

- A. CA will provide appropriate contractors with a specific request for the type of submittal documentation the CA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent. All documentation requested by the CA will be included by the Subs in their O&M manual contributions.
- B. Commissioning Agent will be given the opportunity to review all pertinent submittals related to equipment or systems to be commissioned for conformance to the Contract Documents, and more specifically as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The Commissioning Agent will notify the appropriate persons as requested, of items missing or areas that are not in conformance with Contract Documents as it relates to the commissioning process, and which require resubmission.
- C. CA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.
- D. Submittals sent to the CA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, although the CA will review them.

3.4 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned. Some systems that are not comprised so much of actual dynamic machinery may have very simplified PCs and startup.
- B. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plans will be required by the CA who shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for prefunctional checklists and startup are identified in the commissioning scoping meeting and in the checklist forms. Parties responsible for executing functional performance tests are identified in the testing requirements.
 - 1. Checklists indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.
 - 2. Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form may have more than one trade responsible for its execution.
 - 3. Each Subcontractor responsible for the purchase of each item of equipment shall develop the full start-up plan for that equipment by combining (or adding to) the CA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan. The full start-up plan could consist of something as simple as:
 - a. Prefunctional checklists developed jointly by the CA and the subcontractors.
 - b. Manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - c. Manufacturer's normally used field checkout sheets.
 - 4. Each Subcontractor shall submit the full startup plan for which they are responsible to the CA for review and approval.
 - 5. CA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.

6. Full start-up procedures and the approval form may be provided to the CM for review and approval, depending on management protocol.
- D. Sensor Calibration of all sensors shall be included as part of the prefunctional checklists performed by the Contractors, according to the following procedures:
1. Sensors Without Transmitters, Standard Application type, shall include taking readings with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.

<u>Sensor</u>	Required Tolerance (+/-)		Sensor	Required Tolerance (+/-)
Unit wet bulb or dew point	1.0 Deg.F.		Flow rates, air	10%of design
Indoor and outdoor air pressure differential	0.05 Inches W.G.		Pressures, air	5% of design
Outside air, space air, coil air temps	1.0 Deg.F.		Watt-hour, voltage & amperage	2%

- E. Execution of Prefunctional Checklists and Startup.
1. Four weeks prior to startup, the Subcontractors and pertinent vendors shall schedule startup and checkout with the GC and CA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
 2. CA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved).
 3. For lower-level components of equipment, (e.g., fans, sensors, controllers), the CA shall observe a sampling of the prefunctional and start-up procedures. The sampling procedures are identified in the commissioning plan.
 4. Subcontractors and vendors shall execute startup and provide the CA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
 5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for supervisors to fill out these forms if they have not witnessed the test.
- F. Deficiencies, Non-Conformance and Approval in Checklists and Startup:
1. Subcontractors shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the

procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CA within two days of test completion.

2. CA reviews the report and submits either a non-compliance report or an approval form to the Sub or GC. The CA shall work with the Subcontractors and vendors to correct and retest deficiencies or uncompleted items. The CA will involve the GC and others as necessary. The installing Subcontractors or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CA recommends approval of the execution of the checklists and startup of each system using a standard form.

3.5 FUNCTIONAL TESTING

- A. This sub-section applies to all commissioning functional testing for all Divisions.
- B. Objectives and Scope of functional testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, no flow, equipment failure, etc. shall also be tested.
- C. Development of Written Test Procedures shall begin with the CA obtaining all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The CA shall then, with the assistance the contractor, develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Subcontractor or vendor responsible to execute a test, shall provide assistance to the CA in developing the procedures (answering questions about equipment, operation, sequences, etc.). Prior to execution, Subcontractors shall review the tests for feasibility, safety, equipment and warranty protection. The CA may submit the tests to the A/E for review, if requested. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.
- D. Test Methods shall include the following:
 1. Functional testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the

- performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The CA will determine which method is most appropriate for tests that do not have a method specified.
2. Simulated Conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
 3. Altering Set points rather than overwriting sensor values, and when simulating conditions is difficult, altering set points to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
 4. Setup of each function and testing shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
- E. Coordination and Scheduling by the Subcontractors shall provide sufficient notice to the CA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CA will schedule functional tests through the GC and affected Subcontractors. The CA shall direct, witness and document the functional testing of all equipment and systems. The Subcontractors shall execute all tests. In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation by the CA shall include witnessing and documenting the results of all functional tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC for review. CA will include the filled out forms in the Commissioning Report.
- B. Non-Conformance.
 1. CA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported on a standard non-compliance form.

2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. In such cases the deficiency and resolution will be documented on the procedure form.
 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
 4. As tests progress and a deficiency is identified, the CA discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Subcontractor accepts responsibility to correct it:
 - 1) CA documents the deficiency and the subcontractor response and intentions and they go on to another test or sequence
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - 1) The deficiency shall be documented on the non-compliance form with the Subcontractor's response and a copy given to the GC and to the Subcontractor representative assumed to be responsible.
 - 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner.
 - 3) The CA documents the resolution process.
 - 4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CA. The CA reschedules the test and the test is repeated until satisfactory performance is achieved.
 5. Cost of Retesting for the Subcontractor to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
 6. Contractor shall respond in writing to the CA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 7. CA retains the original non-conformance forms until the end of the project.
- C. Approval by the CA shall include notation of each satisfactorily demonstrated function on the test form. CA recommends acceptance of each test using a standard form. The Owner gives final approval on each test using the same form, providing a signed copy to the CA and the Contractor.

3.7 SYSTEMS OPERATION AND MAINTENANCE (O&M) MANUALS

- A. Following System and O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.
- B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the GC for inclusion in the O&M manuals, according to this section, prior to the training of owner personnel.
- C. CA shall receive a copy of the Systems/O&M manuals for review.
- D. Special Control System O&M Manual Requirements shall include, in addition to documentation that may be specified elsewhere, the controls contractor compiling and organizing, at minimum, the following data on the control system in labeled 3-ring binders with indexed tabs:
 - 1. Three (3) copies of the controls training manuals in a separate manual from the O&M manuals.
 - 2. Operation and Maintenance Manuals containing:
 - a. Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included if required in the controls specification section.
 - b. Full as-built set of control drawings.
 - c. Full as-built sequence of operations for each piece of equipment.
 - d. Full points list. In addition to the updated points list required in the original submittal.
 - e. Full print out of all schedules and set points after testing and acceptance of the system.
 - f. Full as-built print out of software program as required.
 - g. Electronic copy on disk of the entire program for this facility if required.
 - h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.
 - i. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 - j. Control equipment component submittals, parts lists, etc.
 - k. Warranty requirements.
 - l. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 - 3. Manual shall be organized and subdivided with permanently labeled tabs for each of the following data in the given order:

- a. Sequences of operation.
 - b. Control drawings.
 - c. Points lists.
 - d. Controller / module data.
 - e. Thermostats and timers.
 - f. Sensors and DP switches.
 - g. Valves and valve actuators.
 - h. Dampers and damper actuators.
 - i. Program setups (software program printouts).
4. Field checkout sheets and trend logs should be provided to the CA for inclusion in the Commissioning Record Book.
- E. Review and Approval of the commissioning related sections of the Systems and O&M manuals shall be made by the A/E and the CA.

3.8 TRAINING OF OWNER PERSONNEL

- A. GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- B. CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.
- C. Mechanical Contractor shall have the following training responsibilities:
 - 1. Provide the CA with a training plan two weeks before the planned training.
 - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, heat rejection equipment, air conditioning units, air handling units, fans, controls and water treatment systems, etc.
 - 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
 - 6. Controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. Training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
8. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written Systems/O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - h. The format and training agenda in *The HVAC Commissioning Process, ASHRAE Guideline 1.1-2007* is recommended.
 - i. Classroom sessions shall include the use of overhead projections, slides, and video/audio-taped material as might be appropriate.
9. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance for all pieces of equipment.
10. Mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central control system.
11. Duration of Training by the mechanical contractor shall include providing training of sufficient length on each piece of equipment according to the requirements of the preceding specification sections. If not listed in the equipment sections, the following schedule shall be used.

<u>Hours</u>	<u>System</u>
<u>6</u>	Rooftop A/C Units
<u>4</u>	Exhaust Fans

D. Controls Contractor shall have the following training responsibilities:

1. Provide the CA with a training plan four weeks before the planned training.
2. Controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.
3. Training manuals shall include the standard operating manual for the system and any special training manuals which shall be provided for each trainee, with three

extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals *and* in all software displays. Copies of audiovisuals shall be delivered to the Owner.

4. Training will be tailored to the needs and skill-level of the trainees.
5. Trainers will be knowledgeable on the system and its use in buildings. The Owner shall approve the instructor prior to scheduling the training.
6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
7. Controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
8. There shall be three training sessions:
 - a. Training I - Control System: The first training shall consist of 24 hours of actual training. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - b. Training II - Building Systems: The second session shall be held on-site for a period of 8 hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:
 - 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
 - 2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - 3) All trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
 - 4) Every screen shall be completely discussed, allowing time for questions.
 - 5) Use of keypad or plug-in laptop computer at the zone level.

- 6) Use of remote access to the system via phone lines or networks if included.
- 7) Setting up and changing an air terminal unit controller.
- c. Training III - General Overview: The third training will be conducted on-site six months after occupancy and consist of 8 hours of training. The session will be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.
- E. TAB contractor shall have the following training responsibilities:
 - 1. TAB shall meet for 2 hours with facility staff after completion of TAB and instruct them on the following:
 - a. Go over the final TAB report, explaining the layout and meanings of each data type.
 - b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 - c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 - d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - e. Other salient information that may be useful for facility operations, relative to TAB.

3.9 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the start-up and initial checkout plan described and the filled out start-up, initial checkout, pre-functional, and functional checklists, training plans and records of training. These work products will be supplied to the CA to be included in the final commissioning report.

END OF SECTION

SECTION 23 09 00**INSTRUMENTATION AND CONTROLS FOR HVAC****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

- A. Comply with Division 1 - General Requirements and referenced documents.
- B. Comply with Section 23 05 00, General Provisions, and all other Division 23 Sections, as applicable.
- C. Refer to other divisions for coordination of work with other trades.

1.2 SYSTEM DESCRIPTION

- A. The scope shall include the furnishing and installing of Energy Management System devices with new direct digital controllers, all local and remote control panels, temperature control field devices, appurtenances, etc., to accomplish specific control sequences specified herein, to provide fire and freeze protection; sensing and indicating devices; pressure and temperature indicating instruments; supporting structures, and other required components for a complete and operating system.
- B. The scope shall include all new electric connections to new thermostats, sensors, dampers and actuators, and relays, and all other new components of the system requiring electric connections.
- C. The scope shall further include all temperature control and interlocking wiring and wiring devices, including raceways, as indicated herein.
- D. Provide all software programs as required to effect the sequences of control, monitoring, reporting, etc., as indicated herein.
- E. The new system installed shall be fully automatic, subject to various types of remote surveillance, routine remote adjustments, remote status, remote alarms, remote data collection for trending/historical files, and other operations as indicated herein, from a new local remote microprocessor-based Local Area Network (LAN), with the local system capable of stand-alone operation. The system shall be capable of being monitored and controlled remotely on site by an IBM compatible Workstation (not provided under this contract) and off site by an existing Central Processing Unit (CPU) at the Facilities Central Maintenance Office via the web.
- F. Bidders are specifically advised that full and effective two-way communication between the new system installed under this contract and the Owner's existing CPU

must be achieved in an approved manner, including whatever may be required in the form of interface hardware and software without effecting or interrupting other system software. Simultaneous on-line communication of this system and others with the Central EMS is mandatory.

- G. This system of equipment and software shall be provided and installed by the single factory and authorized sales, installation and service agent of Reliable Controls (Enviromatic Systems).

1.3 QUALITY ASSURANCE

- A. The equipment provided under this Section of the Specifications shall be installed, calibrated, adjusted, and put in completely satisfactory operation by a Control Systems installer experienced in this type of work.
- B. The successful Control Systems installer shall meet the following requirements:
 - 1. All spare parts must be locally stocked and readily available within a 24 hour period.
 - 2. Service personnel shall be available, on call, on a 24 hour a day, year round basis, or service personnel will respond by visitation to the site within four (4) hours of a service call considered serious in nature or classified by the Owner as an emergency.
 - 3. Be able to provide evidence of having successfully installed similar sized and types of systems for a minimum of ten (10) years.
- C. All control devices shall be as specified in the technical portion of this section of the specifications. The system shall be installed by workmen skilled, experienced, and specifically trained in the application, installation, calibration, adjusting, and testing of instrumentation of the type specified.
- D. A service representative of the installer shall check the instrumentation for proper installation, calibrate all instruments and make all adjustments necessary to insure proper operation of the system in full cooperation with the Testing, Adjusting, and Balancing (TAB) Firm. Refer to Section 23 05 93. All instruments required for checking, calibrating, and proving the system shall be provided under this Section of the Specifications. The service representative shall spend sufficient time with all of the Owner's Representatives after the system is installed and properly functioning to instruct the Owner's Representative (Operations and Maintenance Personnel) in the operation of the system for a minimum of sixteen (16) hours for the basic Controls System and eight (8) hours for the EMS. At final completion of the installation provide personnel and instruments of satisfactory quality available to check the calibration of all instruments, and to demonstrate system operation as described in "Sequences of Operation".

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

1.4 SYSTEM START-UP AND COMMISSIONING

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

1.5 SUBMITTALS

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

1.6 PRODUCT HANDLING

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

PART 2 - PRODUCTS

2.1 TEMPERATURE SENSORS

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

2.2 RELATIVE HUMIDITY SENSORS

- A. Provide a 100% solid state copolymer wafer, of bonded layer hygrometric materials, humidity sensor and transducer. Sensor shall require no periodic maintenance or recurring calibration. Sensor shall be linear and temperature compensated.
- B. Sensor shall have +/-2% Relative Humidity (RH) accuracy over a 100% RH range and +/-1% over the 30-80% RH range.
- C. Sensor shall produce outputs of 4-20 ma or 1-11 vdc.
- D. Sensor shall be in an impact resistant cover with ventilating openings in occupied spaces. Provide duct or remote mount probes as required for the application.

- E. Wall mounted sensors shall be mounted 48 inches above finished floor to comply with A.D.A., unless indicated or otherwise approved by the Architect or Owner's Representative.
- F. Acceptable Manufacturers:
 - 1. Vaisala ($\pm 2\%$ to 3% acceptable).
 - 2. General Eastern (± 2 to 3% acceptable).
 - 3. Reliable Controls ($\pm 2\%$ only).

2.3 CARBON DIOXIDE SENSORS

- A. Furnish and install "CarboCap" technology (Vaisala) or Single Beam, dual wavelength, Infrared type technology (Tel-Aire) carbon dioxide sensors where indicated and as specified elsewhere herein.
- B. Sensors shall accurately sense carbon dioxide levels from 250-2000 Parts Per Million (PPM) with an accuracy of ± 60 ppm ($\pm 2\%$ of range (2000 PPM) and $\pm 2\%$ of reading (use 1000 PPM)), repeatability of $\pm 2\%$ of full scale, maximum drift of $\pm 5\%$ of full scale in five (5) years, $\pm 1\%$ of full scale in six (6) months, and linearity of less than $\pm 3\%$ of full scale.
- C. Sensors shall be suitable for operation in environments of 60 Deg.F. to 104 Deg.F. and 15-95% relative humidity, non-condensing, and air velocity ranges of 200 to 2750 feet per minute when located in ductwork. Wall mount sensors shall be able to sense accurately with air velocities as low as 20 feet per minute.
- D. Sensors shall be calibrated at the factory at 1,000 PPM, ± 50 PPM; at 72 Deg.F, ± 4 Deg.F.; and at 50% relative humidity, $\pm 5\%$.
- E. Power requirements shall be 24 volts AC with a power consumption not to exceed 5 watts.
- F. Wall mount sensors shall be mounted at 48-54 inches above the finished floor.
- G. Sensors shall be as manufactured by:
 - 1. Vaisala, Model GMD/W20 or equals by;
 - 2. Tel-Aire (Model 8101/8102), or
 - 3. Alternate models by Veris Industries.

2.4 COMBINATION SENSORS

- A. Where space temperature, relative humidity and/or carbon dioxide sensors are all designated to be located in the same location for control or monitoring purposes combination sensors are desired such that one wall mounted device and single back box is required.

- B. Where combination sensors are required the specified levels of accuracy will be required. The use of combination sensors does not relieve these requirements.

2.5 CARBON MONOXIDE SENSOR AND ALARM (CLASSROOM/AREAS)

- A. A carbon monoxide detector shall be installed in each classroom as shown on the Drawings.
- B. The carbon monoxide detector shall be similar to Gentex Carbon Monoxide Alarm Model CO1209 Series.
- C. The carbon monoxide detector shall have the following features and functions.
 - 1. The carbon monoxide alarm shall utilize an electrochemical sensing element with an expected 5-year life.
 - 2. The carbon monoxide alarm shall be calibrated in accordance with ANSI/UL 2034 requirements to alarm at 70 PPM CO for 1-4 hours, 150 PPM CO for 10-50 minutes, and 400 PPM for 4-15 minutes.
 - 3. The alarm shall have a 9V alkaline battery as back-up in the event that building power is lost. Battery impedance shall be verified by the circuit of the CO alarm. The CO alarm shall provide an indicator when the battery is low in power or high impedance or is missing.
 - 4. The CO alarm will provide an audible indicator of 3 quick chirps every 30 seconds at the end of life of CO sensor.
 - 5. The CO alarm shall be a solid state piezo alarm rated at 85dBA at 10ft.
 - 6. An easily accessible test button shall be provided to indicate functionality of the sensor.
 - 7. The device shall have tandem interconnect capability for up to 18 CO alarms and tandem interconnect with other CO alarms, smoke alarms, or combinations thereof.
 - 8. The device shall have auxiliary relay contacts for initiating remote functions and annunciation.
 - a. The device shall be installed such that it sends a signal to the EMS for alarming purposes.
 - b. The device shall be installed such that it is employed in the sequence of operation for roof top air conditioning units.
 - 9. The device shall be UL 2034 listed.

2.6 SMOKE DETECTORS

- A. One (1) smoke detector shall be furnished under Division 28 (Fire Alarm Contractor) and installed by the Mechanical Contractor for each new air handling equipment item handling over 2,000 CFM of airflow or where units are serving two (2) or more spaces; to be mounted in the return air stream, which shall stop the fan motors upon detection of smoke.

- B. Coordinate with Electrical and Fire Alarm Contractor requirements to insure sampling tubes are provided suitable to the width of duct in which installed.
- C. Detectors shall be supplied with 24 volts, power supply under Division 26/28. Control circuit interlock wiring shall be installed by fire alarm contractor under Division 26/28. Controls Contractor to provide wiring to unit. Fire alarm Contractor to provide wiring to smoke detector or panel. Fire Alarm Contractor to install shut-down relay and supply and terminate wiring from coil to Fire Alarm panel/smoke detector. Controls Contractor to supply and terminate wiring to shut-down contact relays in unit.
- D. Acceptable duct detectors, where not specified elsewhere, shall be THORN-DH-22, BRK-DH2851AC, or Gamewell MS-69433, suitable for single station operation.

2.7 ROOM SENSOR AND THERMOSTAT PROTECTIVE COVERS

- A. Provide opaque Lexan thermostat guards with mounting brackets and tamper proof screws for each new wall mounted thermostat and sensor installed, unless indicated otherwise. Administrative office areas and classrooms shall not require guards. Generally, guards shall be provided in Institutional Public Use Areas, such as Cafetorium and Public Use Corridors.
- B. Painted cast iron guards, shall be used in high abuse areas such as gymnasiums, shops, locker rooms, etc., without exception.
- C. Guards shall be sized to accommodate the thermostat or sensor to be enclosed, and include ventilation openings, ring base, and key lock.
- D. Guards shall be as manufactured by:
 - 1. Mason.
 - 2. Honeywell.
 - 3. Best Engineered Control Products.

2.8 AUTOMATIC DAMPERS

- A. Provide all control dampers, under this Section of the Specifications, of the types and sizes indicated on the Drawings, including but not limited to outside air intakes, return, relief, and other motorized air control dampers where shown, or where not an integral part of the equipment furnished and specified in other sections of these specifications. All dampers shall be special low leakage extended performance type.
- B. Damper frames shall be not less than 16 gauge galvanized steel formed for extra strength with mounting holes for flange and enclosed duct mounting.
- C. Dampers shall be available in two-inch size increments from 8" horizontal and vertical to 48". Requirements for dampers over 48" in size shall be met by using standard

modules with interconnecting hardware to limit damper blade length to a maximum of 48". Provide separate actuator for damper modules exceeding 32.0 square feet and as required for smaller sizes due to torque requirements.

- D. All damper blades shall be not less than 16 gauge galvanized steel roll formed for high velocity performance. Blades on all dampers must be not over 6" wide.
- E. Blade bearings shall be nylon or oilite with 1/2" zinc plated steel shafts.
- F. All blade linkage hardware shall be of corrosion-resistant finish and readily accessible for maintenance after installation.
- G. Provide continuous replaceable neoprene or butyl rubber edging seals for all outdoor and relief air dampers where blade edges meet when dampers are closed. Spring loaded stainless steel side jamb seals shall be provided for all dampers.
- H. Dampers and seals shall be suitable for temperature ranges of -20 degrees F to 200 degrees F at specified leakage ratings.
- I. Dampers used for proportional control shall have opposed blades.
- J. Leakage rates for all controlled dampers shall not exceed 5 CFM of air flow per square foot of face area based on a 16 square foot damper, at 1.0" W.C. differential, rated in accordance with AMCA 500. Furnish test data with Submittals.
- K. Acceptable manufacturers (No other manufacturers will be allowed):
 - 1. Johnson Controls, Inc.
 - 2. Honeywell, Inc.
 - 3. American Warming and Ventilating, Inc.
 - 4. Ruskin.

2.9 ELECTRIC DAMPER ACTUATORS

- A. All control dampers shall receive electric actuators.
- B. Electronic direct-coupled actuation devices shall be provided.
- C. Electric Actuators shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a "V" bolt design with associated "V" shaped toothed cradle attaching to the shaft for maximum strength and to eliminate slippage.
- D. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jack shaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or set screw type fasteners are not acceptable.
- E. Actuators shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end

switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.

- F. For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable. This applies to all dampers directly connected to outside and relief air systems. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
- G. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. Floating point type control is acceptable on fan coil units, unit heaters and variable air volume terminals. All actuators shall provide a 2 to 10 VDC position feedback signal.
- H. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA.
- I. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper or valve when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose.
- J. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
- K. Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
- L. Actuators shall be Underwriters Laboratories Standard 873 listed.
- M. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a minimum 2-year manufacturer's warranty, starting from the date of substantial completion.
- N. All actuators connected to all sequenced dampers shall have independent control and adjustment from one another to emulate a pilot positioner.
- O. Acceptable Manufacturer's:
 - 1. Belimo.
 - 2. Johnson Controls, Inc.
 - 3. Siemens.
 - 4. Invensys.

5. Honeywell, Inc.

2.10 CURRENT SENSING STATUS RELAY

- A. Prove current sensing status relays for motor operation status monitoring as specified elsewhere herein.
- B. Sensors shall be 100% solid state, no mechanical parts, and have no calibration drift.
- C. Sensors shall have an adjustable trip level, be isolated, have single set point adjustment, require no external power (power induced from conductor), and have integrated adjustable wall or floor mounting bracket.
- D. Sensors shall be suitable for motor loads from 0 to 100 HP, with a supply current of 1 ampere up to 135 amperes, 600 VAC RMS, set point adjustable to +/-1% range from 0-95% non-condensing relative humidity.
- E. Sensors shall be as manufactured by Veris Industries.

2.11 AIR FLOW DIFFERENTIAL PRESSURE SWITCHES

- A. Air flow differential pressure switches shall be provided to detect clogged air filters duct pressure, and building space pressure unless specified in other sections of these specifications.
- B. Switches shall be capable operating in ambient temperatures from 0 Deg. F. to 165 Deg. F.
- C. Setpoints shall be field adjustable from 0.05 to 5.0 inches water column to suit the application. Provide concealed scale plate with adjusting screw for setpoint adjustment. Scale shall be selected such that the normal operating range is at the midpoint of the scale; i.e. an operating range of 0.30 to 0.70 needs a scale of 1.0.
- D. Materials of Construction:
 - 1. Buna_N Diaphragm.
 - 2. Molded polycarbonate enclosure.
 - 3. Zinc plated cold rolled steel; 0.040 inches thick for diaphragm housing and 0.032 inches thick for cover material.
- E. Provide appropriate mounting brackets and any remote mounting probe kits as necessary for each particular mounting condition.
- F. Acceptable Manufacturers:
 - 1. Johnson Controls, Inc.
 - 2. Honeywell, Inc.
 - 3. Invensys.
 - 4. Siemens.

- 5. Robertshaw.
- 6. Dwyer.

2.12 LOCAL CONTROL PANELS

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

- L. Permanently affix inside each panel a final "as-built" control drawing of the piping and wiring of the panel.
- M. All panels shall be factory assembled, piped and wired.

2.13 ENERGY MANAGEMENT SYSTEM

- A. Network Level Controllers shall have a 16 bit based microprocessor with EPROM operating system. DDC programs and data files shall be in non-volatile EEPROM or flash memory to allow simple and reliable additions and changes. Each controller shall have an on-board 30 day battery backed realtime clock. Controllers shall be provided as required with capacity to accommodate input/output (I/O) points required for the application plus any spare points as specified. Each panel shall be provided with a socket for a Portable Operators Terminal (POT), and a port for network communications at no less than 78,000 baud. Controllers shall have outputs which shall be binary for On-Off control, with true variable voltage (0-10v), for driving analog or pneumatic transducer devices. Analog outputs shall have a minimum incremental resolution of one percent of the operating range of the controlled device. Controllers shall have LEDs for continuous indication of all bus communications, power, and operational status. All panel electronics and associated equipment shall be installed in suitable enclosures.
- B. Terminal Equipment Controllers (TEC's) shall be UL916 standalone EEPROM based and configured to perform the sequences specified, and with I/O selected for the application. TEC enclosures shall be compact plastic conforming to UL94-5V or plated steel. Each TEC shall be provided with LED type annunciation to continually display its operational mode; power, normal, or in an alarm state. TEC networks operating on a 9000 baud rate shall be grouped with no more than 20 TEC's per primary bus connected device. For TEC networks operating over 50,000 baud, up to 100 TECs may be so grouped.
- C. General:
 - 1. Software development and programming shall be as directed by the Owner and as described herein. Contractor shall install all program operating time schedules as furnished by the Owner. During construction, the Contractor may operate equipment in what is considered a Construction Schedule. The control systems installer, at Substantial Completion, shall remove such schedules and replace these with individual, independent, operating schedules for each system and individual piece of equipment, specifically air handling equipment.
 - 2. Program trend logging of all analog and binary points of control at intervals as directed by the Owner, initially use five (5) minutes.

3. Overall systems control shall be performed by a field programmable direct digital controller, microprocessor based, which incorporates Direct Digital Control, all necessary energy management functions and provides for digital display and convenient local adjustments of desired variations at each individual controller cabinet. This shall include scheduled programming and system interlocks.
4. DDC Control Units and all hardware shall be capable of continued operation at room temperatures of 40 Deg.F. to 120 Deg.F. and humidity from 10% up to a non-condensing point of 90%. All inputs shall be capable of withstanding continuous shorting to 120 VAC.
5. Provide any external electrical power supply protection devices to protect controllers from external voltage surges to include high voltage and lightning disturbances/protection.
6. Provide function switches in a local control panel if not integral with the DDC Controller with "on-off" control and a "manual-auto" switch for each new DDC output (contact type) with switch status information being available to the central systems historical data files for new rooftop units over 2000 CFM in capacity, exhaust fans over 2000 CFM in capacity, and make-up air fans. Switches shall be local and easily accessible and adjacent, or within sight of, controlled equipment. If switches are not an integral part of the Energy Management System or locally accessible for use, then furnish similar set of switches on the Local Control Panel, dip switches less than 1/4" wide and 1/4" tall shall not be acceptable for this function.
7. The new EMS system installed shall be automatic, subject to various types of remote site surveillance, routine adjustment, and operation as indicated herein, from a microprocessor-based Local Area Network (LAN), capable of stand-alone operation. In addition, basic control and LAN interface shall be provided in a Central Control Panel located where shown on the drawings. The entire system of control and automation at this building shall thus become an integral part of the Owner's existing Energy Management System (EMS) front end.
8. Bidders are specifically advised that full and effective two-way communication between the new system installed under this contract and one (1) of the Owner's three (3) existing CPU's must be achieved in an approved manner, including whatever may be required in the form of interface hardware and/or software without effecting or interrupting concurrent communications with other connected buildings. No additional CPU's are allowed at the Central Digital Monitoring location.
9. Existing color graphic mouse commands shall be retained in a similar fashion.
10. Provide Control Graphics/Equipment Schematics for each piece of controlled equipment with on-line display of system control parameters. Program all graphics at system front end to include on-line alarm reporting resulting in print outs occurring each time an alarm message is reported on site.
11. Provide a hard wire connection between the Building LAN serving all new Controllers to the Central Facilities Management System. Verify dependable utilization of this system and transfer of local system data and functions to the existing control system CPU. General data reporting and alarms transmission shall be verified.

12. An operator shall be able to define the minimum time delay between the stopping of a piece of equipment and its subsequent restart. This time delay shall be in effect for motors in the software control mode and for EMS controlled motors in the “manual” control mode. Provide equipment fail restart software that will restart equipment shut down as the result of a fire alarm system, power outage or other building wide shut-down, following the return to normal conditions. This shall consist of designated groups of RTU’s and other EMS controlled equipment being restarted at staggered time intervals to prevent excessive demand on the power supply.

D. Control:

1. Control algorithms shall be available and resident in the digital system controller to permit Proportional, Integral, and Derivative control modes in any combination to meet the needs of the application. Other control modes such as incremental, floating, or two-position must be available to adapt to job needs.
2. All control shall be performed in a digital manner using the digital signal from the microprocessor based controller converted through electronic circuitry for modulation of electric actuators or through transducers to produce the pneumatic signal for operation of pneumatic actuators.
3. Provide sensitivity, proportional, and integral adjustments for all DDC output control points.

E. Energy Management: The digital system controller shall perform all the energy management functions necessary to reduce energy consumption. The programs shall include, not necessarily utilized, but not be limited to:

1. Optimal start-stop using an adaptive algorithm to prevent the need for manual adjustment of parameters.
2. Optimization programs controlling equipment using outdoor dry bulb and dew point temperatures. The outdoor wet bulb temperature shall be calculated by the following equation:

$$WB = (DB-DP)K+DP \text{ where } K = 0.560-0.0068 (DP-30)$$

3. Client Tailored Programs: The library of routines available in firmware must be capable of generating additional programs as may be required for specific client requirements. The Owner shall be capable of revising programs without the aide of the installer.

F. Local Display and Adjustment:

1. The DDC shall be provided with a Central Master Panel for digital parameter display, programmed to display analog variables, binary conditions, off normal scans and other analog or binary information required for analysis and adjustment of the system being controlled. The DDC shall further contain display features to indicate automatic operation, manual or override operation, alarm indication, and other auxiliary displays associated with special purpose auxiliary function keys. Additionally, provide one portable operators terminal to make adjustments at any controller where connected to the network.

2. The associated keyboard shall contain all alphanumeric keys to call-up the desired points and type of value to be displayed and have several special dedicated keys for such functions as manual-auto, test and function and value enter, as an aid to the operator. A minimum of two keys shall be programmable for auxiliary functions that may be used frequently.
3. Adjustments of control variables shall be conveniently available at each local DDC panel or device through a resident or portable keyboard and display. The adjustments shall include, but not be limited to, proportional gain, integral rate, the velocity and acceleration constants associated with incremental control and on/off values of two-position control.

G. Field Programmable:

1. The Local DDC Controllers shall contain all necessary mathematic, logic, utility functions; and all standard energy calculations and control functions in ROM to be available in any combination for field programming the unit. These routines shall include, but not be limited to:
 - a. Math Routines:
 - Basic Arithmetic
 - Binary Logic
 - Relational Logic
 - Fixed Formulas for Psychometric Calculations
 - b. Utility Routines for:
 - Process entry and exit
 - Keyboard functions
 - Variable adjustments and output
 - Alarm Indication
 - Restart
 - c. Control Routines For:
 - Signal compensation
 - Loop control
 - Energy conservation
 - Timed programming
2. Final field programs shall be stored in battery backed up RAM.

H. Expandability: The DDC shall be expandable by adding additional field interface units that operate through the central processor of the DDC. The processor in the DDC shall be able to manage remote field interface units thereby expanding its control loop and energy management point capacity. Remote units shall be able to stand alone and have two-way communication in a LAN configuration. Systems furnished shall be fully manufacture-supported and under current production.

I. Calibration Compensation: To maintain long term analog accuracy to the controller sensing circuits, the DDC shall sense the voltage being supplied to the resistance

sensing element and through firmware compensate for power supply changes due to long term drift or drift due to ambient temperature changes at the power supply.

- J. Battery Backup: The DDC system shall be supplied with a minimum of 48 hours of nickel-cadmium battery backup, during power outages, for the RAM, with an automatic battery charger to maintain charge while power is on, to prevent internal component damage or failure. DDC modules shall have automatic restart capabilities with sequencing after a power failure without program interruption.
- K. Associated Hardware:
 - 1. All actuators for dampers shall be supplied under this section of the specifications.
 - 2. Where electric actuators are used they shall be compatible with the (pulse width modulated) output of the Digital System Controller.
- L. Diagnostics: The Digital System Controller shall contain in its program a self test procedure for checking the digital controllers, and by means of a non-destructive memory, check the computer.
- M. Default Operating Procedure and Alarms:
 - 1. All variables shall be identified as being reliable or unreliable. When a calculation is required to use a value (sensed or calculated), which is identified as being unreliable, the unreliable data value will flash. The calculation will use a default value programmed into the unit.
 - 2. All alarms (a fan that did not start, etc.) and all deviation alarms (temperature, off, normal, etc.) will locally display an alarm as well as report to the remote CPU the type of alarm, designate equipment or system effected, date and time of alarm. A hard copy printout of alarms shall be generated at the remote CPU location. A scan can then identify all alarm conditions and their identifier.
- N. Cabinet:
 - 1. The DDC modules, central and remote units, shall be enclosed in a metal frame cabinet. The cabinet shall be constructed such that it can be mounted and electrical terminations can be made during the construction phase of the project. The DDC electronics are to be removed and added at a later date, only prior to start-up.
 - 2. Cabinet shall be installed on the wall in the Mechanical Rooms or elsewhere as indicated.
 - 3. DDC cabinets in Mechanical Rooms shall be provided with a key lock. All cabinets on each installation shall utilize one master key. Sheet metal set screw locking covers are not acceptable.
 - 4. All control wiring and system communications shall be electrically terminated inside DDC cabinets.
- O. U. L. Approval: The DDC system panels shall be an approved U.L. System, with U. L. listing as a Signaling System.

- P. General software features of system, with sufficient internal memory, shall include the following as a minimum (although not all are necessarily used):
1. Start-Stop Functions.
 2. Optimized Start-Stop Control (warm-up and cool-down).
 3. Time Programmed Commands.
 - a. Normal occupancy.
 - b. Holiday.
 - c. Occupancy overrides.
 - d. Schedules shall be programmable up to one year in advance with system wide or global scheduling and local, point by point scheduling.
 4. Duty Cycle Control (not used).
 5. Night Setback/Setup.
 6. Electric Demand Limiting (not used).
 7. Override Feature.
 8. Run Time Totalization with data in non-volatile module memory. Provisions shall be made for on-line programming and override.
 9. Staggered start of Groups of Equipment following power outages or Mass Building Equipment Shutdown.
- Q. Individual On/Off Points of System Control and run Status shall be provided for each of the following:
1. Each Rooftop A/C Unit; Refer to plans for quantities, sizes and related requirements.
 2. Exhaust Fans:
 - a. New kitchen grease hood exhaust fan – status only.
 - b. Existing Dishwasher Hood Exhaust fan – status only.
 - c. EMS controlled Toilet Exhaust Fans, refer to plans for quantities.
 - d. Electrical Rooms, refer to plans for quantities.
 3. Make-Up Air Fan for grease hood – status only.
 4. Exterior Lighting Controls: Re-use all existing currently controlled exterior lighting controls contactors and schedules.
- R. Run Status (On/Off) of all individual equipment indicated above shall also be capable of being accessed for on-line programming. Verify by using current sensing relays on all fan motors.
- S. Failure Alarm Status for the following items shall be provided through the EMS:
1. Combined Safety and Failure Alarm: One (1) for each EMS controlled exhaust fan, make-up air fan, or Rooftop AC Unit.
 2. High/Low Temperature Sensor Alarm for each Temperature Sensor installed; initially set at 3 Deg. F. above or below setpoint.

3. High Relative Humidity (RH) Sensor Alarm for each RH Sensor installed, initially set at 65% R.H.
 4. High Carbon Dioxide Level Alarm for each carbon dioxide sensor installed, on a rise above 1300 Parts Per Million, PPM, adjustable.
 5. Emergency Overflow Condensate Moisture Detection/High Water Level Alarm (**all rooftop units**): De-energize unit served and sends alarm to EMS.
 6. High Carbon Monoxide Level Alarm for Classroom Areas, on a rise above 70 Parts Per Million, PPM, adjustable. Provide for individual alarm indication of Carbon Monoxide Sensor for each Classroom Unit, separate from general safety alarm circuit alarm.
- T. Provide cumulative run time logging and indication for equipment noted in Paragraph “R”, above.
- U. Provide analog indication for the following:
1. For each Rooftop A/C Unit receiving new controls:
 - a. Space temperature, Deg. F.
 - b. Supply air temperature, Deg. F.
 - c. Space Relative Humidity, % R.H., new units only (except as noted below where units share common sensor).
 2. Re-use existing indication of outside air temperature in Deg.F. for each building.
 3. Re-use existing indication of outside air relative humidity in % R.H. for each building.
 4. Space Temperature, Degrees F.:
 - a. Main Electrical Room.
 - b. MDF Room.
 - c. All IDF Rooms, refer to plans for quantity
 - d. All Electrical Rooms, refer to plans for quantity.
 - e. Main Fire Riser Room.
 5. Space Carbon Dioxide Level, PPM, (refer to plans for quantities and locations):
 - a. Gymnasium.
 - b. Cafetorium.
 - c. Library.
- V. Building Computer Software Management features:
1. Provide minimum of 15 User Selectable Passwords with a minimum of three levels of access. Highest level provides system access, secondary level provides access for command to field devices only, lowest level provides monitoring capabilities only with no field control allowed. Password access will be logged with time/date stamp and associated user ID.
 2. Provide a minimum of 16 Point Group Summaries with each point inclusion selectable by system operator. Summaries will have a minimum of six character

identifiers for each group. A separately selectable All Points Summary shall be available to the operator for a view of the complete system. Alarm Summaries, listing all points in an alarm status shall be provided, and shall be Owner definable.

3. Trend logs and summaries:
 - a. The Network Manager, and existing Central Computer, shall be provided with, as a part of this contract, the ability to periodically trend any hardware, software, or simulated point within any of the attached DDC panels, for this project, at an Owner selectable interval of a minimum of once per second, up to at least once per 1000 minutes.
 - b. The trending programming for selected points and all feature attributes of these points shall be accomplished online at the CPU with no disruption of dynamic communication with the remote DDC panels. The operator shall be able to add, delete, and modify points and attributes at any time while online. Online programmable attributes shall include:
 - Point addition, deletion, and modification
 - Sampling intervals and ranges
 - Historical samples to be stored per individual point
 - Dynamic data values
 - Engineering units of each point
4. Online editing capabilities shall be provided for, but not limited to the following:
 - a. Add/Delete Points
 - b. Modify Engineering Units
 - c. Modify/Create Point Groups
 - d. Adjust Set Points
 - e. Adjust Individual Start/Stop Time
 - f. Trend Selected Points
 - g. Observe Any System Point, Hardware, or Software

This editing capability shall be for both CPU resident programs and remote DDC panel programs.
5. English language shall be used for all inputs, outputs, and display. Code or computer language will not be acceptable.
6. Remote DDC Field Communication: Communication between the Network Manager and the remote DDC panels shall be achieved via digital transmission utilizing a distributed polling technique for recognition of all field points both software and hardware points status issuing of commands, programming of DDC units, etc. Additionally provide software for the existing Central Computer to allow the same interaction/communication features as noted for the Computer Workstation Building. Data transmission via hardwire interlock shall be compatible with electric category type 3002 as described in Bell System technical publications for data transmission using 4600 Baud Rate.
7. CRT Format:

- a. The existing CPU located at the Facilities Central Maintenance Office CRT format shall include and display in an individually dedicated and protected area of the viewing screen the following Dynamic information:
 - 1) The current time, date, and day of week (including Holidays).
 - 2) Sequential as occurred alarms.
 - 3) Visual indication of “alarm”, “on” or “off” normal conditions which are active; all alarms to print out as they occur at the system front end.
 - 4) Current operator identification.
 - 5) Operator work area to display various forms of point information issue commands, and data base information relevant to current activities.
- b. Operator will have full access to the system for issuing commands, etc. while this display is active.
- 8. Provide a graphic software package and programming to result in a schematic illustration for each controlled piece or group of pieces, of equipment to illustrate all related controlled variables, set points and operating parameters. Additionally provide a building floor plan with room numbers and locations of all space sensors and controlled equipment. The user shall be able to click on any feature to pull up related system graphics.
- 9. Provide a portable operators terminal or fully operable and programmed laptop computer terminal for use by the Owners designated service technician to view, monitor and trouble shoot the control system via service jacks at all controllers and temperature sensors.
- W. For all above ceiling or roof mounted equipment with controllers not mounted on or in the units, the EMS controllers should be mounted directly above the ceiling where the space temperature system is located.

2.14 WEB BROWSER INTERFACE

- A. Provide Internet/Intranet Connectivity utilizing a Web Browser as follows:
 - 1. Shall be a “Server” based product that provides browser access to Ethernet enabled automation controllers. Access is accomplished by utilizing a standard web browser. No other “client” side software shall be necessary to view and utilize the system. The “Server” hosting the Web Application can be located anywhere on the Internet. The software functions by taking real-time data from the active automation systems and combining that information with the appropriate graphic file in an HTML format to be viewed by the web browser. The number of simultaneous users connected to the web application shall only be limited by the capability of the server hosting the application. The application should be able to service multiple sites.
 - 2. The graphics utilized for this system shall not require external applications to convert the images for use between the web server-based application and the

- traditional graphical user interface. Graphics shall be interchangeable between applications.
3. Web Browser Server shall receive server-based software which shall support Microsoft's .NET standards for the exchange and interoperability of information and data.
 4. **Server-based software upgrades shall be free to the owner for the first five (5) years the server is owned by the building Owner.**
- B. The Host Server (existing) shall be reused and shall meet the minimum requirements noted for data servers.
- C. The Web Browser Interface shall include the following user configuration requirements:
1. Usernames and passwords can be setup via the Web Browser Interface. Physical access to the server is not required but will be password protected.
 - a. Individual user names/passwords are to be utilized.
 - b. Usernames/passwords can be specifically unique to allow the user to be automatically redirected to a specific site, and or graphic display when logging into the system.
 2. Passwords can be configured to allow the user to modify setpoints or not.
 3. All user configuration functions shall be provided through an intuitive graphical user interface.
 4. Web Browser Interface shall not require any external applications, "Client Side" software or "Plug-Ins" to connect, view, or control any aspect of the building automation system.
 5. Access to the installed automation system shall be performed through Microsoft Internet Explorer.
- D. Site Graphics shall meet the following requirements:
1. Graphics displayed through the Web Browser Interface must be the same graphic images provided through the Graphical User Interface described above. No external applications are to be required to interchange graphic images between the web server application and the graphical user interface.
 2. Trend data must be able to be displayed graphically and in "spread sheet" format without the addition of any additional client side software, plug-Ins, or additional applications.
 3. Digital Start/Stop Logging shall be able to be displayed and printed from the browser interface without the addition of any additional "client side" software, plug-Ins, or additional applications.
 4. The display and printing of alarm data shall be performed without the addition of any "client side" software, plug-Ins, or additional applications.
 5. Points that are manually overridden shall be displayed on the graphic screen by an icon adjacent to the overridden point to provide a quick visual indication of any points on the screen that are overridden.

6. The viewing and modification of weekly schedules shall be performed in a graphically intuitive manner that is consistent with the non-Web Enabled application. This shall be performed without the addition of any “client side” software, plug-Ins, or additional applications.
7. The viewing and modification of annual holiday schedules shall be performed in a graphically intuitive manner that is consistent with the non-Web Enabled application. This shall be performed without the addition of any “client side” software, plug-Ins, or additional applications.
8. “Right clicking” on the point and modifying the value shall perform the editing of point values.
9. Points can be placed in “manual” or “automatic” mode from the Web Browser, providing password restrictions for the user allow such functionality.”

2.15 ELECTRICAL WIRING

- A. All wire, wiring, and conduit required for the operation of the control system shall be the responsibility of this section of the specifications and shall be installed as described and in full accordance with the requirements of Division 26 of these Specifications. Conduit down in walls to space sensors and back to accessible ceiling space to be provided by Division 26. Automatic Controls Contractor to coordinate installation of conduit of space sensors with Division 26 and provide if not provided by Division 26.
- B. The control manufacturer shall be responsible for supplying complete and approved wiring diagrams and installation supervision of the wiring of the control system and shall perform all necessary set-up and calibration labor.
- C. Starters, furnished in other sections of these specifications, shall be installed under Division 26, but all wiring from auxiliary contacts or relays shall be under this section of the specifications.
- D. All wiring, including Class 2 signal wiring, shall be installed as a Class 1 electrical system as defined by the National Electrical Code (NEC).
- E. All control conduits with #8 conductor or smaller (cross-sectional area) shall have one (1) spare conductor each run in conduits carrying 5 or more conductors. Spare conductor shall be same size as the majority of conductors sized in the conduit. Conduits with 9 or more conductors shall have two spare conductors. Terminate spare conductors at control panels in an acceptable manner and tag wires as “spare”.
- F. The electrician shall be licensed by the City and local authorities having jurisdiction over the area in which the work is to be performed.
- G. All class 1 control wiring conduit shall be run with not more than 30% fill based on inside conduit diameters and cross-sectional area. This provision is for future modifications or additions to the control system.

- H. All conduit carrying shielded twisted pair cabling, communication, or signal, Class 2 wiring, shall be sized for a maximum of 40% fill based on inside conduit diameter and cross-sectional area. This provision is for future modifications or additions to the control system.
- I. All wiring shall be run in conduit. All Class 1 power wiring shall be run in conduit. All Class 2 signal wiring, low voltage control type, shall be run in conduit. No exposed wiring of any kind will be allowed. Class 2 signal wiring may be installed without conduit but only when installed above fully accessible lay-in ceilings and if run-in plenum rated cable supported independently from structure and run parallel and perpendicular to the structure.
- J. All conduit shall be 3/4 inch size minimum, except raceways terminating at control devices manufactured with 1/2" knock-outs, i.e., conduit from junction box to smoke or fire detectors (local single device wiring only).
- K. Electrical Systems Installer on project may perform temperature control conduit and wiring installation on project only that this portion of work shall be bid directly to the Temperature Control Systems Installer, and all work in relation to temperature control wiring shall be done subordinate to this Section of the Specifications. Wiring terminations shall be under this Section of the Specifications.
- L. Under this Section of Specifications, coordinate the furnishing and installation (by the job site electrician), at an early stage of construction (when walls are being constructed) galvanized steel back boxes for all wall mount space sensors, suitably secured with 3/4" EMT routed to four inches (4") above an accessible ceiling. This will also require the installation of pull wire for installation of sensors and related wiring at a later stage of construction under this Section of Specifications.
- M. Work Not Included Under this Section of Specifications: The Electrical Systems Installer shall provide:
 - 1. Branch circuit and motor feeder circuit conductors, raceway, connections, and overcurrent protection for each motor or item of equipment furnished by the Owner or other Contractors.
 - 2. Installation of motor controllers furnished by the Owner or other Contractors, along with branch circuit and motor feeder circuit conductors, raceway, and connections in accordance with the manufacturer's approved wiring diagrams.
 - 3. Disconnect switches, where indicated on the drawings or required by codes, except as provided as an integral part of manufactured equipment.
 - 4. Power supply conductors, raceway, connections, and over-current protection for input power to HVAC Temperature Controls, HVAC Automation, and HVAC Energy Management Systems in accordance with approved rough-in and connection diagrams furnished by the system suppliers only when shown on Division 26 Drawings.

5. The above represents an outline of the work for the purpose of describing one division of the work which is acceptable to insure that all work is contained within the General Contract. The Contractor is fully responsible for the installation of complete, operating systems in accordance with the functional intent of the specifications.
 6. Nothing herein shall be construed to confine the Contractor from assigning the work to any single member or group of systems installers deemed best suited for executing the work to effect completion of the contract. Refer to specific bidding instructions of the General Contract for the actual division of the work.
 7. Installation of all control conduit in walls to accessible above ceiling space.
- N. Work Included Under this Section of the Specifications: The Mechanical Systems Installer shall provide:
1. Motors and equipment, erected in place and ready for final connection of power supply wiring, along with manufacturer's approved wiring diagrams.
 2. Motor controllers, in suitable enclosures and of the type and size in accordance with the manufacturer's recommendations and NEMA requirements, along with properly sized overload elements or devices which are normally provided as part of manufactured equipment.
 3. Disconnecting switches or devices which are normally provided as a part of manufactured equipment.
 4. Rough-in and connection diagrams for input power supply and connections for the HVAC Temperature Control, HVAC Automation, and HVAC Energy Management Systems.
 5. The above represents an outline of the work for the purpose of describing one division of the work which is acceptable to insure that all work is contained within the General Contract. The Contractor is fully responsible for the installation of complete, operating systems in accordance with the functional intent of the specifications.
- O. Contractor, under this Section of the Specifications, shall insure the furnishing and installation of:
1. All new branch circuit wiring, conduits, protective devices and accessories for power wiring to serve new control panels, control transformers, electric control dampers and valve actuators, combination fire-smoke dampers and any other control system power requirements where not shown to be performed by others. Field verify spare electrical circuits available where applicable. Do not tap into existing branch circuits without approval by the Owners Representative. Run all new circuits back to electrical feeder panels.
 2. Conductors and raceways for the HVAC temperature control, HVAC automation, and HVAC Energy Management System in accordance with approved rough-in and connection diagrams furnished by the system suppliers.
 3. Termination of all conductors, raceways, devices, and connections for low voltage systems for the HVAC Temperature Control, HVAC Automation, and HVAC Energy Management Systems in accordance with the provisions of Division 26,

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

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

2.16 GENERAL

- A. System shall be installed complete with DDC panels, remote panels, thermostats, sensors, control dampers, all actuators, switches, relays, alarms, etc., in accordance with the extent of the sequences of operation. Provide all auxiliary equipment required. All controls shall be installed under this section of work, with the exception of automatic dampers and taps for flow switches and pressure sensing devices which shall be installed under Section 23 30 00.
- B. Control Systems manufacturer shall submit a complete and final check list verifying final calibration and set points for each system prior to final construction review.

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

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATION - ROOFTOP UNITS WITH HOT GAS RE-HEAT (SINGLE ZONE TYPE) - (3 TONS AND LARGER)

- A. The direct digital control system shall monitor and control each rooftop A/C unit. An electronic room temperature sensor shall, through a local terminal unit DDC Controller, one per unit, control its DX Cooling (minimum 2-stage for units 7 tons and greater (required on units over 7 tons in size)), hot gas reheat coils, 1 or 2-stage gas heaters (for units 3 tons in size and larger) and economizer, outside, return and relief/exhaust air dampers to provide the following sequences:
 - 1. The DDC controller shall be of the automatic change-over type to provide for a heating and a cooling set point to be software interlocked to prevent the cooling set point from being set below the heating set point and vice-versa. Provide for a minimum 2 Deg.F. dead band between set points, adjustable up to 5 Deg.F.
 - 2. Include optimized start and stop features for unit control where the space temperature is compared to the ambient outdoor air temperature to calculate the

minimum run time necessary to attain the normal mode set point by the occupied time scheduled.

3. Any time the rooftop A/C unit is in operation in the "Occupied" mode, the outdoor air damper shall open to its minimum position except during morning warm-up (optimized start), night set-back, morning cool-down (optimized start) and night set-up. For units specified to have carbon dioxide sensors, the outside air dampers shall remain closed in the occupied space, except when the unit is operated in the normal occupied mode in which case the outside air dampers shall open to the minimum-minimum position scheduled. Once the carbon dioxide set point of 1,100 PPM, adjustable, is reached; the outside air damper shall modulate further open to maintain this set point but in no instance shall it open beyond the minimum-maximum position scheduled.
4. Upon a need for mechanical cooling, the DX cooling system shall be energized in such a manner as to maintain a stable space temperature set point of 72 Deg.F (adj.). On a rise above set point the 1st stage of cooling, first compressor, shall be energized. For 2 stage units the second compressor (or stage) will only be energized upon a further rise above set point and when the first compressor (or stage) has been on longer than 5 minutes, adjustable. On a decrease in demand for cooling the second stage compressor (or stage) shall be cycled off. On a further decrease in space temperature, the first stage compressor shall be cycled off. For units with greater than 2 stages of cooling a similar sequence shall occur for each stage up to full capacity of the unit. Each stage of cooling shall have a minimum off time of approximately 5 minutes (Variable as determined through PID loop control).
5. The space relative humidity (R.H.) sensor shall, through its DDC controller output signal, cause the unit to go into the dehumidification mode only when there is not a sensible cooling demand; and, upon a rise in space R.H. above set point, 60% R.H., adjustable. All units shall have a hot gas reheat coil, energized via a hot gas solenoid valve, which shall be used to reheat the supply air to a nearly neutral temperature only when in the dehumidification mode. Provide R.H. sensors for all units. Should the space temperature drop to below the heating set point, the dehumidification mode shall be de-energized and the gas heat shall be allowed to cycle on as needed to satisfy the heating set point once the compressor is cycled off.
6. The heating temperature set point shall be 70 Deg. F., adjustable. On a drop in space temperature below heating set point, the furnace section shall be energized, in stages, as required, to maintain set point. The cooling system and hot gas reheat shall be de-energized while heating with natural gas. A supply air high limit control feature shall be provided to prevent the supply air temperature from raising above 90 Deg.F. by overriding and de-energizing the heat as required. The heat, when a demand for heat remains, shall shut-off for a minimum of three (3) minutes, adjustable, and be energized when the supply air temperature drops (fan runs continuously) below 80 Deg.F., adjustable. For 2-stage or greater heating units, the furnace heating sections will stage on as required to meet demand in a stable fashion.

7. When the outdoor air temperature is below 60 Deg. F., adjustable, the economizer dampers shall modulate, in sequence, as required, to satisfy the space temperature sensor's cooling set point. If the economizer cannot satisfy the space temperature set point (100% open) then energize the cooling system of compressor(s), as required. No enthalpy or return air comparison economizers allowed. Should the space relative humidity rise to 60% RH, adjustable, while in the economizer mode inversely reset the outside air dry bulb set point downward until the relative humidity drops to below 60% R.H. (use a 4% R.H. differential). Carbon dioxide sensor control shall be disabled when the unit is in the economizer mode.
 8. An evaporator fan differential pressure switch will be interlocked through the DDC system in such a manner that anytime the unit fan is de-energized the gas fired heat and cooling compressors will also be de-energized unless operated for a heat purge sequence upon furnace shutdown after which time the furnace will shut down.
 9. Space temperature sensors will also be used to operate the units in the unoccupied modes of operation.
 10. During the optimized start morning "warm-up" mode (winter), the air unit fan motor will be cycled on and the unit furnace will be energized, as required, to bring space temperature to the normal heating set point. During this mode the minimum outdoor air damper will be closed. When the space reaches warm-up set point, one (1) Deg.F. below the heating set point, the unit will then be allowed to operate in the "occupied" mode at which time the outdoor air damper will be allowed to open to minimum position, or be controlled by a carbon dioxide sensor as indicated elsewhere herein, and the system will be controlled as described above. Warm-up shall occur not more than once each day. The discharge air temperature high limit control sequence shall remain in control during the morning warm-up mode.
 11. During the optimized start morning cool-down (summer) mode, the air unit fan motor will be cycled on and the unit cooling system will operate at the capacity as required to bring the space temperature to the normal cooling set point. During this mode, the outdoor air damper will be closed. When the space reaches cool-down set point, one (1) Deg.F. higher than the cooling set point, the unit will operate in the occupied mode at which time the outdoor air damper will be allowed to open to its minimum position, or be controlled by a carbon dioxide sensor, as indicated elsewhere herein, and the space temperature sensor will control as described above. Cool-down shall occur not more than once each day.
 12. During the night set-forward and night set-back modes the equipment will be cycled as required to maintain those set points; on at 80 Deg.F. and off at 76 Deg. F., adjustable, for set-forward and on at 55 Deg.F. and off at 60 Deg.F., adjustable, for night set-back. The outdoor air dampers shall be closed in both of these modes. The discharge air temperature high limit control sequence shall remain in control during the night set-back mode.
- B. Rooftop A/C units shall be furnished with factory assembled modulating economizers with digital controller which shall be interfaced in such a manner as to:
1. Allow the mechanical cooling system to be locked out and economizers to be enabled and disabled as hereinafter described. However, should the economizer be

- unable to maintain the cooling set point, the mechanical cooling system shall be energized as needed.
2. Digital controller shall be interfaced in such a manner that when the A/C unit is in the economizer mode of operation it shall be controlled so it opens the outdoor air, above minimum setting, where applicable, only on a cooling demand by the space temperature sensor.
 3. Instrumentation and Control system provider shall furnish and install all necessary signal conditioners, relays, etc. to perform the economizer interface as described herein. Coordinate these requirements with each specified equipment manufacturer.
 4. Provide for a discharge air temperature control, which shall prevent the discharge air temperature from dropping below 53 Deg. F., adjustable, when the unit is operated in the economizer mode. Override the economizer dampers as needed to achieve this low limit condition. Coordinate this provision with each specified equipment manufacturer.
- C. Provide a wall mounted carbon dioxide sensor which shall modulate, via an analog signal to the rooftop unit, the return and outside air dampers, in sequence, to maintain a maximum level of 1000 Parts Per Million (PPM), adjustable for following units:
1. Gymnasium units – RTU- GYM-NE, GYM-NW, GYM-SE, and GYM-NW.
 2. Cafetorium units - RTU-CAFÉ-SW, CAFÉ-SE, CAFÉ-NE, and CAFÉ-NW
 3. Library – RTU-LIB-N, E and W.
- Outside air dampers of multiple units shall modulate together when they are energized. The return damper shall modulate from its fully open position to the corresponding sequenced position with the outside air damper, which shall go from its fully closed position up to its maximum-minimum value scheduled. The return air damper shall have a software safety interlock that will not allow it to go past 50% closed during mechanical cooling. Carbon dioxide sensor control shall be locked out when the unit enables the economizer cycle.
- D. Should the space temperature drop to 1 Deg.F., adjustable, below heating set point while the RTU is operating in the dehumidification mode, the unit shall go into alarm and revert to fan and compressor or furnace cycling (on-off) to meet space temperature (sensible load only) requirements until reset.
- E. For multiple units serving a common space, units shall stage on to maintain space temperature for portion of space served.
- F. Cafeteria roof top units, and Kitchen rooftop units shall be interlocked with existing grease hood and Dishwasher hood exhaust fans in the following manner:
1. If any fan is energized and Kitchen unit (RTU-KITCHEN) and Cafeteria units are not currently energized, Kitchen Unit shall be energized.
 2. When any fan is energized, kitchen unit outside air dampers shall modulate to the minimum-maximum position. If EF-DW is energized then no additional units shall

- be energized. If KEF-KITCHEN is energized, then additional Roof-Top Units shall be energized as noted below.
3. When KEF-KITCHEN is energized, the make-up air fan, SF-KIT shall be energized and continue to run until KEF-KITCHEN is de-energized.
 4. When two fans are energized or KEF-KITCHEN is energized, the Four Cafeteria Units will be energized and their outside air dampers shall modulate to the minimum-maximum position. When this occurs, this shall override the carbon dioxide sequence control for that unit(s). This will not override the economizer control sequence.
 5. When the Kitchen fans are de-energized, the Kitchen unit shall modulate the outside air damper to the minimum-minimum position and the Cafeteria units shall return to normal operation.
- G. Provide a condensate overflow moisture sensor/float in upper portion of drain pan that shall alarm the EMS and have a unit interlock shutdown when actuated. All new units shall be provided with this.
- H. Provide a carbon monoxide sensor in each classroom mounted to the ceiling which shall alarm the “EMS and have a unit interlock to shutdown when over 70 PPM of carbon monoxide is sensed.
- I. Unit safety circuit shall consist of fire alarm system interlock for all units over 2,000 CFM, overflow alarm in condensate drain pan, and carbon dioxide alarm (for classroom units).
- J. Two temperature sensors shall be provided for the following units:

UNIT DESIGNATION	PRIMARY SENSOR LOCATION	SECONDARY SENSOR LOCATION
RTU-C103	Principal C103	Reception C102
RTU-72D	Office 72A	Office 72F
RTU-69	Workroom 69	Lounge 68

The primary sensor shall control heating and cooling set point, unless the space temperature in secondary space is greater/less than 2.5 Deg.F., difference from set point. When this occurs, the secondary sensor shall control the heating set point until such time as it is within 1 Deg.F. of space set point. Once this temperature is reached, the primary space temperature sensor shall return to being the control sensor for the unit.

- K. For units less than 3 tons in capacity, they shall cycle to maintain space temperature and are NOT equipped with humidity control. Units that do not have hot-gas re-heat coils, shall cycle to maintain space temperature such that when space temperature is reached the unit shall shut-off for a minimum of 5 minutes, adj., prior to re-energizing.

3.2 SEQUENCE OF OPERATION - EXHAUST AIR FANS

- A. Where fans are designated to be thermostatically controlled, on a rise in space temperature above 78 Deg.F., the respective fan controlled shall be energized. When a fan is energized, the respective make-up air dampers, where indicated on the Drawings, shall be opened. On a fall in temperature to 75 Deg.F., the fan shall stop, and interlocked dampers shall be closed. Where fans are to be interlocked with heaters serving the same space, coordinate the furnishing of combination heating-cooling thermostats (individual thermostats for the fan and heater not allowed) such that heating and cooling cannot occur simultaneously.
- B. Install fan speed control switches at a convenient location on direct drive fans on the load side of the disconnect. Refer to equipment schedules on the Drawings for direct drive fan designation. Fan speed controllers are furnished with the fans as specified under other Sections of these Specifications.
- C. Other exhaust fans shall be interlocked, be provided with locally manually controlled motor rated toggle switches with pilot lights where manual switches are scheduled and where specified in other sections of these specifications.
- D. EMS controlled fans shall run continuously during normal occupied mode and be de-energized during all other modes of operation.
- E. Kitchen dishwasher machine exhaust fans shall be interlocked to immediately be energized when the dishwasher is started. Include the addition of a time delay relay in the control circuit such that the exhaust fan will continue to run for five (5) minutes, adjustable, after the dishwasher machine is de-energized (interlock through booster heater control panel).
- F. Interlock kitchen grease hood exhaust and makeup air supply fans, with respective fire suppression system of hood served to shutdown fans during discharge of suppression agent as required by local Code. Generally the make-up air fans or make-up air unit are turned off and the exhaust continues to run. Provide fan interlocks to operate exhaust and make-up air fans or unit when switched "on" and "off" at the respective hood served. Switches are furnished with the hoods as specified in other Sections of these Specifications. Additionally, provide for the interlock with the grease exhaust hood manufacturer furnished exhaust air thermostat which shall energize the hood exhaust air system upon a rise in temperature above its set point.
- G. Dry Storage exhaust fan shall be energized based on a rise in space temperature over 78 Deg F, adjustable, during cooling mode only. Dry storage fall shall also be energized based on a wall switch. The space temperature sensor and wall switch shall be wired in parallel such that either shall be able to energize the fan.

- H. For the Kiln Room the exhaust fan system shall be interlocked to energize the RTU that serves this room should the space temperature rise to above 80 Deg.F., adjustable. Alarm the front-end monitoring system and “page” the designated maintenance personnel should this space temperature ever rise to above 90 Deg.F.
- I. Provide firestats for each make-up fan, over 600 CFM and under 2000 CFM capacity, set at 125 Deg.F. (adjustable), automatic reset type, to de-energize fans on a rise above setpoint.

3.3 SEQUENCE OF OPERATION - NIGHT SET-BACK

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

3.4 SEQUENCE OF OPERATION - MORNING WARM-UP MODE

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

3.5 ELECTRICAL INTERLOCKS

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

3.6 TEST, ADJUST, AND BALANCE SUPPLEMENTARY PROVISIONS

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

3.7 DDC CONTROL

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

END OF SECTION

SECTION 23 21 13**HYDRONIC PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SYSTEM DESCRIPTION

- A. Furnish and install all piping of every kind required, specified, or shown on the Drawings for the installation of the work specified in Division 23. The location, direction, and size of the various lines are indicated on the Drawings. Lines for pilot and controls and instrumentation are not shown but shall be installed as required and as specified.
- B. Piping systems shall include all appurtenances shown on the drawings and specified herein.
- C. The work shall include the furnishing and installing of all supporting structures and members for pipes, ducts, and equipment.
- D. Support devices and members shall include vibration and noise isolating devices and assemblies. Penetrations of walls to structure shall be sealed off to limit noise transmission through sleeves.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Product Data: Submit complete manufacturer's descriptive literature and installation instructions in accordance with Division 1 for all piping materials to be used for each system, valves and hydronic specialties as specified herein.

B. Shop Drawings:

1. Submit in accordance with Section 01 30 00 and Section 23 05 00.
2. Submit 1/4" = 1'-0" Scale HVAC and Plumbing Piping Shop Drawings.
3. Overlay piping Shop Drawings over other Shop Drawings of other trades to include electrical and sheet metal Shop Drawings.
4. Plan views of congested areas and sections thereof shall be drawn at a scale of 3/8" = 1'-0".
5. A "Release of Liability" form must be signed after which a file exchange site link will be provided.

- C. Fully coordinate all piping shop drawings with sheet metal shop drawings and other trades. Failure to submit shop drawings in a timely manner, as required to keep pace with the construction and work of all other trades, will result in delays, and possible stoppage, of payment to the Contractor. Additionally, no work may proceed until such shop drawings are submitted, reviewed, and found to be acceptable by the Engineer.

1.5 PRODUCT HANDLING

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

PART 2 - PRODUCTS**2.1 PIPING MATERIALS**

- A. In general, the following listed materials shall be used in fabricating the piping systems. Where special classes of piping are involved and are not listed, the Contractor shall request instructions as to the class of material involved and the method of fabricating it before ordering the materials. Steel pipe 2-1/2" and larger shall generally have plain ends to be assembled by welding and pipe 2" and smaller shall generally have screwed ends, except where special requirements dictate otherwise.
 1. Condensate drains from cooling coils: Type "M" or DWV (1-1/4" and larger) hard drawn copper.

2. Condensate drain lines with Pro-Press type fittings: Type "L" hard drawn copper tubing.
 3. Refrigerant Piping: Type "ACR" hard drawn copper with 156 Silfos solder joints. Refer to specification Section 23 23 10, "Refrigerant Piping".
- B. Condensate piping on roof for extended runs: Schedule 40 PVC up to roof penetration. Apply two (2) coats of NOMACO K-Flex R-374, or Foster 30-64, or approved equal, protective coating (ultra-violet rays), white in color. Steel pipe shall be made and tested in accordance with the latest edition of the "Standard Specifications for Welded Steel Pipe" of the National Tube Company, or Youngstown Sheet and Tube Company. Piping 2" and smaller shall be manufactured by LeClede, Sawhill, or Wheatland. Piping 2-1/2" and larger shall be manufactured by Tex-Tube, Paragon, U.S. Steel, or Armco. Unless otherwise specified, all pipe shall be Schedule 40 of ASA Standard B36.10.
- C. In general, fittings used for the various piping systems shall be as listed below. Special fittings shall be used where required by job conditions and when approved for particular use.
1. Welding Fittings: All fittings in welded lines shall be factory fabricated welding fittings of the same material and the same schedule or weight as the piping system in which installed.
 - a. All elbows, reducers, tees, caps and special fittings shall be standard factory fabricated butt welding fittings, conforming to ANSI B16.9, with the following exceptions: Branch takeoffs from lines 2-1/2" in size and larger and where the size of the takeoff does not exceed two-thirds of the nominal diameter of the mains to which connected may be made with shaped nipples or with Bonney or Grinnell Weldolets or Threadolets as required by the class of fabrication. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
 - b. Welding fittings shall be Weldbend Corporation, Tube Turn, Hackney, or approved equals. Welding and fittings shall have the same bursting pressure as pipe of the same size and schedule. All elbows shall be the long radius type unless noted otherwise.
- D. Screwed Fittings in Steel Lines: 150 lb. black malleable iron banded pattern screwed fittings made by Grinnell Company, Crane Company, or Walworth Company. All screwed fitting elbows shall be the long radius type unless noted otherwise.
- E. Fittings for non-propress copper tubing shall be Chase Sweat Fittings, Nibco, Elkhart, or Mueller Brass Company's "Streamline" type solder fittings. Drainage type fittings shall be used wherever possible in drainage systems only. All solder for copper tubing shall be 95-5, Silfos or Eutectic No. 180F. All piping shall be installed according to the manufacturer's instructions. All joints shall be thoroughly cleaned before connecting.

Silfos solder shall be used on all refrigerant piping. All elbows shall be the long radius type unless noted otherwise.

- F. As an alternate to standard sweat fittings for copper tubing, Pro Press type fittings shall be allowed for all drain or expansion lines as follows:
 - 1. 3" and smaller, wrought copper. Press fittings, or ASME 16.2.2, ASME 15.18 sealing with EPDM sealing element for ½" to 2" and ProPress XL for 2-1/2" to 3.
 - 2. Contractor shall provide Owner at completion of project one (1) complete set (½" to 3") of new actuators and jaws.
- G. Miscellaneous Fittings: Provide all reducers, increasers, adapters, bushings, etc., as required to properly inter-connect the various items, to change sizes, etc. Steel fittings shall be used in steel lines, and copper and red brass fittings shall be used in copper lines.
- H. All piping materials and fittings shall be manufactured in the United States.

2.2 FLANGES

- A. Flanges in welded lines for water systems shall be 150 pound forged steel, welding neck flanges, except where cast iron fittings are used as specified elsewhere in these specifications, and except as otherwise shown.
- B. Flanges in screwed ferrous lines shall be 125 pound cast iron or 150 pound forged steel screwed flanges.
- C. Where ferrous flanges connect to flat faced flanges on valves, items of equipment, etc., the companion flange shall be flush faced and where the flanges on items of equipment are raised face flanges, the companion flanges shall have raised faces.
- D. Flanges in copper lines shall be solder joint type cast brass flanges.
- E. Flange bolts and nuts shall conform to the applicable requirements of the latest edition of the Code for Pressure Piping.
- F. Slip-on welding neck flanges are prohibited.
- G. Flanges shall be Weldbend, Tube Turn, Hackney, or approved equals.

2.3 GASKETS

- A. Install gaskets between flanges of all flanged joints. Where used with brass or bronze flanges or with flat face ferrous flanges, they shall be full face type. For all other flanges they shall be ring gaskets properly cut to fit within the inside edges of the bolts.

- B. Gaskets in water lines shall be Garlock No. 24 Wire Insertion Red Rubber Sheet Packing, 1/16" thick and for any other systems use special materials suitable for the duty as recommended by their manufacturer.

2.4 INSULATING FITTINGS

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

2.5 PIPE HANGERS

- A. Pipe hangers shall be as manufactured by Anvil International, Inc. and be of a type suitable for each use. Approved equals by Mason Industries, Inc., B-Line, Grinnell, and PHD Manufacturing, Inc. will be considered.
- B. For cast-iron pipes up to three inches (3") in size, use Anvil Fig. 104 malleable iron, adjustable, split ring, swivel hanger, or Anvil Fig. 590 steel clevis hanger. For cast iron plumbing piping four inches (4") and larger, use only Anvil Fig. 590 steel clevis hanger.
- C. Where several pipes are routed parallel to each other and at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where rollers are called for elsewhere by these specifications.
- D. For bare copper pipes (uninsulated only) up to and including three inches (3") in size, use Anvil Fig. CT-109 malleable iron, copper plated, split ring, hangers or Anvil Fig. CT-65 copper plated clevis hangers. For uninsulated copper pipes larger than three inches (3"), use Anvil Fig. CT-65 copper-plated clevis hanger.

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

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

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

Pipe up to, and including 1-1/4"	8 feet
Pipe 1-1/2" and 2"	10 feet
Pipe 2-1/2" and 3"	12 feet
Pipe 3-1/2" and 4"	14 feet

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

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

- H. There shall be a hanger within two feet (2') of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps. Vertical pipes within a space shall have not less than two (2) supports. Where the vertical run of pipe in a space exceeds 14 feet then three (3) supports shall be required.
- I. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and

firmly anchored. No piping shall be self-supporting; nor shall it be supported from equipment connections.

- J. Inserts shall be used where piping or equipment is to be hung from concrete construction. Inserts shall be Anvil Fig. 281, wedge type, concrete inserts. All inserts shall be pre-treated to prevent rusting. After the forms are removed, clip off all nails flush with the exposed surface of the inserts.
- K. Expansion bolts shall be Ackerman-Johnson.
- L. Beam clamps suitable for the use with the type of steel construction involved shall be an Anvil product or an approved equal as indicated elsewhere herein.
- M. No perforated straps shall be used to support any mechanical equipment item or piping of any kind.
- N. Condensate drain piping hangers shall be sized to go around the insulation with shields being provided to protect the insulation. Shields shall be Anvil Fig. 167.
- O. All steel hangers, base plates, supports, nuts, bolts, and all thread rod located outdoors, in crawl spaces, and exposed to the weather, shall be made of galvanized steel or equally suitable corrosion resistant steel alloy or aluminum. Where steel components are allowed and used under these conditions they shall be painted with an equivalent protective coating similar to a two-part epoxy. Refer to Section 09 90 00.
- P. For pipe sizes 8" and under use Anvil Fig. #93 and 94 beam clamps. For pipe sizes 10" through 18" use Anvil Fig. #66 in the "U" position.

2.6 SLEEVES AND ESCUTCHEONS

- A. Generally where pipes pass through interior building walls or floors above the first floor (out of the ground), 22 gauge galvanized sheet metal sleeves shall be used. Sleeves shall extend a minimum one inch (1") above a floor or beyond the wall, as applicable.
- B. All pipes penetrating grade beams, exterior walls, concrete structural members, or concrete slabs of mechanical equipment rooms on the first floor shall generally use standard weight galvanized steel pipe as the sleeving material.
- C. For concrete or masonry walls, sleeves shall be inserted into the masonry, decking or form work prior to the pouring or placement of concrete or masonry units to create a leave out.
- D. The sizes of all sleeves shall be such as to permit the subsequent insertion of the intended pipe of the proper size with adequate clearance for movement due to expansion and contraction. In the case of insulated lines, the diameter of the sleeves

shall be at least 1/2" greater than the outside walls of the pipe with specified thickness of insulation. This will require that the inside diameter of galvanized steel pipe sleeves be at least 1/2" greater than the outside diameter of the service pipe with insulation. Galvanized steel pipe sleeves set in floors shall project two inches (2") above the floor.

- E. After the pipes are installed, fill the annular space between the pipe, and insulation as required, and its sleeve with an approved mastic or caulk. Use loose fibrous insulation packing as required to accomplish this. In all cases the annular spaces around the pipes within the sleeved openings shall be filled with loose fibrous insulation and then sealed with an approved caulking or expanded foam insulation.
- F. Escutcheons, except as specifically noted or specified, shall be installed on all pipes passing exposed through floors, walls, or ceilings. Escutcheons shall be equal to the Crane No. 10, chrome plated sectional floor and ceiling plates, and shall fit snugly and neatly around pipe or pipe insulation or insulated lines. Solid chrome plates with set screws shall be used if sectional plates do not fit properly or stay in place. Where multiple pipes penetrate floors or walls in close proximity in concealed areas, shop made sheet metal escutcheons may be used.
- G. Pipes sleeved through grade beams open to basements, crawl spaces or void spaces below grade shall additionally receive "Link Seal" or equal closures made of interlocking synthetic rubber links. Seals shall provide for absolute water tightness. Seal shall be constructed to insulate electrically pipe from wall. Install as recommended by manufacturer. Provide Century-Line sleeves with water stop and anchor collar for pipes penetrating grade beams designated to be anchored.
- H. Where PVC pipes, 3 inches and smaller, and small copper water piping under 2 inches in size, penetrated a horizontal floor slab a metal sleeve will not be required. For these piping systems, completely wrap the piping with a polyethylene tape, or wrapping. This tape shall be minimum 4 mils thick and shall be wrapped at least two times around the pipe and secured sufficiently to hold the wrap in place during the pouring of the slab. This wrap shall be in sufficient length or height to insure that no concrete will be in contact with the pipe. All other piping shall be sleeved as indicated elsewhere herein.
- I. Refer to Section 23 05 00 for additional requirements of penetrations through fire-rated assemblies.

2.7 ACCESS DOORS

- A. Wherever access is required above inaccessible ceilings, in walls, furrings, chases or soffits to physically reach concealed piping, ductwork, fire/smoke dampers or mechanical equipment installed under Division 23, provide access doors of sufficient

size to maintain, repair, replace or suitably access devices intended to be adjusted as indicated herein.

- B. Provide an access door or panel for each of any valves, group of valves, damper pull rods, splitter dampers, manual volume dampers, actuators or other controlling mechanism installed under Division 23 which would otherwise be concealed in the building construction with no access.
- C. All access doors in toilet rooms, locker rooms, showers, or other similar wet areas shall be the flush mounted type and be made of brush or satin finish stainless steel as manufactured by Milcor.
- D. All access doors shall be minimum 12" x 12" in size unless otherwise approved in writing in advance by the Engineer. Doors shall be increased in size as required to allow for a person to reasonably access, adjust, maintain, service, inspect or replace the largest single component concealed. Provide special sizes of access doors as required.
- E. Coordinate the final location of all concealed equipment and devices requiring access with the final location of the required access panels or doors. Allow ample space for the removal of all parts and equipment that require replacement or servicing.
- F. Where mounting heights are not detailed or dimensioned, install mechanical piping and overhead equipment to provide the maximum headroom possible while maintaining reasonable access and service to those items being accessed.
- G. Extend all equipment grease fittings to an accessible location which shall be within reach (maximum of 18") from the access door.
- H. Install all access doors in locations to suit the intended purpose but have each location reviewed and approved by the Architect. In no case shall access doors be located such that the intended purpose is rendered useless.
- I. Access doors shall all have spring concealed hinges, screwdriver operated cam latches, be the flush mounted type, open up to, but not more than, 175 degrees, be made of steel, or stainless steel to suit the application, be fire rated (U.L. rated) to match the rating of the surface where the door is placed, and have a powder coated electrostatic primer paint on all steel doors. Furnish the following access door types as described below:
 - 1. Milcor Style DW - Flush drywall type with frame made of 16 gauge steel, panel door made of 14 gauge steel, galvanized steel drywall bead on frame, and removable hinge pins for removal of panel door. Provide minimum of two hinges (12" x 12" and larger) up to 24" x 24" in size and three hinges on access doors above this size. Provide one cam for access doors 14" x 14" and smaller and a minimum of three cams on larger sizes.

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

PART 3 - EXECUTION

3.1 PIPING - GENERAL

- A. Where special classes of piping are involved and are not listed, the Contractor shall request instructions from the Owner's Representative as to the class of material involved and the method of fabricating it before ordering any material. All steel lines 2-1/2" and larger shall be assembled by welding. All steel lines 2" and smaller may be assembled either by welding or by screwed fittings as specified.
- B. Welding shall be done by mechanics who satisfy qualification requirements of the American Welding Society. The pipe ends to be welded shall be machine beveled wherever possible. Gas cuts shall be true and free from all burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no metal shall project within the pipe. Fully ream, to the full inside pipe diameter dimensions, the inside of all piping to be welded. Miter joints will not be allowed in any case. All headers, connections, elbows, reducers, flanges, and special flanges and special fittings shall be made using forged steel welding fittings of the same weight as the pipe to which they are attached. All unions and connections to valves 2-1/2" and larger shall be made by the use of welded flanges.
- C. Branches in lines where the branch side is equal to 2/3 of the size of the main or smaller may be connected by using Weldolets or Thredolets; where the sizes are greater than 2/3 of the main, standard weight seamless tees as manufactured by Tube-Turns or Grinnell, A.S.T.M. Standard A-234 shall be used.
- D. The location, direction, and size of all lines are generally indicated on the drawings. Branch connections in general are indicated and shall be so installed as to provide proper grades.

- E. All lines shall be made up straight and true at proper grades. All water filled and condensate drain lines shall grade down to drains.
- F. Piping shall follow as closely as possible the routes shown on the plans and take into consideration conditions to be met at the site. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
- G. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which the lines are connected.
- H. All headers shall be assembled as indicated using welding fittings throughout.
- I. All screw joints shall be made with taper threads, properly cut. Joints shall be made tight with graphite and oil applied to the pipe threads only and not to the fittings.
- J. Dielectric couplings shall be installed where ferrous pipe joins copper lines and shall be rated for the intended medium pressure and temperature or service.
- K. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of systems. No unions will be required in welded lines or lines assembled with solder joint fittings except at equipment items or coils, machinery items and other special pieces of apparatus. Unions in 2" and smaller lines shall be ground joint and unions 2-1/2" and larger shall be flanged unions. Unions shall be the same material and strength as other fittings in the lines. Companion flanges on lines at various items of equipment, machines, and pieces of apparatus shall serve as unions to permit removal of the particular item.
- L. All piping shall be supported by hangers independently of equipment connections. The weight of the piping and it's contents shall not be imposed on the equipment in any way.
- M. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
- N. Swing joints or expansion loops shall be provided wherever shown on the Drawings or wherever else necessary to allow for the expansion and contraction of piping. This shall be accomplished in an approved manner and this Contractor shall be responsible for any damage which may occur as a result of expansion and contraction of his piping.
- O. Nipples shall be of the same size and material as the piping in the system in which the nipples are installed, except that "close", or "all thread" nipples shall not be used.
- P. Keep all open ends of piping in each system plugged or capped to prevent dirt or other debris from entering the pipe at any and all times during construction and before

fixtures or equipment is connected. All piping shall be flushed clear prior to connection to the central building systems.

- Q. The ends of all piping furnished and installed in all systems shall be thoroughly reamed to the full inside diameter of the respective pipe.
- R. Exposed and concealed lines shall be run parallel with, and perpendicular to building lines and wherever possible shall be grouped together for easy service and identification. Whenever possible, horizontal and vertical runs shall be held as close as possible to the walls, ceilings, struts, members, etc., so as to occupy the minimum space consistent with the proper installation requirements for insulation, conduit, ductwork, lighting fixtures, etc., and the expansion requirements of each of these items and the building proper or the removal of the respective or adjacent pipes, conduits, and ductwork, and to allow for necessary access to valves, other pipes, conduits, dampers, etc.

3.2 CROSS CONNECTION AND INTERCONNECTIONS

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

3.3 FLASHINGS

- A. Flash around all pipes passing through the roof with sheet lead, built a minimum of 10" into the roofing, in all directions from the outside of the pipe running up the pipe a minimum of 10" and more where vent terminals must be higher to conform to the requirements of the local Plumbing Code in effect, and then turned over one inch (1") into the pipe cavity. All seams and joints shall be completely soldered closed and the entire flashing shall be completely waterproof.
- B. Make all roof penetrations in accordance with the roofing system manufacturers approved methods.

3.4 PIPE INSULATION INSERTS AND SHIELDS

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

- B. Refer to Section 23 07 00, Insulation.

3.5 SAFETY GUARDS

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

3.6 TESTING AND REPAIRING

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

- H. Additional testing shall be as specified in the individual Sections of these Specifications.
- I. During testing and cleaning of piping systems, use a fine mesh, 20 mesh or smaller, start-up strainer screen for all strainer pipe sizes. After piping system is cleaned each strainer shall be taken apart, cleaned, and final strainer mesh shall be placed back in strainer for normal operating conditions.

3.7 SEALING PENETRATIONS

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

3.8 PAINTING

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

END OF SECTION

SECTION 23 30 00**HVAC AIR DISTRIBUTION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SYSTEM DESCRIPTION

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

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the quality as specified herein. All work shall comply with the most recent Local Building Code, Mechanical Code, Fire Code, and all other applicable National, State and Local Codes or ordinances.
- B. All equipment and materials shall be installed in a workmanlike manner by trained and experienced sheet metal technicians and mechanics as recommended by the manufacturers of the products installed.
- C. Where the standards and requirements of this specification exceed those of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) the requirements herein shall govern. As a minimum all ductwork shall be constructed to meet all functional criteria defined in Section 11 of the 2005 SMACNA "HVAC Duct Construction Standards, Metal and Flexible," Third Edition. However, all ductwork shall comply with all code requirements noted above to include meeting deflection limits established in the local Mechanical code.

- D. The work shall be guaranteed for a period of one (1) year from and after the date of acceptance of the job, "Substantial Completion", against noise, chatter, whistling, or vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall either be removed and replaced or reinforced as directed by the Owner's Representative.
- E. Air quantities shown on the Drawings, or specified, are based on air at 75 Deg.F. dry bulb, 50 percent relative humidity, and 29.92 inches H.G. barometric pressure.
- F. Except where specified otherwise, all sheet metal used shall be constructed from prime galvanized steel sheets or coils up to 60 inches in width. Each sheet shall be stenciled with manufacturer's name and gauge. Coils of sheet steel shall be stenciled throughout on 10 foot centers (fabricate with stencils to the outside of the ductwork so they are visible when installed) with manufacturer's name and gauge tolerances in inches:

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

- G. Contractor shall comply with this specification section in its entirety. If during a field observation, the engineer of record finds changes have been made without prior written approval, the contractor shall make the applicable changes to comply with this specification at the contractor's expense.
- H. At the discretion of the Engineer of Record, sheet metal gauges and reinforcing may be randomly checked to verify all duct construction is in compliance with this is specification section.
- I. All ductwork and fittings shall have a computer generated label affixed to each section detailing all applicable information including the duct dimensions, gage, reinforcement type/class, and connector type of the systems manufacturer. In addition, galvanizing thickness and country of origin shall be clearly stenciled on each duct section.

1.4 SUBMITTALS

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

include all costs, in revising any portion of the sheet metal work that is deemed unacceptable by the Owner's Representative to include any conflicts discovered in installation that could have been resolved through the Shop Drawing process.

1.5 GUARANTEE

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

1.6 PRODUCT HANDLING

- A. Cover and protect material in transit and at site. Material not properly protected and stored, which has been damaged or defaced, or which has gotten wet during storage or construction shall be rejected.
- B. Prior to ductwork being installed the roof system, or floor above the ductwork, must be sufficiently installed to protect ductwork from rain water entering ductwork. All openings in the ductwork shall be covered with minimum three (3) MIL thick plastic during construction. All open ends shall be covered in plastic at the end of each construction day. Whenever the system is operated with the ducts open the open ends must be covered with a pleated media fabric fastened to the open end (use MERV11 for these filters and only remove the filters to make final tie-ins).
- C. Storage and protection of materials shall be in accordance with Section 23 05 00.

PART 2 - PRODUCTS

2.1 DUCTWORK

- A. General:
 - 1. All ductwork shown on the Drawings, specified or required for the heating, ventilating, and air conditioning systems, shall be constructed and erected in a first-class workmanlike manner by trained and skilled sheet metal workers.
 - 2. All ducts shall be erected in the general locations shown on the Drawings, but must conform to all structural and finish conditions of the building. Before fabricating any ductwork, Contractor shall check the physical conditions of the job site, and shall make all necessary changes in cross sections, offsets, etc., whether they are specifically indicated or not.

3. Before starting shop drawings or fabrication of any ductwork, the Contractor must have an approved reflected ceiling plan with which he can coordinate location of air outlets, lights, tile patterns, etc.
4. The sizes of ducts indicated on the Drawings are the required net internal air stream dimensions, and where ducts are lined, the sheet metal sizes shall be increased three inches (3") in both dimensions to accommodate the linings (1-1/2" thick lining, unless indicated otherwise). Assume all rectangular ducts are lined (one inch (1") thick) unless noted otherwise.
5. Ductwork shall be classified, for construction standards, as follows:
 - a. All exhaust ductwork, except grease or other special exhaust systems specified elsewhere herein, all constant volume ductwork (supply, return relief and outside air) served by packaged roof mounted heat pumps, and all transfer air ducts shall be constructed to meet one inch (1") W.G. standards.
6. Except as noted otherwise, ducts, plenums, and casings shall be constructed of new lock forming quality galvanized prime grade steel sheets. The gauges of metal to be used, duct construction details, and the construction and bracing of joints shall be in accordance with the latest edition of the published standards of the ASHRAE Handbook or in accordance with the latest editions of Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) "Duct Construction Standards Manual, Metal and Flexible".
7. Plenum chambers shall be constructed of 18 gauge sheets thoroughly braced with 1-1/2 inch angle irons. All duct panels in rectangular galvanized steel ducts which are 12 inches and wider and which are not lined shall be crossbroken.
8. Make square elbows where shown or required, with factory fabricated double thickness turning vanes. Job fabricated vanes will not be acceptable. Except as otherwise specified or indicated on the drawings, make all other changes in direction with rounded elbows having a centerline radius equal to 1-1/2 times the width of the duct in the plane of the bend.
9. Make transformations in duct shape or dimension with gradual slopes on all sides. Normally, make increases in dimension in the direction of air flow, with a maximum slope of one inch (1") in seven inches (7") on any side. Where conditions prevent the normal slope specified above, a maximum slope of one inch (1") in four inches (4") will be allowed only where conditions necessitate.
10. Where a transition must be made with less slope than that noted above, install single thickness guide vanes to insure proper air flow, and to minimize air pressure drop. Transitions that require less slope than that noted above shall be noted on Shop Drawings, and require review and approval by the Engineer prior to installation.
11. Ducts shall be routed in conjunction with all types of pipes, electrical conduits, ceiling hangers, etc., so as to avoid interferences insofar as possible. When duct penetrations are unavoidable, provide streamline-shaped sleeves around such material penetrations, made airtight at duct surfaces, except that such sleeves are not required at tie rods. When the Contractor believes such penetrations are unavoidable, notify the Owner's Representative for approval prior to commencing with such work. Otherwise all such penetrations are not expected to occur and are

not allowed. Such penetrations will not be allowed for the convenience of, or lack of coordination by, the Contractor. Where obstructions necessitate, are approved by the Owner's Representative, and are of a size exceeding 10% of the total duct area, the duct shall be transformed to maintain the same original duct area.

12. Where each duct passes through a fan room wall, it shall be wrapped with not less than 1/2" thick closed cell neoprene tightly fitted to the outer surface of the duct all around and sealed. In lieu of this method, completely fill the annular space between the duct and penetration by packing with fibrous insulation and seal the perimeter of the penetration around the duct, on both sides of the penetration, with a flexible non-hardening sealant, to be fire rated when applicable.
13. All outlets or grilles in ceilings shall be supported rigidly from ceiling construction with suitable adapters or bucks installed as necessary and as shown to insure outlets and grilles will be accurately trued up with ceiling.
14. Ductwork shall be fabricated in a manner to prevent the seam or joints being cut for the installation of grilles or diffusers.
15. All sheet metal ductwork shall be securely hung from the building construction. All ducts shall be hung adjacent to the seam in the duct and shall be secured in a suitable manner to both the duct and the building construction. All vertical riser ducts shall be supported at each floor with angle iron secured to the ducts and set on the structure members. These angles shall be the same size as specified for bracing.
16. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for any length of time. All panels of uninsulated ducts twelve inches (12") and larger shall be cross broken. In general, sheet metal screws shall not be used in duct construction unless the point of the screw is in the air stream unless specifically indicated otherwise elsewhere herein.
17. Manual dampers shall be installed as shown and as required to afford complete control of the air flow in the various duct systems. In rectangular supply ducts, a splitter damper shall be installed at each point where a branch is taken off and additional volume dampers shall be installed where shown or required to achieve the final air balance. No splitter dampers shall be installed in medium pressure ductwork, unless specifically shown on Drawings.
18. Splitter dampers and volume dampers of the "butterfly" type, installed in rectangular ducts, shall be constructed of 16 gauge galvanized steel riveted or welded to square operating rods. Dampers shall have brass, bronze, or approved plastic bearings. The length of any splitter damper blade shall be 1-1/2 times the width of the smaller split in the duct, but shall be not less than twelve inches (12"). Where splitter dampers exceed 12 inches in height two (2) pull rods shall be used. Splitter dampers 12 inches (12") in height or less shall have one (1) pull rod.
19. Butterfly damper blades in round ducts shall be the full width of the duct in which they are installed. Dampers shall be constructed of a minimum 22 gauge metal. Dampers over twelve inches (12") in diameter shall be constructed of 20 gauge metal, have a continuous rod with end bearings opposite the damper handle, and a quadrant type locking handle.

20. The operating rods of all dampers shall be fitted with Young Regulators and the operating head shall be securely fastened in place so as to be accessible in the finished building unless shown otherwise. Operators shall be attached to duct where regulator occurs above a lay-in ceiling. Use a Ventlock No. 555 locking quadrant on accessible concealed splitter dampers. Where dampers occur above or behind plaster or other inaccessible ceilings, walls, chases or furrings, the regulator shall be the concealed type with adjustable cover plate equal to Young Regulator Company Type 315 with maximum 2-1/2" diameter cover plate and required accessories. Young Regulator bearings shall also be provided on the opposite end of each operating rod.
21. Behind each ceiling supply outlet, provide and install a turning vane or approved equalizing grid, where noted or scheduled. Where adjustable air pick-ups are indicated at points branch ducts meet trunk ducts, they shall be Titus AG-45 or approved equal with operator adjustable from the duct exterior.
22. Rectangular opposed blade volume dampers shall be as manufactured by American Warming and Ventilating or Ruskin. Blades shall not exceed 48 inches in length or twelve inches (12") in width, and shall be the opposed interlocking blade type. The blades shall be of not less than No. 16 gauge steel supported on one-half inch (1/2") diameter rustproofed axles. Axle bearings shall be the self-lubricating ferrule type.

B. Low Pressure Ductwork:

1. Rectangular low pressure ducts, systems designated to be operating at up to two (2) inches W.G., shall be constructed of the following gauges:

Largest Dimension of Duct	U.S. Gauge of Metal	Maximum Reinforcement Spacing
Up to 26"	26	5'-0"
27" to 42"	24	4'-0"
43" to 48"	22	4'-0"
49" to 60"	20	4'-0"
61" to 84"	18	4'-0"
85" to 96"	18	3'-0"
97" and Over	18	2'-6"

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

2. Rectangular low pressure ducts, for systems designated to be operating at up to one (1) inches W.G., shall be constructed of the following gauges:

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

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

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

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

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

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

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

- c. Vertical ducts shall be supported where they pass through the floor line with 1-1/2" X 1-1/2" X 1/4" angles for ducts up to 60". Above 60" the angles must be increased in strength and sized on an individual basis considering space requirements.
6. All low pressure ductwork shall be reinforced to maintain a maximum reinforcement spacing as scheduled with the rigidity classification as needed to meet the specification construction standard. Reinforcement spacing shall be reduced as required to meet the construction standard specified using the gauge thickness scheduled.

C. Round Flexible Insulated Ductwork:

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

2.2 ROUND LOW PRESSURE DUCT TAPS

- A. Provide round low pressure, systems operating at a maximum of two inches (2" inches) water gauge (W.G.) static pressure, duct taps to serve air devices where shown on the drawings and in accordance with details for these taps
- B. Duct taps shall consist of spin-in, or spin on, collar type manufactured fittings specifically made for commercial ductwork systems. Spin-in fittings shall be the conical type as shown and detailed on the drawings to include integral manual balance damper with locking device. Fittings shall be fabricated using continuous weld longitudinal seams. No riveted construction allowed.
- C. All spin-in fittings shall be made with hot dipped, G-60 or G-90, galvanized steel (per ASTM A 653) and be a minimum of 26 gauge in thickness for all sizes from 4" to 12" round. All sizes 14" to 20" round shall be a minimum of 24 gauge in thickness. Thicker gauges shall be provided on larger fittings as required per SMACNA and the Mechanical Code, where required.
- D. Provide plain or beaded ends for connection of duct work as required for the application. Crimped ends are not allowed.
- E. All ductwork systems are called out elsewhere in these specifications to be externally sealed to limit air leakage. These fittings may either be factory sealed (all seams sealed) or be sealed by the contractor in the field.
- F. All spin-in fittings shall also include integral manual balance dampers unless indicated otherwise. Damper options shall be as follows:
 - 1. All manual volume dampers shall be the butterfly type, using a single round damper blade and positive locking regulator damper hardware.
 - 2. Sizes 4"-12" round shall have a reinforced damper axis (not a continuous damper shaft) with 1/4" regulator and spring loaded, retractable bearings.
 - 3. Sizes 14" through 20" round shall have a minimum 3/8" continuous damper rod axis with nylon grommets installed at damper sleeve penetrations
 - 4. Provide dampers, which shall include an extended threaded shaft that aligns with a sheet metal stand-off bracket (spot welded to the fitting) with the stand-off distance to be 2" to clear the thickness of any external duct wrap insulation. Coordinate stand-off dimensions with specified duct insulation thickness (only when thicker than 2"). Damper handle and wing nut to be fastened at the outside of the stand-off bracket.
 - 5. Provide premium optional balance dampers to include a 2" stand-off bracket, spot welded to the fitting, to include a 3/8" square shaft extended to the stand-off bracket, with U-bolt, nylon bushings, locking quadrant and handle.
- G. Acceptable Manufacturers:
 - 1. Flexmaster or equals by,
 - 2. Crown Company Products,
 - 3. Ductmate,
 - 4. Hercules Industries.

2.3 FIRE, SMOKE, AND COMBINATION SMOKE-FIRE DAMPERS

- A. Contractor shall furnish and install fire, smoke, and combination smoke-fire dampers in air passages, openings, and ductwork wherever shown on the Drawings, and as required by the local authorities having jurisdiction. Installations shall be in accordance with all

applicable NFPA standards and the SMACNA Duct Manual. All dampers shall carry the U.L. Label and shall be installed such as to conform to conditions under which the U.L. Label was granted. All dampers shall be constructed and tested in accordance with the latest edition of U.L. Safety Standards 555 or 555S, as applicable. Provide sleeves, typically 12" in length minimum, for all dampers as required for the installation conditions encountered.

- B. Fire dampers shall be constructed in accordance with the recommendations of the NFPA and shall be of metal gauges required by the class of separation in each case.
 - 1. Interlocking curtain blade type fire dampers carrying the Underwriters' Label will be acceptable, except at locations where an operating type damper is required to meet local requirements, to meet sequence of operations indicated in Temperature Control Specifications, Section 23 09 00, or to meet the limited spaces available.
 - 2. Use Style "B" rectangular and style "CR" for round dampers such that blades are out of the air stream.
 - 3. For grille installations at fire rated partitions, use Style "B" thin line fire dampers or Style "G" integral sleeve type for grilles.
- C. Smoke dampers shall be designed for vertical or horizontal applications as encountered in accordance with NFPA 90A and meet the latest requirements of UL 555 S. Smoke dampers shall be installed in, or adjacent to, the smoke barrier; but in no case, more than 24 inches from the smoke barrier. Smoke dampers shall be a Ruskin Model SD35, 36, 37, or SDRS25 as applicable for the application. Frames shall be made of 16 gauge single piece galvanized steel hat shaped channel frames. Blades shall be 6" wide galvanized steel and be the triple V-groove or air foil type. Provide stainless steel jamb seals, silicone edge type blade seals where required for the classification, stainless steel sleeve bearings and linkages concealed in the frame. Leakage Class shall be Class 1, 2, or 3, as required, to meet the requirements specified elsewhere herein. Provide compatible electric actuator on all dampers, factory installed.
- D. Combination fire-smoke dampers shall be Leakage Class 1 dampers with electric, manually resettable, fuse link operated by 120 volt electric actuator furnished with the damper. Fire-smoke dampers shall be Ruskin FSD-60, or equal, with minimum 16 gauge galvanized steel hat channel shaped frames. Fire-smoke dampers shall be increased in size to maintain a minimum of 90 percent free area of the ductwork size indicated on the Drawings thru each fire-smoke damper. Leakage shall be Class 1, 2, or 3, as required, to meet the requirements specified elsewhere herein. Provide compatible electric actuator on all dampers, factory installed.
- E. Insulated all metal access panels, secured with sash locks, shall be installed to service all fire, smoke, and combination smoke-fire dampers. Access panels shall be identified with "FIRE DAMPER", "SMOKE DAMPER", or "SMOKE-FIRE DAMPER" stenciled thereon in a visible or conspicuous location. Removable flexible duct shall not be

permitted as a means of damper access. Access shall be direct and shall not be obstructed by turning vanes or other duct accessories.

F. General Requirements:

1. For ductmate connections at fire, smoke, or combination smoke-fire dampers, do not use screw fasteners.
2. Use four inch (4") draw band connections at round duct fire damper connections.
3. Use blade dampers when the blade width exceeds 12 inches.
4. Install vertical or horizontal mount dampers suitable for the application.
5. Dampers shall be suitable for the maximum air system operating pressures expected to be encountered. Medium pressure ductwork is expected to operate at up to six inches (6") W.G.
6. Use multi-section dampers where damper size openings are larger than single section maximum sizes.
7. Fire, smoke and combination smoke-fire dampers shall be sized to provide for 100 percent of the ductwork size (minimum 95% free area) indicated on the Drawings through each damper.
8. Provide 165 Deg.F. rated fusible links for fire dampers.

G. Acceptable Manufacturers:

1. Ruskin, or approved equals by:
2. Greenheck, or
3. Nailor, or
4. Prefco, or
5. National Controlled Air (N.C.A.), or
6. Air Balance, or
7. Pottoroff.

2.4 FLEXIBLE CONNECTIONS

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

2.5 ACCESS DOORS

- A. Furnish and install hinged, low leakage access doors in ductwork or plenums to provide access to all fire, smoke and combination fire - smoke dampers, mixed air plenums, automatic dampers, coils, filters, and elsewhere as detailed on the Drawings.
- B. Where the ducts are insulated, the access doors shall be double skin doors with a minimum one inch (1") of insulation in the door. The insulation shall have a minimum R-value of 5.0. Increase the thickness of the insulation as needed to comply. Where the access door is installed in non-insulated ductwork the access door shall be unlined sheet metal of the same gauge thickness as the duct.
- C. In no case shall access doors be smaller than eight (8") by eight inches (8"). Access doors shall be sized to permit testing or servicing of duct mounted components, such as, for coil cleaning, installation of control devices, resetting of fusible links, filter replacement, etc., as applicable and suitable for the application.
- D. Where duct access doors are above a suspended, normally non-readily accessible ceiling, such as plaster, gypboard or spline type ceilings, Contractor, under this Section of Specifications, shall be responsible for the proper location, and furnishing of, ceiling access doors, or panels, to make duct access doors easily accessed through the ceiling system. Ceiling access doors, or panels, shall be rated, where applicable, to match the fire rating of the ceiling system penetrated. Ceiling access doors, or panels, shall be installed under other Sections of these Specifications. Ceiling access doors, or panels, shall be centered directly beneath duct access doors or immediately adjacent thereto when duct access is through the side of the duct.
- E. In rectangular grease exhaust ducts, install access doors every twenty feet (20') maximum, center to center, and at all 90 degree elbows, when the total developed length exceeds forty feet (40'). Install access doors at every other floor level for vertical grease exhaust duct risers.
- F. All access doors shall be fully double gasketed, door to frame and frame to duct, and include a sash type or compression latches for sizes under eighteen inches (18") by eighteen inches (18"). Use one (1) sash type latch per twelve inches (12") of height or width. Access doors 18" x 18" and larger shall have quarter turn handle latches; Provide one handle per 24" section, height or width, of door. As an example, provide two (2) handle type latches for a 48" tall access door.
- G. Provide a minimum of two (2) heavy loose pin hinges for each access door unless indicated otherwise herein. Piano style hinges will be an allowed substitute.

- H. Where the installation conditions prohibit suitable access with hinged access doors, then non-hinged access doors may be used in conjunction with a corrosion resistant cable or chain, of suitable length, attached to the access door and duct.
- I. For duct systems constructed to 2 inches W.G standards, or less, provide standard access doors meeting all requirements specified herein, which have a tested air leakage rating of less than 4.0 CFM at a test pressure of 2 inches W.G., and as manufactured by:
 - 1. Ventlok with hinges and No. 90 or No. 99 latches (less than 18" x 18"), or No. 100 or No. 140 latches (18" x 18" and larger), as applicable, or approved equals by:
 - 2. Ductmate, or
 - 3. Duro Dyne DDIAD-0806, or
 - 4. NCA Manufacturing ADH-T-1, or
 - 5. Pottorff HAD or CAD, or
 - 6. Nailor 08SH with HP Seal, or 0890, or
 - 7. Cesco Products HDG, or
 - 8. Ward Sandwich Style Access Doors, DSA or DDA, for round ductwork.

2.6 DUCT LINER

- A. Where indicated on the Drawings or specified herein, all rectangular transfer ducts; except kitchen grease hood, kitchen dishwasher and fume hood exhaust ducts; shall be lined with Fiberglass mat faced duct liner in the thicknesses, type, and locations as indicated elsewhere herein.
- B. Kitchen grease hood exhaust, kitchen dishwasher exhaust, kitchen hood make-up air, and fume hood make-up air and other industrial type exhaust air ducts shall not be lined. Line all other general building exhaust air ducts within 10'-0" on each side of each in-line exhaust fan with one inch (1") thick liner. Roof mounted exhaust fan ductwork shall also be lined, one inch (1") thickness, but only for the first 10'-0" of ductwork from the roof curb toward the occupied space.
- C. All transfer air ducts shall be lined with one inch (1") thick duct liner.
- D. The liner insulation system shall be one and one-half inches (1.5") in thickness on all conditioned air, heated or cooled, as well as outside air intake ducts, and mixed air plenums to obtain a minimum R-value of 6.0 thereon.
- E. All ductwork systems are required to meet the most recent version of the International Energy Conservation Code.
- F. All duct liners shall comply with NFPA 90A and 90B and ASTM C 1071, Type I, for ducts and Type II for plenums (rigid liner). Liner shall consist of flexible, matt faced insulation made of inorganic glass fibers bonded by a thermosetting resin with an encapsulant edge coating, and shall be a rotary style duct liner product with a water

repellant ingredient on the mat face to help keep moisture from penetrating the air stream surface. Other technical requirements shall include:

1. Be suitable for temperatures up to 250 Deg.F. per ASTM C 411.
 2. Be suitable for air velocities up to 6,000 FPM per ASTM C 1071 for Type I products and 5000 FPM for Type II products.
 3. Water vapor sorption shall be less than 3% by weight per ASTM C 1104.
 4. Air stream surface mat facing shall be tested with an EPA registered anti-microbial agent to aid in the prevention of fungal and bacterial growth. Mat face, as treated, shall not support the growth of mold, fungi, or bacteria per ASTM C 1338, ASTM G 21 and ASTM G 22.
 5. Does not exceed a Flame Spread of 25 and Smoke Developed and Fuel Contributed of 50 per ASTM E 84, NFPA 225, and UL 723.
 6. Conductance of 0.24 (R-value of 4.2) for a 1.5 PCF or 2.0 PCF duct liner at a 75 Deg.F. mean temperature per ASTM C177 for a one inch (1") thick product.
 7. Greenguard Compliant (Greenguard Environmental Institute).
 8. Noise Reduction Coefficient (NRC) of 0.70 or higher for a one inch (1") thick product and 0.80 for a two inch (2") thick product per ASTM C 423, type A mounting.
- G. All duct liners shall be able to be cleaned in accordance with the North American Insulation Manufacturers Association (NAIMA) "Cleaning Fibrous Glass Insulated Air Duct Systems Recommended Practices".
- H. Liner shall be applied to the inside of rectangular ducts and plenums with fire-resistant adhesive, Fosters 85-60, or 85-65, or Childers CP-127, Hardcast "Seal-Tack" or Ward "Premium Duct Liner Adhesive", or equal, complying with ASTM C 916, completely coating the clean sheet metal. All joints in the insulation shall be "buttered" and firmly butted tightly to the adjoining liner using fire resistant adhesive. Where a cut is made for duct taps, etc., the "raw" edge shall be accurately and evenly cut and shall be thoroughly coated with this same fire resistant adhesive.
- I. On ducts over twenty-four inches (24") in width or depth, the liner shall further be secured with mechanical fasteners. Fasteners shall be Graham or Gemco weld pins. "Stick Clips", "Sheet Metal Clips", or other fasteners secured to the ducts by adhesive are not allowed. Fasteners shall be placed on a maximum spacing of eighteen inches (18") and shall be pointed up with fire-resistant adhesive. Fasteners shall not compress the insulation more than 1/8".
- J. Liner shall be accurately cut and ends thoroughly coated with adhesive so that when the duct section is installed, the liner shall make a firmly butted and tightly sealed joint. Provide metal nosings securely installed over transversely oriented liner edges facing the air stream at all fan discharges, at access doors, and at any interval of lined duct preceded by unlined duct.

- K. Where rectangular ducts are lined and adjoins externally insulated rectangular ducts, the two insulations shall be overlapped not less than twenty-four inches (24").
- L. Dimensions given on the Drawings are inside air stream, free area, dimensions only and sheet metal sizes shall be increased in size to maintain these free area dimensions when liner is installed.
- M. All exposed ductwork shall be internally lined unless specifically indicated otherwise.
- N. Refer to Section 23 07 00, Insulation, for further related requirements.
- O. Acceptable liner manufacturer shall be:
 - 1. Certainteed, Tough Gard R with enhanced surface.
 - 2. Knauf, Rotary Duct Liner E-M with Hydroshield.
 - 3. Owens Corning, Quiet R Acoustic Duct Liner, Type 150 or equivalent Duct Liner Board.
 - 4. Johns Manville, Linacoustic RC or R-300.

2.7 GRILLES, REGISTERS, AND DIFFUSERS

- A. Grilles, registers, ceiling outlets, diffusers and other air devices shall be as scheduled on the Drawings and shall be suitable for the intended use.
- B. Provide air devices with sponge rubber or soft felt gaskets at flanges where the devices mate up to a ceiling or wall surface.
- C. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level or criteria, face velocity, throw, drop, pressure drop, air diffusion, etc., before the submittal is made. Selections shall meet the manufacturers' own published data for the above performance criteria. The throw shall be such that the terminal velocity will be not more than 50 FPM or less than 25 FPM at the point of penetrating the occupancy zone. The occupancy zone is defined as six feet (6') above the finished floor and six inches (6"), or farther, from the walls.
- D. Noise levels shall not exceed those published in current ASHRAE Standards and Guidelines for the type of space being served (N.C. level) or that scheduled.
- E. Locations of outlets on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be governed by the established pattern of the lighting fixtures, structure and Architectural Reflected Ceiling Plan (RCP). Air devices shall have margins, frames, and sizes to be compatible with the ceiling and wall systems installed. All color and finishes are subject to final approval by the Architect.
- F. Where called for on the schedule, grilles, registers, ceiling outlets, diffusers and other air devices shall be provided with deflecting devices and manual dampers.

- G. Where indicated on the Drawings, provide a fire rated blanket on the back side of steel ceiling mounted air devices (supply, return, exhaust, etc.).
- H. Where indicated on the Drawings, provide an insulation blanket on the back side (all surface area) of ceiling mounted supply air devices to prevent condensation.
- I. All air devices shall be the standard product of the manufacturer, subject to review by the Architect. Acceptable manufacturers are:
 - 1. Titus, or approved equals only by:
 - 2. Krueger.
 - 3. Nailor.
 - 4. Metal-Aire.
 - 5. Carnes.
 - 6. Price Industries.

2.8 LINED SPIRAL DUCT

- A. Lined spiral duct shall be United McGill Acoustic-K27 duct or equivalent. Utilize duct-duct slip joint connector, conical reducing tees, and 5 gore elbows (60 Deg. and 90 Deg.) for offsets and end runs.
- B. Inner duct liner shall be perforated 28 gauge galvanized steel with 1.5" thick 1.0" thick allowed if ductwork is exposed in a conditioned space, 1.5 pound density, fiberglass insulation sandwiched between it and the outer duct. The outer duct shall be spiral seam construction, and be a minimum of 24 gauge galvanized steel.
- C. In lieu of the perforated steel and factory installed insulation liner, an extra heavy density liner, field installed, may be used as an equivalent to the 1.5" thick Johns Manville Spiracoustic Plus. This system shall have a minimum R-value of 5.0 at 75 Deg.F Mean Temperature, with a noise reduction coefficient of 0.80. The airstream surface shall be coated and be suitable for mechanical cleaning.
- D. Externally seal all duct connections, transverse and longitudinal, with a sealant being listed and labeled in accordance the requirements of U.L. 181A or U.L. 181B such as Foster 32-19 duct sealant.

2.9 KITCHEN HOOD EXHAUST DUCTS

- A. The kitchen hood exhaust duct system shall be constructed of 16 gauge carbon steel with liquid tight continuous external welds at all seams and joints in accordance with NFPA 96 and local codes.
- B. The ductwork shall be installed with access doors at every 20 feet on center, as applicable, and at each elbow to facilitate cleaning, as required by code, and as required

to provide access to fire protection devices in the duct. Access doors shall be grease tight construction with suitable hinges and latches.

- C. The duct shall slope 1/4 inch per foot from the discharge point toward the hood.
- D. All changes in direction shall be made with 1-1/2 times the duct width to centerline radius elbows; no turning vanes or mitered fittings will be allowed.
- E. The ductwork shall be enclosed in a fire-rated duct enclosure, refer to Architectural Drawings, from the point of ceiling penetration to the outside air. The duct enclosure shall be sealed around the duct at the point of penetration to the outside air. The duct enclosure shall be sealed around the duct at the point of penetration and vented to the exterior through weather-protected openings.
- F. Make rigid connections to the hood and fans, transitioning as required, for connection at each piece of equipment. Seal duct connections to fan and hood.
- G. Do not internally line grease exhaust ductwork.

2.10 AIR FILTERS

- A. Provide appropriately sized and number of air filters for each piece of individual air handling equipment to include, but not be limited to, the following:
 - 1. Split DX AC Units.
 - 2. Roof-top AC Units.
 - 3. Elsewhere as required to protect air type heat exchangers, such as warm air furnaces, or coil surfaces, such as duct mounted direct expansion coils.
- B. High performance, extended area, 2" or 4" nominal depth, mini-pleated, disposable filters shall be provided where scheduled or as indicated in other Sections of these Specifications. These filters shall have the following characteristics:
 - 1. Filter media shall be assembled in compact secure enclosures.
 - 2. Filter media shall consist of 100% melt-blown, polypropylene joined with fire retardant bonding agents. Polypropylene separators shall be bonded to the media that are designed to maintain pleat configuration and stability. Media shall have a progressive denier of fibers with coarse fibers on the air entering side and finer fibers on the air exiting side.
 - 3. The media pack, or filter frame, shall be completely enclosed and bonded around the perimeter to a high wet-strength "beverage" board enclosing frame. This frame shall include diagonal support members on the air entering and air exiting sides to maintain pleat spacing and to provide adequate support to maintain the filter pack shape under operating conditions.
 - 4. Filters shall be capable of withstanding 10 inches W.G. without distortion of the media pack or filter frame.
 - 5. Sizes shall be standard sizes that are readily available by multiple sources and be as indicated elsewhere herein.

6. These filters shall have an efficiency of 80-85% when tested in accordance with the most recent version of ASHRAE Standard 52.1. The filters shall have a MERV rating of 13 when tested in accordance with the latest version of ASHRAE Standard 52.2. Initial pressure drop of clean filters at 500 FPM shall not exceed 0.45" W.G.
 7. Provide product test data and related details in accordance with ASHRAE Standards 52.1 and 52.2 for each efficiency specified.
 8. Acceptable Manufacturers:
 - a. Camfil Farr, Inc., Model "AP-Thirteen", or approved equals by:
 - b. Environmental Filter Corporation.
 - c. Eco-Air.
- C. Medium efficiency air filters shall generally be one (1") or two inches (2") thick, unless indicated otherwise and shall be the pleated media, disposable type, listed by Underwriters Laboratories as Class 2, with the following features:
1. Air filters shall be rated in accordance with the most recent version of ASHRAE Standards 52.1 and 52.2, test methods as indicated herein, and shall conform to Section 7.4 of ARI Standard 850.
 2. Filter media enclosing frame shall be constructed of rigid, heavy duty, high wet-strength resistant, "beverage" board with diagonal support members on the air entering and air exiting sides. Expanded diamond grid media support, integral with frame, shall be chemically bonded to filter media at each pleat, to insure pleat spacing and stability. Pleated media shall be bonded to the inside of the frame to eliminate air bypass.
 3. Filter media shall be high performance, non-woven, reinforced cotton-poly, synthetic blend fabric formed in a V-shape.
 4. Filters shall have the following performance data:

THICKNESS	SQUARE FEET MEDIA AREA TO ONE SQUARE FOOT FACE AREA	MINIMUM PLEATS PER LINEAL FOOT	INITIAL AIR RESISTANCE (INCHES W.G.)	RESISTAN CE BASED ON AIR FLOW OF
One Inch (1")	2.4	16	0.25 (350 FPM)	1400 CFM
Two Inch (2")	4.3	15	0.28 (500 FPM)	1500 CFM
Four Inch (4")	6.9	11	0.27 (500 FPM)	1500 CFM

5. Filters shall be suitable for operation with varying velocities of up to 500 feet per minute (FPM) for 2" and 4" filters and 350 FPM for 1" filters.
6. Filters shall have a minimum efficiency of 20% for particles in the 0.3 to 1.0 micro range, 65% for particles in the 1.0 to 3.0 range, and 85% for particles in the 3.0 to 10.0 micron range as tested in accordance with ASHRAE Standard 52.1. Filters

shall also have a MERV rating of 11 as tested in accordance with ASHRAE Standard 52.2.

7. Refer to equipment schedules for more specific filter MERV rating requirements.
8. Acceptable Manufacturers:

- a. Camfil Farr, Inc., Model AP-Eleven, or approved equals by:
- b. Environmental Filter Corporation.
- c. Eco-Air.

- D. All filters shall be standard sizes that are readily and locally available, in stock, through multiple over the counter sources without requiring special order. Standard acceptable sizes shall be 16" x 20" and 16" x 25".

2.11 ADHESIVES AND SEALANTS

- A. All adhesives and sealants used on this project must have a Volatile Organic Compound (VOC) content less than that listed in the current South Coast Air Quality Management District (SCAQMD) Rule 1168, and all sealants and fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
- B. All adhesives and sealants shall meet the most current Leadership in Energy and Environmental Design (LEED™) requirements.

2.12 TURNING VANES

- A. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct.
- B. Turning vane front and back panels shall be securely locked together with adequate crimping to prevent twisting of vane. Vanes shall be capable of withstanding 250 pounds of tensile load when secured according to the manufacturer's instructions.
- C. Rails for mounting vanes shall have self locking, friction fit tabs designed to facilitate proper alignment of vanes. Tab spacing shall be as specified in Figure 4-3 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible", Third Edition standard. Rail systems with non-compliant tab spacing shall not be accepted.
- D. Acoustical Turning Vanes shall be used in applications that require quiet operating systems. Mounting rails shall have friction insert tabs that align the vanes automatically. These shall only be required where designated on the Drawings.
- E. Approved Manufacturers:
 1. Ductmate Industries PRO-Rail Turning Vane or approved equals.

2.13 FIBERGLASS DUCTBOARD

- A. Fiberglass duct board of any type is not allowed on this project without exception.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all ductwork and equipment as indicated on the Drawings in full accordance with these specifications including foundations, hangers, supports, etc.
- B. Seal all ductwork as specified, pressure test and repair leaks.
- C. Should defects or installation deficiencies become apparent, or are observed, after the systems have been in operation, the deficient components shall be removed and replaced or reinforced as directed by the Owner's Representative.

3.2 CLEANING OF DUCT SYSTEMS

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

3.3 AUTOMATIC CONTROL DAMPERS

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

3.4 FILTERS

- A. No air moving equipment may be operated at any time without filters being fully installed in equipment.
- B. Provide a minimum of three (3) spare sets of two inch (2") thick, medium efficiency, pleated media filters for all air handling and fan coil units, as well as for filter return air grilles where scheduled, in addition to manufacturer furnished filters specified elsewhere herein. Where other sections of these specifications require one inch (1") or four inch (4") thick filters, or other types of filters, provide spare sets of matching thickness and type.
- C. Additionally replace filters during construction as directed by the Owner's Representative.

- D. Install one (1) new complete set of filters, as directed by the Test and Balance (TAB) Firm, just prior to performance of TAB work.
- E. Install one (1) new set of filters at "Substantial Completion" of the project.
- F. Where the minimum number of filter sets are not used for the aforementioned purposes, provide the left over filters to the Owner for maintenance stock.
- G. Document, in writing, when each filter change-out occurs.

3.5 STATIC PRESSURE DUCT TESTING - LOW PRESSURE SYSTEMS

- A. All designated low pressure duct systems (ERV exhaust and outdoor duct work shall be pressure tested by the Contractor, witnessed by the Testing, Adjusting, and Balancing (TAB) firm, according to the most current version of the SMACNA HVAC Air Duct Leakage Test Manual test procedures.
- B. Design pressure for testing low pressure duct work shall be two inches (2") of water gauge, unless indicated otherwise herein. All pressure tests shall be conducted under a positive pressure, even for systems intended to operate at negative air pressures such as exhaust systems.
- C. Test duct work from fan connection up to and including the hard sheet metal tap just prior to the final connection at each air device. Test in sections as required based on the Leakage Test Kit utilized. Use a United McGill Corporation LTK-S (small) or LTK-L (large) Leakage Test Kit with accessories as required to perform the test. This shall include a calibrated orifice tube with certified calibration chart, fan, and two U-tube manometers with connecting tubing.
- D. Tests shall be performed as soon as possible after the first section of duct work to be tested is installed to evaluate the quality of the installation early in the process to allow corrective actions to be taken before the entire installation is completed.
- E. Cap all open ends of duct systems to be tested for testing purposes. Make temporary openings for test equipment as required. Patch these to match new installation conditions when tests are complete and accepted per criteria stated herein. Generally, follow United McGill's procedures as published in their document titled "System Pressure Testing for Leaks", or the SMACNA Manual referred to herein.
- F. All ducts shall have been sealed as specified, during installation, and shall be sealed as a Seal Class "A" per SMACNA.
- G. Leaks that whistle or are excessive, as determined by the Owner's Representative, shall be repaired and the test repeated until such are eliminated.

- H. Maximum leakage rate of each system shall not exceed 5% of the design operating air volume; or, whichever is most restrictive, be equal to 6.0, or less, in accordance with the following equation (from International Energy Conservation Code, 2009);

$$\text{Leakage Rate} \leq 6.0 = R \times P^{0.65}$$

F = Measured Leakage Rate in CFM per 100 square feet of duct surface

P = Test Static Pressure, In W.G.

- I. Provide duct leakage test report summary for submission and review by the Owner's Representative. At least one test, preferably the first to occur, shall be witnessed by the Testing, Adjusting, and Balancing (TAB) Agent. Test Report Summaries shall include the following:
1. Cut sheets on test equipment used along with calibration sheet for orifice tubes used.
 2. Drawing or diagram depicting portion of duct system tested. Indicate square footage of duct work in test section.
 3. Indicate test pressure used in test, versus, construction class of duct installed.
 4. Note allowed leakage in CFM for test section.
 5. Indicate actual leakage recorded during the test.
- J. All tests shall be repeated until the sections tested all pass the test per the criteria stated herein.

3.6 KITCHEN HOOD EXHAUST DUCTS

- A. Prior to the concealment of any portion of the grease duct system, an air leakage test shall be performed as noted in Paragraph 3.3.
- B. Prior to the concealment of any portion of the grease duct system a light test shall also be performed on all field or shop welded or brazed joints in the system to include hood-to-duct connections. The light test shall involve passing a lamp with a power rating of no less than 100 watts through the entire length of duct work. The lamp shall be exposed and fully open to allow light to emit equally in all directions. Systems may be tested in Sections, if necessary, provided that all joints are tested. Provide duct light test report summary (suitable video tape confirmation is acceptable) for submission and review by Owners Representative. Testing shall comply with Section 5.06.3.2.5 of the 2009 International Mechanical Code (IMC) or later.

END OF SECTION

SECTION 23 34 00**EXHAUST AND SUPPLY AIR FANS****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

1.2 SYSTEM DESCRIPTION

- A. Provide exhaust fans of the type, rotational speed, and arrangement indicated.
- B. Each fan shall be rated to deliver the capacity indicated in the tabulation on the Schedule against the external resistance of the system in which it operates.
- C. Provide high efficiency motors as specified in Section 23 05 13 for motors one (1) horsepower and larger.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the best quality.
- B. All equipment and materials shall be installed by experienced mechanics and as recommended by the fan manufacturer.
- C. All fans shall bear the AMCA and U.L. Labels. Capacity ratings shall be based on tests performed in accordance with the latest version of AMCA Standard 210 and Publication 211.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions together with fan curves.
- B. Shop Drawings: Submit in accordance with Section 23 05 00.
- C. When equipment, other than specified, is proposed, the Contractor shall be completely responsible for electrical revisions necessitated. Submit listing of electrical feeder and conduit sizes, breaker sizes, and motor starter sizes for each item of equipment where motor sizes are required to be larger than specified to meet scheduled capacities.

1.5 PRODUCT HANDLING

- A. Cover and protect fans in transit and at site. Fans not properly protected and stored and which are damaged or defaced during construction shall be rejected. Cover all openings to prevent entrance of dirt and debris until final connections are made.
- B. Storage and protection of materials shall be in accordance with Section 23 0500.

PART 2 - PRODUCTS

2.1 FANS – POWER ROOF VENTILATORS (UPBLAST AND DOME TYPE)

- A. Fans shall be direct or belt-drive, down blast or up blast type, units as indicated, positively ventilated, permanently lubricated, have sealed motors and fan shafts with ball bearings. Belt drive units shall be complete with cast iron adjustable sheaves.
- B. Provide centrifugal all aluminum fans with static and dynamic balance and with capacities as scheduled on drawings, all tested, approved, rated and bearing the AMCA Seal of Approval.
- C. Provide all aluminum weatherproof housing, venturi throat inlet, bird screen and disconnect. Provide for concealed wiring such that power wiring does not penetrate roof but runs within curb.
- D. New Curbs shall be minimum eighteen inches (18") high, made of galvanized steel and be insulated with minimum 1-1/2", 1-1/2 PCF density insulation, have continuous perimeter treated wood nailer and be furnished with a neoprene isolation strip to be placed on the top of the nailer. Provide sloped bottom of curbs to match roof pitch to allow for fans to be installed level. Custom adapter curbs shall be minimum height required to have no greater than a 45 degree offset to existing curb and be constructed of minimum 18 gauge G-90 galvanized steel. Custom adapter curbs shall be fully welded with no seams and fully sloped so that there are no flat portions of the curb in the horizontal (Refer to Drawings for curb type). Curbs shall 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. Curbs shall provide for the full support for the exhaust duct. For custom adapter curbs provide shop fabricated curb sized for existing curb dimensions. Provide for a separate thru utility vertical entry point within the footprint of the inside of the curb; no penetrations allowed in the side (vertical portions) of curbs. Curbs shall be fully perimeter insulated with minimum one inch (1") thick neoprene coated rigid fiberglass insulation, minimum 1.5 pcf density, either factory or field insulated.
- E. Furnish automatic backdraft dampers for all fans, unless indicated otherwise. Only up blast grease exhaust models will not have backdraft dampers.

- F. Provide grease container, hinged curb-base for inspection and cleaning of duct, and minimum 16" high vented curb extension to sit on top of base curb on all up blast grease hood exhaust fans. Minimum distance required from top of finished roof to grease exhaust discharge elevation shall be 40". Where the 16" extension does not achieve this elevation requirement increase the base curb height as required, in two inch (2") increments, to achieve this requirement.
- G. Use up-blast type fans for dishwasher and light duty science laboratory fume hoods, middle or High School level, and provide an epoxy coating on all materials of construction exposed to the air stream.
- H. For kiln exhaust systems the exhaust fan and drive assembly shall be rated for a minimum of 300 Deg. F.
- I. Provide SCR fan speed controller on direct drive motors with minimum stop for motor protection to be factory mounted on unit to be used for final air balance purposes.
- J. Acceptable manufacturers:
 - 1. Loren Cook.
 - 2. Greenheck.
 - 3. ACME.
 - 4. Penn.
 - 5. Flo-Aire.
 - 6. Twin City Fans and Blowers.

2.2 CEILING CABINET EXHAUST FAN

- A. Provide in-line type ceiling cabinet exhaust fans with the capacities and characteristics scheduled.
- B. Fans shall be AMCA certified and bear the label thereof.
- C. Casing shall be made of galvanized steel and acoustically insulated for quiet operation. Housing shall be installed to provide for accessibility and removal of motor and blower without removing housing from the system.
- D. Motors shall be permanently lubricated and have accessible internal wiring. Provide permanent split capacitor (PSC) motors. Provide external toggle disconnect switch with each fan.
- E. Provide noiseless backdraft damper integral with unit.
- F. Provide SCR fan speed controller with minimum stop for motor protection to be factory mounted on unit to be used for final air balance purposes.
- G. Provide flat roof caps of the sizes indicated for each fan. Each cap shall be a minimum of eight inches (8") in diameter and shall be the curb mounted type to ensure proper

flashing. New curbs shall be minimum 18" high and curb extensions shall be a minimum of 12" high, made of galvanized steel and be insulated with minimum 1-1/2", 1-1/2 PCF density insulation, have continuous perimeter treated wood nailer and be furnished with a neoprene isolation strip to be placed on the top of the nailer. Provide sloped bottom of curbs to match roof pitch to allow for roof caps to be installed level.

H. Acceptable manufacturers:

1. Loren Cook Gemini.
2. ACME Masterette.
3. Greenheck SP/CSP.
4. Penn Zephyr.
5. Flo-Aire.
6. Twin City Fans and Blowers, T or TL series.

2.3 AIR SUPPLY PACKAGED FANS

- A. Furnish and install air supply packaged fans of capacities and sizes as indicated on the Drawings.
- B. Fan housing shall be a heavy gauge G-90, galvanized steel material, be of low silhouette design, shall have all corners mitered, be completely weatherproof, and have a removable cover. Insulated cover shall be held in place with four (4) secure type latches for quick and easy access.
- C. Housing shall be equipped with, permanent, one inch (1") thick aluminum type washable filters, and shall be easily removed for cleaning.
- D. Fans shall be roof mounted on minimum eight inch (8") high factory fabricated, acoustically insulated, two inch (2") thick, galvanized steel roof curbs. Provide two inch (2") wide continuous strip of 3/8" thick neoprene rubber along curb top rail to limit mechanical vibration and noise. Provide sloped base curbs to allow fan to be set level on the roof, as applicable.
- E. Fan drives shall be the belt drive type. Belts shall be the non-static oil resistant type. Motor and drive assembly shall be accessible from the roof. Motor speed shall be 1750 RPM. Motor drives shall be machine cast iron and variable pitch up through 5 horsepower and fixed pitch over 5 horsepower. Shafts shall be solid steel, ground and polished. Motor and blower bearings shall be permanently lubricated with sealed ball bearings.
- F. Fan wheels shall be double width double inlet (DWDI) forward curved centrifugal blowers. Fan assembly capacities shall be rated in accordance with AMCA standards with air filters in place, and bear the seal thereof. Furnish duct connection adaptor.
- G. Unit blower assembly shall be mounted on vibration isolators.

- H. Provide bird screens if not inherently protected through design.
- I. Furnish 120 Volt, single phase, motorized backdraft dampers.
- J. Furnish disconnect switch within blower housing for fan servicing.
- K. Acceptable manufacturers:
 - 1. Loren Cook, ASP.
 - 2. Greenheck.
 - 3. ACME.
 - 4. Brundage.
 - 5. Penn Ventilator.
 - 6. FloAire.
 - 7. Twin City Fans and Blowers.

PART 3 - EXECUTION

3.1 DELIVERY AND PROTECTION

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

3.2 FANS – INSTALLATION

- A. Install fans suspended from structure, or as indicated, and provide vibration isolation internally or externally as required, as specified herein, or as specified in other sections of these specifications.
- B. Suspended fans shall be set level with all thread rod from structure above.
- C. Field install motor and other accessories not factory installed.
- D. Verify operation of automatic motorized and backdraft dampers.
- E. Adjust fan drives and replace sheaves as required to obtain scheduled capacities as directed by the Test and Balance firm.

3.3 ROOF MOUNT CURBED EXHAUST FANS

- A. Install all roof mounted exhaust fans on the factory fabricated and insulated roof curbs.
- B. Flash and counterflash to prevent leakage.

- C. Mount fan base on neoprene strips on curb tops.
- D. Secure fans base to curb with non-ferrous fasteners.
- E. Field install motor and other accessories not factory installed.
- F. Verify operation of backdraft and motorized dampers.
- G. Adjust fan drives or replace sheaves as directed by the Test and Balance Firm to obtain scheduled capacities to and as required to meet field conditions.

3.4 CLEAN-UP

- A. Clean all fans and components after installation is complete.
- B. Vacuum clean all debris from inside scrolls, on fan wheels and at drives.

END OF SECTION

SECTION 23 81 32
ROOFTOP AIR CONDITIONING UNITS (GAS - ELECTRIC)
(BELOW 3 TONS)

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 SYSTEM DESCRIPTION

- A. The work shall include installing new electric cooling, gas heating, roof mounted air conditioning units to meet scheduled capacities.
- B. The units specified herein are intended to cycle on and off to meet thermostatic control, and are not intended to introduce outside air continuously or to control space relative humidity.
- C. Contractor shall connect all ductwork, condensate drain piping, roof curbs, controls, factory furnished field installed accessories, appurtenances, insulation, supports, flashing, etc. to make a complete and operational system.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the best quality complying with all standards specified herein.
- B. All equipment and materials shall be installed in a workmanlike manner by trained and experienced mechanics as recommended by the equipment manufacturer and as detailed on the Drawings.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions and method for the configuration of equipment proposed, including wiring diagrams, piping connections, ductwork connections, capacities at scheduled conditions, fan capacity curves, accessories furnished, and other descriptive literature necessary to fully evaluate the Submittals for full compliance with these specifications.

- B. Shop Drawings: Submit in accordance with Section 23 05 00.

1.5 PRODUCT HANDLING

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

1.6 INSTALLATION, OPERATION, AND MAINTENANCE BROCHURES

- A. Furnish all installation manuals required by a trained and experienced mechanical technician for proper installation of equipment. Manuals shall be provided with equipment and be attached thereto.
- B. Furnish three (3) complete bound Operating and Maintenance Brochures with spare parts lists, which shall be submitted at "Substantial Completion".
- C. Furnish extended four (4) year compressor and fourteen (14) year heat exchanger warranty certificates to begin at the end of the first year warranty. Indicate specific model and serial numbers for all items of equipment furnished.

PART 2 - PRODUCTS

2.1 ROOFTOP PACKAGED A/C UNITS

- A. Units shall be a one-piece, air cooled, electric cooling, gas heating unit, and shall be mounted on a full perimeter roof curb.
- B. Total and sensible cooling capacities shall meet or exceed scheduled requirements.
- C. Unit compressors shall be serviceable semi-hermetic or welded fully hermetic type with crank case heaters and suitable spring vibration isolators. Refrigerant type shall be R-410A. Compressors shall be of the same manufacture as unit and shall have a 5 year warranty. Scroll type compressors shall have electric power phase reversal protection, or equivalent feature, to prevent sustained reverse rotation of the compressor to prevent burn out of, or damage to, the compressor. Include an insulated panel under compressor section to prevent condensation forming on the bottom.
- D. Coils: Indoor and outdoor coils shall be of non-ferrous construction with aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed.
- E. Fans and Motors: Indoor blowers shall be either double inlet forward curved, centrifugal, direct driven type with multi-speed drives (5 speed or ECM) or belt drive double inlet, forward curve fans with adjustable sheaves. Motor shall have permanently

lubricated bearings. Outdoor fans shall be of the propeller type, with direct driven permanently lubricated motor. Outdoor fans shall discharge upward. Furnish high efficiency (premium) evaporator fan motors for motors one (1) horsepower and larger in size. Premium motors that are furnished as a standard option by the manufacturer will be accepted. Refer to Section 23 05 13 for general motor requirements.

- F. Unit cabinets shall be constructed of galvanized steel, bonderized and coated with a baked enamel finish. Cabinet interior shall be insulated with one inch (1") thick neoprene coated fiberglass. Cabinet panels shall be easily removable for service to all operating components. A condensate drain sloped for continuous positive drainage, to prevent standing condensate, for the indoor evaporator coil shall be provided.
- G. Controls: The cooling system shall be protected with high pressurestat, low pressurestat, loss-of-charge protection, and current and temperature sensitive overload devices. Each of these devices shall be wired to prevent compressor restart until reset at the thermostat (or unit circuit breaker). All control devices specified herein shall be factory installed.
- H. Heat Exchanger shall be tubular in design and constructed of corrosion resistant type 409 or 316 stainless steel. Heat exchanger shall carry a fifteen (15) year warranty. Burners shall be constructed of aluminum painted cold rolled steel and be of the in-shot type.
- I. Heating controls shall consist of a redundant gas valve, electronic spark ignition, remote pilot flame sensor, time-delay relay, limit switches, and centrifugal switch. Burner shall be power draft type.
- J. Unit Electrical Connections: Cabinet shall contain suitable openings for routing of all utility connections. The base unit shall contain a terminal strip in the control compartment to allow for terminal-to-terminal connection of room thermostat and field installed accessories. This shall include a Conventional Thermostat Interface (CTI) to allow for an energy management system to control the unit fan and all cooling and heating stages.
- K. Accessories and Options: The following factory-installed options (FIOP) or field-installed accessories shall be provided:
 - 1. Roof curb shall generally be supplied by the same supplier as unit. Alternately, a custom curb manufacturer meeting the specified requirements shall be used if the equipment manufacturer cannot comply with the specified requirements. Dimensions shall be provided to allow for easy duct location and connection to roof curb prior to unit placement. Curb design shall comply with National Roofing Contractors Association (NRCA) requirements. This, typically, requires a curb extending a minimum of eight inches (8") above the top surface of the roof which results in a minimum 18" tall curb. However, due to planned roofing projects, all

new curbs are required to be a minimum of 184" in height. Curbs shall be made from minimum 18 gauge G-90 galvanized steel, have a treated 2" x 4" wood nailer, have hinged corners and be pitched to match the roof slope, from 1/4" to 12", such that the curb top and unit sit level. Custom adapter curbs are not allowed, except where specifically specified and noted on the contract documents. This is only shown at Big Springs Elementary School on the Gym RTU. These adaptor curbs shall be minimum height required to have no greater than a 45 degree offset to existing curb and be constructed of minimum 18 gauge G-90 galvanized steel. Custom adapter curbs shall be fully welded with no seams and fully sloped so that there are no flat portions of the curb in the horizontal (Refer to Drawings for curb type). Curbs shall 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. Curbs shall provide for the full support for both the supply and return air ducts. For custom adapter curbs provide shop fabricated curb sized for existing curb dimensions. Provide for a separate thru utility vertical entry point within the footprint of the inside of the curb; no penetrations allowed in the side (vertical portions) of curbs. Curbs shall be fully perimeter insulated with minimum one inch (1") thick neoprene coated rigid fiberglass insulation, minimum 1.5 pcf density, either factory or field insulated.

2. Outside air shall be controlled by an optimized dry-bulb type economizer with multi-stage integrated economizer and compressor operation for optimum benefit:
 - a. The economizer shall consist of motor operated fully modulating type outdoor and return air dampers, both sequenced and fully adjustable, constructed from low leakage dampers that utilize metal blades with rubber edge seals and aluminum or stainless steel end seals. Damper blades shall be gear driven and be designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2" W.G. air pressure differential across the damper, or less than 2% at a total static pressure of 0.5 Inches W.G., with a negative return air static pressure of 0.05 Inches W.G.
 - b. Damper motors shall be the spring return type to insure the tight closing of the outdoor air damper during periods of unit shut down or power failure. The outside air damper and actuator shall be capable of opening to a pre-set minimum when the unit is operated in the normal occupied mode. Provide a field adjustable end switch, or equivalent control feature such as a potentiometer or SCR, to allow minimum outside air adjustment to that as scheduled.
 - c. The economizer shall be completely factory installed, wired and run tested.
 - d. Damper actuators shall be compatible with standard 0-10 Vdc Energy Management System output signal to allow modulating control of the minimum outside air flow rate for return air carbon dioxide level control, whether utilized or not. Actuators shall be a "Belimo MFT" type actuator.
 - e. Provide weather protected hoods over each outside air intake and relief air outlet. Provide protection from birds on all hoods, using galvanized steel bird screen (1/2" x 1/2" wire mesh) or other approved method.
 - f. Provide an automatic barometric relief damper to relieve positive building pressure on all units capable of introducing over 25% outside air through the

unit. Relief dampers shall be sized and capable of relieving 75% of total design air at 0.03 inches water gauge static pressure at the relief damper location. Provide oversized damper and hood system as required to comply. Submit data to confirm compliance with this requirement.

3. Alternate motor and/or drive assembly to produce added cfm and static pressure capability where required based on scheduled requirements.
 4. Time Guard Circuit to prevent compressor short cycling as a result of a rapid change in thermostat setting. Also, automatically prevents restart for at least 5 minutes, or other minimum time per the unit manufacturer, after shut-down.
 5. Provide filter rack to accept standard 2" thick filters. Ship units to job site with 2" thick throwaway filters for coil and heat exchanger protection. All return and outside air shall be filtered by the same single common set of filters.
 6. Condenser fin hail and vandal guards. Guards shall be made of hot dip galvanized steel; or UV inhibited, PVC coated steel; or factory enamel or epoxy painted steel; or other approved corrosion resistant material. Flat expanded metal, field made devices, and screen or fencing materials are not acceptable.
 7. Condensate drain and electrical connections shall be routed within the roof curb such that no roof penetrations exterior to the unit roof curb are required for either service.
- L. All roof top A/C Units shall have a minimum EER and furnace efficiency as scheduled, both of which shall meet or exceed the 2018 International Energy Conservation Code.
- M. Units shall be as manufactured by:
1. Trane.
 2. Lennox.

2.2 TEMPERATURE CONTROLS

- A. Under Specification Section 23 09 00, Controls and Instrumentation, space temperature sensors, as applicable, shall be provided for field installation along with factory mounted and wired terminal unit controllers to control units.
- B. Each rooftop A/C unit shall have wiring terminals to receive signals from the Terminal Unit controller to receive 4-20 ma, or 0-10 volt D.C. as applicable, signals to stage on and off heat, energize compressor(s), as applicable, modulate the outside and return air dampers. Provide contacts to energize and de-energize the unit.

PART 3 - EXECUTION

3.1 DELIVERY AND PROTECTION

- A. Deliver all equipment to each site. All equipment shall be handled carefully to avoid damage and be protected from exposure to the weather and dirt.

- B. All equipment shall be examined upon delivery to the site and evidence of abuse, damage, or exposure to weather and dirt shall be grounds for refusal to accept individual pieces of equipment. Rejected items shall be replaced promptly at no cost.
- C. During construction, take all steps necessary to protect equipment from damage or vandalism. All damage or vandalism shall be repaired at no cost to the Owner.

3.2 ROOFTOP A/C UNITS

- A. Install manufactured roof curbs on the roof square and level to receive the units. Provide and install additional steel framing as required to provide safe, noiseless, operating systems.
- B. Coordinate the electrical services and control wiring with the Electrical Systems Installer. Coordinate the condensate drainage system with the Plumbing Systems Installer.
- C. Coordinate the exact unit locations with the structural systems and the ceiling systems as actually installed.
- D. Make all sheet metal supply and return duct connections with flexible duct connections.
- E. Install sound and vibration isolation devices as detailed and specified elsewhere herein and on the Drawings.
- F. Provide for one (1) additional set of fan sheaves for each belt drive unit, as required by the Testing and Balancing Firm, to obtain design air flows. For bidding purposes provide one (1) set sheaves, and belts where required, as follows:

# of Units	Minimum # Sets of Belts & Sheaves
1 - 5	3
6 - 10	5
11 - 15	7
16 - 20	9
21 - 30	14
31 or more	33%

- G. Gas furnaces shall be jumpered to operate at full fire, with the supply fan operating, for a minimum of thirty (30), but not more than sixty (60), minutes to burn off dust, lint,

and factory produced oil films. Remove jumper after this process is completed. Perform this work in such a fashion as not to void equipment warranties.

3.3 CLEANUP

- A. Clean evaporator and condenser coils, condensate pans and condensate drain piping after installation of rooftop A/C units is complete.
- B. Clean all debris from inside rooftop A/C unit casings
- C. Replace air filters with new as specified in Section 23 30 00.
- D. Tighten and align fan belts and lubricate all bearings. Verify proper rotation of moving parts.
- E. Install all field installed accessories.
- F. Make all power and control wiring connections.
- G. Verify correct operation of equipment, accessories, and control devices.

3.4 OPERATING PROCEDURES AND REQUIREMENTS

- A. Operating and service instructions in illustrated and bound form shall be furnished by the manufacturer, three (3) copies, at "Substantial Completion".
- B. At startup, the equipment manufacturer shall furnish skilled personnel, separate from the installing contractor's work force, to supervise, check out performance, make any required adjustments, place all units in service, and instruct the Owner's personnel for a full period of two (2) hours for each 15 units provided. Fill-out a manufacturer's start-up report, to be typewritten, for each new unit installed which shall reflect the operating conditions of the electrical power supply, refrigeration system and gas furnace.
- C. The manufacturer of each item of equipment shall provide complete wiring diagrams to the Electrical Systems Installer and shall provide drawings indicating all required external wiring and arrangements of connections.

3.5 WARRANTY

- A. Transfer Warranty to Owner for a full one year period after "Substantial Completion".
- B. Transfer any and all other warranties as applicable over to the Owner at "Substantial Completion", including extended 4-year compressor warranties, as applicable, on refrigeration equipment, and extended 14-year warranties, as applicable, on heating furnace sections.

END OF SECTION

SECTION 23 81 33**SEMI-CUSTOMIZED ROOFTOP AIR CONDITIONING UNITS (GAS - ELECTRIC)
(3 TONS AND LARGER)****PART 1 - GENERAL****1.1 RELATED REQUIREMENTS**

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

1.2 SYSTEM DESCRIPTION

- A. The work shall include installing new specialty semi-customized electric cooling gas heating roof mounted air conditioning units to meet scheduled capacities and to effect outside air control by modulation and space relative humidity control.
- B. Contractor shall connect all ductwork, condensate drain piping, gas piping, roof curbs, temperature controls, power supply, disconnects, factory furnished field installed accessories, appurtenances, insulation, supports, flashing, etc. to make a complete and operational system.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the best quality complying with all standards specified herein.
- B. All equipment and materials shall be installed in a workmanlike manner by trained and experienced mechanics as recommended by the equipment manufacturer and as detailed on the Drawings.
- C. Units shall be rated in accordance with ARI Standards 210/240 or 360 and 270, as applicable, and be capable of starting and running at ambient outdoor temperatures as high as 115 Deg.F. while operating to meet the maximum load requirement.
- D. Units shall be designed to conform to ASHRAE Standard 15, latest revision.

- E. Units shall be U.L. Tested and Certified in accordance with ANSI Z21.47 Standards as a total package for safety requirements.
- F. Insulation and adhesive shall meet NFPA 90A and B requirements for flame spread and smoke generation.
- G. Each unit shall be American Gas Association (AGA) Certified.
- H. Unit casings shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 500 hour salt spray test.
- I. Each individual unit shall be subjected to a completely automatic factory run test on the assembly line. Each unit shall pass this run test, repair as necessary, prior to being allowed to be shipped to the project site.
- J. Unit manufacturer shall establish an inventory parts program with the District to ensure the timely availability of the most common parts requiring repair or replacement. Inventory list shall be determined by mutual agreement with the Owner.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive literature and installation instructions and method for the configuration of equipment proposed, including wiring diagrams, piping connections, ductwork connections, capacities at scheduled conditions, fan capacity curves, accessories furnished, and other descriptive literature necessary to fully evaluate the Submittals for full compliance with these specifications.
- B. Shop Drawings: Submit in accordance with Section 23 05 00.

1.5 PRODUCT HANDLING

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

1.6 INSTALLATION, OPERATION, AND MAINTENANCE BROCHURES

- A. Furnish all installation manuals required by a trained and experienced mechanical technician for proper installation of equipment. Manuals shall be provided with equipment and be attached thereto, or contained therein.

- B. Furnish three (3) complete bound Operating and Maintenance Brochures with spare parts lists, which shall be submitted at "Substantial Completion" with Close-Out documents.
- C. At project close-out, furnish an extended four (4) year compressor and fourteen (14) year heat exchanger warranty certificates to begin at the end of the first year warranty.
- D. The first year Warranty begins at Substantial Completion. Indicate specific model and serial numbers for all items of equipment furnished to be Warranted. Extended warranties cover parts only.

PART 2 - PRODUCTS

2.1 PACKAGED ROOFTOP A/C UNITS

- A. Packaged Rooftop Units shall be factory assembled, tested, piped, internally wired and shipped in one piece complete with an operating charge of refrigerant and oil. Units shall be direct expansion cooling, natural gas heating, with downflow discharge mounted on a full perimeter roof curb. Packages shall be complete with all operating and safety controls. All units shall be factory test run in the cooling and heating modes with the following items being monitored for each individual unit:
 - 1. Amperage for each electrical component.
 - 2. Refrigerant suction and discharge pressures with corresponding ambient temperatures and relative humidity.
 - 3. Gas flow rate to burners.
 - 4. Verify operation of all safeties by simulating condenser fan and evaporator blower failures.
 - 5. Provide all test information along with a wiring diagram and a maintenance and operation manual inside each unit.
- B. Cooling capacities shall be rated in accordance with A.R.I. standards. Capacities scheduled are gross capacities. Net capacities include deductions of fan motor heat. Submittals must show both gross and net capacities.
- C. Unit casings shall be constructed of phosphatized G90 galvanized steel with factory baked acrylic-epoxy paint or bonderized and coated baked enamel finish in beige color on all exposed surfaces. All assembly screws shall be zinc-chromate coated. Unit shall be equipped with factory installed lifting or rigging lugs. Other features shall include:
 - 1. Access to compressors, controls, filters, fan motor and other items needing periodic checking or maintenance shall be through:
 - a. Hinged access panels on units from 3 to 12 tons in size.

- b. Double wall hinged access panels on sizes over 12 tons in size.
2. Blowers shall be made accessible by:
- a. Removable panels on units 3 to 6 tons in size.
 - b. Double wall hinged access panels on units over 6 tons in size.

Air side service access doors shall be fully gasketed with rain break overhangs, and these doors shall have a metal liner to protect insulation. All interior surfaces in contact with the air stream shall have one inch (1") mat-faced fiberglass insulation. All access doors shall be able to be opened **without the use of tools**. The unit casing shall be assembled in such a manner to be waterproof and provide for natural drainage. The unit base shall be watertight and constructed with 14 gauge load bearing members. Cabinet insulation shall meet ASHRAE Standard 62P and shall generally have 1.5 pound density with foil face coating used where exposed to the airstream in the heating section. The unit shall have a factory provided entry way within the cabinet for all wiring to enter from below within the confines of the full perimeter roof curb.

- D. All units shall be provided with direct drive fully hermetic, or semi-hermetic, single or two-stage compressors. Compressors shall be factory rubber-shock mounted for optimum vibration isolation. Provide an oil level sight glass, oil charging valve, and two points of lubrication on semi- hermetic compressors. Provide refrigerant strainers, filter drier, and service gauge connections on the suction, discharge, and liquid lines for all compressors. High strength non-flexing ring type suction and discharge valves shall be provided. Compressor motors shall be suction gas cooled, be provided with a crankcase heater and have a voltage utilization range of plus or minus 10% of name-plate. Two winding thermostats shall be imbedded between the motor windings for semi-hermetic compressors. Scroll compressors shall have only one internal thermal protection device per winding. Any thermal overload in any single winding will be detected and alarm internal to the unit controls. Standard safety controls shall include high and low pressure cutouts, oil pressure cutouts (semi- hermetic compressors only), loss of charge protection, compressor reverse rotation protection (scroll compressors only), freeze protection, line break thermal and current overload protection, and reset relays. System shall have liquid line driers and shall be fully charged with R-410A. All units shall have specific factory installed humidity control features similar to that of the Lennox Energence with hot gas reheat coils to achieve neutral supply air temperatures in the dehumidification mode of operation. All units larger than 7 tons shall have a minimum of 2 compressors without exception. Multiple compressor units shall be furnished with independently mounted circuits. Compressors shall be capable

of operation down to 25 Deg.F. ambient outdoor temperatures. All Units shall have two-stage compressors in the 3 to 5 ton range.

- E. Evaporator coils shall be constructed of seamless copper tubing mechanically bonded to heavy duty aluminum fins.
 - 1. All cooling coils shall have galvanized steel end casings and equalizing type vertical tube distribution with a top suction connection.
 - 2. Cooling coils shall generally have a minimum of 4 rows. Fins shall not exceed 15 fins per inch.
 - 3. Coils shall be equipped with a thermostatically controlled expansion valve. Multi-compressor units shall be circuited with one circuit and one expansion valve per compressor.
 - 4. Multiple circuits shall be intertwined in the evaporator coil. Single evaporator coils may be either the full face active design or be the face split design.
 - 5. Each unit shall be equipped with a 5 minute anti-short cycle delay timer, or equivalent control strategy used for compressor protection, for each compressor.
 - 6. Coils shall be factory pressure and leak tested at 300 PSIG.
- F. Provide sloped condensate drain pans. Pans shall be sloped in two directions for positive drainage to meet ASHRAE Standard 62. Pans shall be fabricated with Type 304 stainless steel, be minimum 18 gauge in thickness and shall have all welded joints. Alternately, condensate pans can be made of a heavy duty plenum rated plastic material.
- G. Condensing coils shall be fabricated of seamless copper tubing with configured aluminum fins mechanically bonded to tubing. Condenser coil shall be designed for a minimum of 10 degrees F. sub-cooling. Coils shall be factory tested to 450 PSIG air pressure and then vacuum dehydrated. Provide condenser fin hail and vandal guards. Guards shall be made of hot dip galvanized steel; or UV inhibited, PVC coated steel; or factory enamel or epoxy painted steel; or other approved corrosion resistant material. Flat expanded metal, field made devices, and screen or fencing materials are not acceptable.
- H. Outdoor condenser fans shall be vertical discharge, direct drive type, propeller fans. Fans shall have aluminum or steel blades and zinc plated steel hubs which shall be statically and dynamically balanced. Motors shall have permanently lubricated ball bearings, built in current and automatic reset thermal overload protection and weather-tight slingers over bearings. Provide a corrosion resistant metal, or PVC coated steel, fan guard. Units shall have ECM motor condenser fans.

- I. All supply air fans shall be either direct drive, double inlet, forward curve fans with multi-speed (5 speed or ECM) or belt driven, double inlet, forward curve fans with adjustable sheaves. Fan motors 1 HP and larger shall be the premium efficiency type, that are furnished as a standard option by the unit manufacturer. Refer to Specification Section 23 05 13 for general requirements on these motors. Where non-standard motor frames, under 5 HP in size, are the standard motor offered by the unit manufacturer and where these motors are exempt from meeting the EPACT requirements, these motors are not required to be the premium efficiency type. Motors shall have permanent lubricated bearings. Fans shall be statically and dynamically balanced. Fan bearings shall be self-aligning, grease lubricated, ball or roller bearings, of the pillow block type with 200,000 hour bearing design, easily accessed for servicing. Fan wheels shall be constructed of aluminum or steel and be coated with a corrosion resistant finish. Provide optional/alternate motor and drive assembly to produce the design CFM and external static pressure scheduled where required based on scheduled requirements.
- J. Outside air shall be controlled by an optimized dry-bulb type economizer with multi-stage integrated economizer and compressor operation for optimum benefit:
 1. The economizer shall consist of motor operated fully modulating type outdoor and return air dampers, both sequenced and fully adjustable, constructed from low leakage dampers that utilize metal blades with rubber edge seals and aluminum or stainless steel end seals. Damper blades shall be gear driven and be designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2" W.G. air pressure differential across the damper, or less than 2% at a total static pressure of 0.5 Inches W.G., with a negative return air static pressure of 0.05 Inches W.G.
 2. Damper motors shall be the spring return type to insure the tight closing of the outdoor air damper during periods of unit shut down or power failure. The outside air damper and actuator shall be capable of opening to a pre-set minimum when the unit is operated in the normal occupied mode. Provide a field adjustable end switch, or equivalent control feature such as a potentiometer or SCR, to allow minimum outside air adjustment to that as scheduled.
 3. A pressure relief damper sized for 100% relief air shall be provided as part of the economizer.
 4. The economizer shall be completely factory installed, wired and run tested.
 5. For units 10 tons in capacity and larger furnish a powered exhaust relief as a part of the economizer package.
 6. Damper actuators shall be compatible with standard 0-10 Vdc Energy Management System output signal to allow modulating control of the minimum outside air flow rate for return air carbon dioxide level control, whether utilized or not. Actuators shall be a "Belimo MFT" type actuator.
 7. Provide weather protected hoods over each outside air intake and relief air outlet. Provide protection from birds on all hoods, using galvanized steel bird screen (1/2" x 1/2" wire mesh) or other approved method.

K. Heating Section:

1. Induced draft power combustion type with energy saving electronic direct spark ignition system and induced draft direct drive centrifugal blower with an electric differential pressure switch to lock out the gas valve until the combustion chamber is purged and combustion air flow is established. Induced draft combustion motor shall have permanently sealed bearings and inherent automatic-reset thermal overload protection.
 2. Heat exchanger shall be of the tubular section type constructed of a heavy gauge Type 409 or 316 stainless steel for enhanced corrosion resistance.
 3. Burners shall be of the in-shot type designed to use natural gas and be equipped with a gas valve and combustion blower. Two to four stage type gas furnaces shall have redundant dual gas valves. Heating control shall be initiated by a 0-10 Vdc signal from a DDC Control System or other signal compatible with the Energy Management System provided and the control sequences specified elsewhere herein.
 4. All gas piping shall enter the unit cabinet at a single location.
 5. Provide flue up discharge deflector where an option exists with the manufacturer.
 6. Unit tubular Type 409 stainless steel gas heat exchangers shall carry a 15-year non pro-rated warranty starting at "Substantial Completion".
 7. Furnace section shall have foil faced insulation on the air side of the casing.
 8. Heating section controls shall also consist of a redundant main gas valve, associated time delay relays, limit switches, centrifugal switch, high temperature limit switch, flame rollout switch and flame proving controls.
- L. Furnish two inch (2") filter racks with two inch (2") thick pleated media filters shipped with the unit, 30% efficient, equal to Camm-Farr 30/30 filters. Both return and outside air shall be filtered by the same filter bank. Filters shall be provided in a large enough quantity to limit the actual face velocity to no more than 375 feet per minute. Filters shall be one standard commercially available size. Filters shall be accessible without the use of tools. All replacement filters shall be as specified in Specification Section 23 30 00. All filter racks shall be provided with accordion type spacers and gaskets to minimize the potential for any bypass air around the filter rack.
- M. Roof curb shall generally be supplied by the same supplier as unit. Alternately, a custom curb manufacturer meeting the specified requirements shall be used if the equipment manufacturer cannot comply with the specified requirements. Dimensions shall be provided to allow for easy duct location and connection to roof curb prior to unit placement. Curb design shall comply with National Roofing Contractors Association (NRCA) requirements. This, typically, requires a curb extending a minimum of eight inches (8") above the top surface of the roof which results in a minimum 18" tall curb. Curbs shall be made from minimum 18 gauge G-90 galvanized steel, have a treated 2" x 4" wood nailer, have hinged corners and be pitched to match the roof slope, from 1/4" to 12", such that the curb top and unit sit level. Custom

adapter curbs shall be used for all units, except where noted on the drawings. These adaptor curbs shall be minimum height required to have no greater than a 45 degree offset to existing curb and be constructed of minimum 18 gauge G-90 galvanized steel. Custom adapter curbs shall be fully welded with no seams and fully sloped so that there are no flat portions of the curb in the horizontal (Refer to Drawings for curb type). Curbs shall 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. Curbs shall provide for the full support for both the supply and return air ducts. For custom adapter curbs provide shop fabricated curb sized for existing curb dimensions. Provide for a separate thru utility vertical entry point within the footprint of the inside of the curb; no penetrations allowed in the side (vertical portions) of curbs. Curbs shall be fully perimeter insulated with minimum one inch (1") thick neoprene coated rigid fiberglass insulation, minimum 1.5 pcf density, either factory or field insulated.

- N. Units shall have a factory installed and wired non-fused disconnect switch or HACR/fused disconnect switch as scheduled on the drawings. All disconnect switches shall be provided by unit manufacturer, unless specifically noted otherwise on drawings. Additionally, provide a non-powered weatherproof 10 amp capacity, 115 volt, GFCI, duplex service receptacle inside the control compartment, or on the exterior of the cabinet, for each unit where shown on the Drawings. Receptacle power supply shall be from separate 115 volt circuit.
- O. All roof top A/C Units shall have minimum ARI, EER or SEER and furnace AFUE efficiencies as scheduled, each of which shall meet or exceed that required by the 2018 International Energy Conservation Code. All rooftop air conditioning units five (5) tons and less in capacity shall be a minimum 15 SEER efficiency.
- P. Factory mount and wire terminal equipment controllers furnished under this section. Operating controls shall include the following:
 - 1. Each unit shall have a minimum of two (2) stages of heating and cooling on all units over 7 tons in size. For units 7 tons and smaller, single stage heaters shall be suitable.
 - 2. Provide a Conventional Thermostat Interface (CTI) with wiring terminals provided by the unit manufacturer to allow for the interface and control of the number of stages of heating and cooling and the supply fan.
 - 3. Integrated controls shall be furnished by the equipment manufacturer on the unit at the factory under this Section of the Specifications. Controls shall be suitable for field wiring of other temperature control related sensors and accessories in the future.
 - 4. Each cooling system shall also incorporate a dehumidification and refrigerant cycle reheat capability to control space relative humidity to no higher than 60% R.H., adjustable. Sensible cooling shall take priority over the dehumidification mode, and this shall be determined internal to the unit, via, an external 0-10 VDC control

signal which shall equate to the space relative humidity level. At the option of the Energy Management System supplier, this can be emulated through the local unit controller. Fully coordinate the method used with all trades involved.

5. The integrated gas controller (IGC) diagnostics board shall include gas heat operation fault notification using a LED (light-emitting diode). Each unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch, or three continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED. The IGC board shall contain algorithms that modify evaporator fan operation to prevent future cycling on high temperature limit switch. LED display shall be visible without removal of control box access panel.
- Q. All refrigeration systems shall use an EPA approved refrigerant that will be readily available in the commercial market for the next 10 years under current legislation and protocols. R-410A is the preferred refrigerant to be used. All units furnished on a project shall all utilize the same refrigerant.
- R. Unit electrical connections shall consist of suitable openings in the cabinet for routing of all utility connections within the roof curb to include through-the-bottom power supply connection. The base unit shall contain a low voltage terminal strip in the control compartment to allow for terminal-to-terminal connection of room thermostat (temperature sensor) and field installed accessories. Electrical controls shall be complete with self-contained low voltage control circuit protected by an automatic reset device. All unit power wiring shall enter the cabinet at a single factory pre-drilled location designed for single point electrical service. Unit voltages shall be as scheduled on the Drawings.
- S. Provide the following additional spare parts for entire order at that facility:
1. One additional main unit control board.
 2. One additional unit mounted disconnect for 4 ton unit size.
 3. One additional 4 ton compressor.
- T. Units shall be as manufactured by:
1. Trane with humidity control units.
 2. Lennox with humidity control units.

2.2 TEMPERATURE CONTROL

- A. Under Specification Section 23 09 00, Controls and Instrumentation, space temperature, and relative humidity, as applicable, shall be provided for field installation along with factory mounted and wired terminal unit controllers to control units. Only designated units will have carbon dioxide sensor control.

- B. Each rooftop A/C unit shall have wiring terminals, low voltage terminal strip, to receive signals from the Terminal Unit controller to receive CTI, PWM, 4-20 ma, or 0-10 volt D.C. signals, as applicable, signals to stage on and off heat, energize compressor(s), hot gas reheat sequence, as applicable, control the economizer cycle, and modulation of the outside and return air damper. Provide contacts to energize and de-energize the unit.

PART 3 - EXECUTION

3.1 DELIVERY AND PROTECTION

- A. Deliver all equipment to each site. All equipment shall be handled carefully to avoid damage and be protected from exposure to the weather and dirt.
- B. All equipment shall be examined upon delivery to the site and evidence of abuse, damage, or exposure to weather and dirt shall be grounds for refusal to accept individual pieces of equipment. Rejected items shall be replaced promptly at no cost.
- C. During construction, take all steps necessary to protect equipment from damage or vandalism. All damage or vandalism shall be repaired at no cost to the Owner.

3.2 ROOFTOP A/C UNITS

- A. Install manufactured roof curbs on the roof square and level to receive the units. Provide and install additional steel framing as required to provide safe, noiseless, operating systems. Locate units with condensate drain pans sloped for positive pan drainage.
- B. Coordinate the electrical services and control wiring with the Electrical Systems Installer. Coordinate the condensate drainage and gas supply piping systems with the Plumbing Systems Installer. The manufacturer of each item of equipment shall provide complete wiring diagrams to the Electrical Systems Installer and shall provide drawings indicating all required external wiring, piping and arrangement of all field connections.
- C. Coordinate the exact unit locations with the structural systems and the ceiling systems below as actually installed. Shim roof curbs, or adjust as applicable, to make entire top of each curb level.
- D. Make all sheet metal supply and return duct connections with flexible duct connections below the roof.
- E. Install sound and vibration isolation devices as detailed on the Drawings. Install continuous 2" wide by 3/8" thick neoprene isolation strip along the full perimeter of the roof curb for a complete air seal.

- F. Provide for one (1) additional set of fan sheaves for each belt drive unit, as required by the Testing and Balancing Firm, to obtain design air flows. For bidding purposes provide one (1) set of sheaves and belts where required, as follows:

# of Units	Minimum # Sets of Belts & Sheaves
1 - 5	3
6 - 10	5
11 - 15	7
16 - 20	9
21 - 30	14
31 or more	33%

- G. Gas furnaces shall be jumpered to operate at full fire, with the supply fan operating, for a minimum of thirty (30), but not more than sixty (60), minutes to burn off dust, lint, and factory produced oil films. Remove jumper after this process is completed. Perform this work in such a fashion as not to void equipment warranties. Documented factory run tests conducted for 30 minutes will be considered, but must be approved by the Engineer.
- H. At start-up, have all units served by a gas pressure regulator, external to the units, operated at full fire, and adjust gas supply pressure to these units to be between 7-10 inches W.G. Document in writing actual pressure measured going into unit, as well as manifold pressure. Include this information in Start-up Report to be submitted with Close-Out Documents.
- I. Verify all items internal to unit controlled by the terminal equipment controller functions when commanded to operate. Verify that all dampers fully modulate and that they close fully when commanded to be in that position.
- J. Do not operate units without specified air filters being installed. Failure to do so will result in the Contractor cleaning coils at no cost to the Owner.
- K. Tighten and align fan belts and lubricate all bearings. Verify proper rotation of moving parts.
- L. Install all field installed accessories.
- M. Make all power and control wiring connections.
- N. Verify correct operation of equipment, accessories, and control devices.

3.3 CLEANUP

- A. Clean evaporator and condenser coils, condensate pans and condensate drain piping after installation of rooftop A/C units is complete. Clean all debris from inside rooftop A/C unit casings.
- B. Replace air filters with new type and when indicated as indicated in Specification Section 23 30 00.

3.4 OPERATING PROCEDURES AND REQUIREMENTS

- A. Operating and service instructions in illustrated and bound form shall be furnished by the manufacturer, three (3) copies, at "Substantial Completion".
- B. At startup, the equipment manufacturer shall furnish skilled personnel, separate from the installing contractor's work force, to supervise, check out performance, make any required adjustments, place all units in service, and instruct the Owner's personnel for a full period of two (2) hours for each 15 units provided. Fill out a manufacturers start-up report, to be typewritten, for each new unit installed which shall reflect the operating conditions of the electrical power supply, refrigeration system and gas furnace.

3.5 WARRANTY

- A. Transfer Full Parts and Labor Warranty to Owner for a full one (1) year period beginning at "Substantial Completion".
- B. Transfer any and all other warranties as applicable over to the Owner at "Substantial Completion", including extended 4-year compressor warranties, as applicable, on refrigeration equipment and extended 14-year warranties on stainless steel heat exchangers, as applicable.

END OF SECTION

SECTION 26 00 00**ELECTRICAL****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 DEFINITIONS

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

1.3 SCOPE OF WORK

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

1.4 GENERAL

- A. The accompanying plans show diagrammatically the location of the various light fixtures, devices, conduits and equipment items, and methods of connecting and controlling them. It is not intended to show every connection in detail or all fittings required for a complete system. The Contractor shall carefully lay out his work at the site to conform to the conditions, to avoid obstructions and provide proper routing of

raceways. Exact locations of light fixtures, devices, equipment, and connections thereto shall be determined by reference to the accompanying Plans, etc., by field measurement at the project, and in cooperation with other Contractors and Sub-Contractors, and in all cases shall be subject to the approval of the Owner. Minor relocations necessitated by the conditions at the site or directed by the Owner shall be made without any additional cost to the Owner.

- B. These specifications and the accompanying drawings are intended to describe and illustrate systems which will not interfere with the structures, which will fit into available spaces, and which will insure complete and satisfactorily operating installations. The Contractor shall be responsible for the proper fittings of his material and apparatus into the building and shall prepare installation drawings for all critical areas illustrating the installation of his work as related to the work of all other trades. Interferences with other trades or with the building structures shall be corrected by the Contractor before the work proceeds. Should any changes become necessary due to failure to comply with these stipulations, the Contractor shall make such necessary changes at his own expense.
- C. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted on the Drawings.
- D. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide those details or special construction as well as to provide material and equipment usually furnished with such systems or required to complete the installation.
- E. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability and that he will install his work in a satisfactory manner which is up to the best standards of the trade, complete and in good working order. If any of the requirements of the Drawings and Specifications are impossible to perform, or if the installation when made in accordance with such requirements will not perform satisfactorily, he shall report such occurrences to the Owner promptly after discovery of the discrepancy.
- F. No extra compensation will be allowed for extra work or changes caused by failure to comply with the above requirements.

1.5 INSPECTION OF THE SITE

- A. The Contractor shall visit the site, verifying all existing items indicated on the Drawings or specified, and familiarize himself with the existing work conditions,

hazards, grades, actual formations, soil, conditions, and local requirements. The submission of bids shall be deemed evidence of such visit.

- B. All proposals shall take these existing conditions into consideration, and the lack of specific information on the Drawings shall not relieve the Contractor of any responsibility.
- C. All site visits shall be coordinated and scheduled with the Owner.

1.6 CUTTING AND PATCHING

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

- F. All damage done to the existing equipment, services, etc., incurred in the execution of this contract shall be repaired and restored to its original conditions by the Contractor.
- G. Holes through concrete shall be drilled with "Mole", or "Core-It", or equal diamond point hole saw.

1.7 DEMOLITION OF EXISTING EQUIPMENT

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

1.8 CODE REQUIREMENTS

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

1.9 RECORD DRAWINGS

- A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all locations of equipment, panels, and all deviations and/or changes in the work shall be recorded. All underground and overhead utilities provided

under, or affected by, work of this Division shall be accurately located by dimensions. These "Record" drawings shall be delivered to the Architect in good condition upon the completion and acceptance of the work and before final payment is made.

1. Refer to Division 1 requirements.

1.10 RECORDS AND INSTRUCTIONS FOR OWNER

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

1.11 SHOP DRAWINGS AND SUBMITTALS

- A. The Contractor shall submit, to the Architect, shop drawings and catalog data on all equipment and materials designated on the Drawings and specified herein.
- B. The submittal will be reviewed for compliance with general requirements of design and arrangement only; it is not a contract document and acknowledgement of compliance does not relieve the Contractor from responsibility for performance of the work in compliance with all provisions and requirements of the Contract Documents. Job measurements and the coordination of all the dimensions for proper fit of all parts of the work and performance of all equipment supplies to meet specification requirements are and remain specific responsibilities of the Contractor.

- C. Shop Drawings shall be furnished by the Contractor for the work involved after receiving approval on the make and type of material and in sufficient time so that no delay or changes will be caused. This is done in order to facilitate progress on the job, and failure on the part of the Contractor to comply shall render him liable to stand the expense of any and all delays, changes in construction, etc., occasioned by his failure to provide the necessary detailed drawings. Also, if the Contractor fails to comply with this provision, the Architect reserves the right to go directly to the manufacturer he selects and secure any details he might deem necessary, and should there be any charges in connection with this, they shall be borne by the Contractor.
- D. The Shop Drawings submitted shall not consist of manufacturers' catalogues or cut sheets therefrom that contain no indication of the exact item offered. Rather, the submission on individual items shall designate the exact item offered.
- E. Shop Drawings submitted without indicating markings or Contractor's stamp shall not be reviewed and will be returned to the Contractor for correction of such discrepancies.
- F. The Shop Drawings are not intended to cover detailed quantitative lists of electrical specialties, and similar items, as the plans and specifications illustrate and describe those items, and it is the Contractor's responsibility to procure the proper sizes and quantities required to comply with the established requirements.
- G. Any Shop Drawings prepared to illustrate how equipment can be fitted into available spaces will be examined under the assumption that the Contractor has verified all the conditions, and obtained any approval thereon shall not relieve the Contractor of responsibility in the event the material cannot be installed as shown on those Drawings.
- H. Various material submissions of such as raceways, switches, panelboards, and related items shall be assembled in brochures or in other suitable package form and shall not be submitted in a multiplicity of loose sheets.
- I. Each Contractor shall process his submitted data to insure that it conforms to the requirements of the plans and specifications and that there are no omissions, errors or duplications.
- J. Shop Drawings shall be accompanied by certification from this Contractor that Shop Drawings have been checked by him for compliance with Contract Drawings.
- K. Samples of various products or mock-ups of particular details or systems may be required by various sections of this Specification.
- L. Refer to Division 1 requirements.

1.12 PENETRATIONS THROUGH FIRE-RATED ASSEMBLIES

- A. Seal voids around ducts and pipes penetrating fire-rated assemblies and partitions using fire-stopping materials and methods in accordance with provisions in Division 1.

1.13 CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

- A. All equipment furnished under other Divisions of the specification requiring service connections shall be connected by this Contractor. Materials and labor required for the connection of this equipment shall be furnished under Division 26. The respective supplier shall furnish proper roughing-in diagrams for the installation of these items. All items shall be roughed-in and connected in strict accordance therewith. All equipment requiring connection may not be specified herein, but may be included in other Division documents. This Contractor shall ascertain for himself all equipment so specified is included as part of his work.

- B. Refer to Section 26 05 23.

1.14 DRAWINGS

- A. The drawings show diagrammatically the locations of the various conduits, fixtures, and equipment, and the method of connecting and controlling them. It is not intended to show every connection in detail and all fittings required for a complete system. The systems shall include, but are not limited to, the items shown on the drawings. Exact locations of these items shall be determined by reference to the general plans and measurements at the building and in cooperation with other trades and, in all cases, shall be subject to the approval of the Architect. The Architect reserves the right to make any reasonable change in the location of any of this work without additional cost to the Owner.
- B. Should any changes be deemed necessary in items shown on the contract drawings, the shop drawings, descriptions, and the reason for the proposed changes shall be submitted to the Architect for approval.
- C. Exceptions and inconsistencies in plans and specifications shall be brought to the Architect's attention before bids are submitted; otherwise, the Contractor shall be responsible for the cost of any and all changes and additions that may be necessary to accommodate his particular apparatus.
- D. Lay out all work maintaining all lines, grades, and dimensions according to these drawings with due consideration for other trades and verify all dimensions at the site prior to any fabrication or installation; should any conflict develop or installation be impractical, the Architect shall be notified before any installation or fabrication and the

existing conditions shall be investigated and proper changes effected without any additional cost.

- E. Titles of Sections and Paragraphs in these specifications are introduced merely for convenience and are not to be construed as a correct or complete segregation or tabulation of the various units of material and/or work. The Architect does not assume any responsibility, either direct or implied, for omissions or duplications by the Contractor due to real or alleged error in the arrangement of matter in the Contract Documents.

1.15 COOPERATION

- A. All work under these specifications shall be accomplished in conjunction with other trades on this project in a manner which will allow each trade adequate time at the proper stage of construction to fulfill his work.
- B. Maintaining contact and being familiar with the progress of the general construction and the timely installation of sleeves and inserts, etc., before concrete is placed shall be the responsibility of this trade as will the installation of the required systems in their several stages, at the proper time to expedite this contract and avoid unnecessary delays in the progress of other contracts.
- C. Should any question arise between trades as to the placing of lines, ducts, conduits, or equipment, or should it appear desirable to remove any general construction which would affect the appearance or strength of the structure, reference shall be made to the Architect for instructions.

1.16 MATERIALS AND EQUIPMENT

- A. All materials purchased for this Project shall be new.
- B. Where specified product is not manufactured, manufacturer's current product meeting specification shall be substituted, subject to written approval of Engineer.
- C. Space allocations in electrical spaces are based on equipment scheduled in each case. Should the Contractor offer equipment of another make, he shall verify that such equipment will fit in the spaces allowed.
- D. Manufacturers' names are listed herein to establish a standard. The products of other manufacturers will be acceptable; if, in the opinion of the Architect, the substitute material is of a quality as good or better than the material specified, and will serve with equal efficiency and dependability, the purpose for which the items specified were intended.

- E. It is fully the Contractor's responsibility to assemble and submit sufficient technical information to fully illustrate that the material or equipment proposed for substitution is equal or superior as the Architect or his Engineer is under no obligation to perform the service for the Contractor. The proposal shall be accompanied by manufacturers' engineering data, specification sheet, and a sample, if practical or if requested. In no event shall a proposal for substitution be cause for delay of work.
- F. Should a substitution be accepted under the above provisions, and should the substitution prove defective or otherwise unsatisfactory for the intended service, within the warranty period, the Contractor shall replace the substitution with the equipment or material specified, and on which the specifications required him to base his proposal.

1.17 STORAGE AND PROTECTION OF MATERIALS

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

1.18 FOUNDATIONS

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

1.19 EXCAVATION AND BACKFILLING

- A. The Contractor shall do all necessary excavating and backfilling for the installation of his work. Trenches for underground conduits shall be excavated to required depths with bell holes provided as necessary to insure uniform bearing. Care shall be taken

not to excavate below depth, and any excavation below depth shall be refilled with sand or gravel firmly compacted. Where rock or hard objects are encountered, they shall be excavated to a grade six inches (6") below the lowermost part of the conduit and refilled to grade as specified. After the conduit has been installed and approved, the trenches shall be backfilled to grade with approved materials, well tamped or puddled compactly in place. Where streets, sidewalks, etc., are disturbed, cut, or damaged by this work, the expense of repairing same in a manner approved by the Architect shall be a part of this contract.

- B. The Contractor shall bear sole responsibility for design and execution of acceptable trenching and shoring procedures, in accordance with State of Texas Regulations. On trench excavations in excess of five feet in depth, contractor shall pay a qualified engineer to prepare detailed plans and specifications directing Contractor in the safe execution of trenching and shoring. It is understood that trench safety systems constitute a means and method of construction for which the Architect, Engineer, and Owner are not responsible. Accordingly, such documents when prepared, shall be separately issued by Contractor's Consultant, independent or project Contract Documents.

1.20 SCHEDULE OF WORK

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

1.21 CONTINUATION OF SERVICES

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

place and maintain the electrical systems in operation unless otherwise directed by the Architect.

- D. Arrange for and provide temporary electric and telephone services to the building where new construction conflicts with existing utility locations.

1.22 COMMISSIONING OF EQUIPMENT AND SYSTEMS

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

1.23 CLEANING UP

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

1.24 FINAL OBSERVATION

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

1.25 CERTIFICATIONS

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

1.26 GUARANTEE

- A. The guarantee provision of this specification requires prompt replacement of all defective workmanship and materials occurring within one year of final job acceptance. This includes all work required to remove and replace the defective item and to make all necessary adjustments to restore the entire installation to its original specified operating condition and finish at the time of acceptance. The Contractor shall also guarantee that the performance of all equipment furnished and/or installed under this Division of the specifications shall be at least equal to the performance as called for in the specifications and as stated in the equipment submittals. Should there be indication

that the equipment and installation is not producing the intended conditions, the Contractor shall make further tests as the Engineer may direct to demonstrate that the equipment installed meets the specifications. If there is indication that the equipment does not meet the specifications, the Contractor shall, at his expense, institute a program to demonstrate the adequacy of the installation. This program shall include all necessary testing and testing equipment. Should the Contractor not have the equipment or technical skill to perform the tests, it shall be his responsibility to provide recognized experts to perform the tests and shall provide certified laboratory tests, certified factory reports and work sheets, or other certified data to support results of any tests required.

B. Refer to Division 1 requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - INSTALLATION

3.1 DEVICE MOUNTING REQUIREMENTS

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

3.2 HOUSEKEEPING PADS

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

END OF SECTION

SECTION 26 05 01**ELECTRICAL DEMOLITION****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

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

1.3 DISRUPTION OF EXISTING FUNCTIONS

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

1.4 SALVAGE, DEMOLITION, AND RELOCATION

- A. It shall be the responsibility of the Contractor to remove and store those items of existing equipment as indicated on the Drawings to be removed. All items of equipment or fixtures removed shall be protected from damage insofar as is practical.
- B. These items shall be stored on site for a minimum of two (2) weeks unless indicated otherwise by the Owner's representative to allow for inspection by the Owner. Deliver, all items tagged to be retained by the Owner to a designated storage location on site or to the Owner's designated Service Center or Warehouse. All items not retained by the Owner shall be removed from the site by the Contractor at no additional cost to the Owner.

C. The attendant conduit, hangers, foundations, etc., of those items of existing equipment to be removed, shall also be removed in their entirety. No hangers, etc., shall be abandoned in place.

D. Relocations:

1. Repair and restore to good functional condition materials and items scheduled for relocation and/or reuse and which are damaged during dismantling or reassembly operations.
2. New materials and items of like design and quality may be substituted for materials and items indicated to be relocated, in lieu of relocation, upon approval of shop drawings, product data and samples.
3. Remove carefully, in reverse to original assembly or placement, items which are to be relocated.
4. Protect items until relocation is complete.
5. Clean and repair and provide new materials, fittings, and appurtenances required to complete the relocation and to restore to good operative order.
6. Perform the relocation work in accordance with pertinent sections of the specifications, utilizing skilled workers.
7. Refer to Drawings for specific requirements of temporary services and relocated equipment and fixtures.
8. Coordinate with the General Contractor repairs required to bring finishes back to their original conditions after demolition and or installation of new equipment.

1.5 CLEAN UP

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

PART 2 - PRODUCTS

2.1 GENERAL

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Field Conditions: Demolition Drawings are based on non-invasive field observations and existing record documents. Report discrepancies in location, dimensions or quantity to Owner and Architect prior to disturbing existing installation.

- B. Abandoned Wiring: Verify that abandoned wiring and equipment serve only facilities scheduled for demolition.
- C. Existing Conditions: Commencing demolition means Contractor accepts existing conditions.

3.2 PREPARATION

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

d. Data System

3.3 DEMOLITION AND EXTENSION OF EXISTING WORK

- A. General: Demolish and extend existing work as indicated or described in the Drawings and Specifications.
 - 1. Lighting fixtures and electrical distribution equipment shall be salvaged for possible re-installation as directed by the Owner and Architect.
- B. Wiring: Remove abandoned wiring and cables to source of supply or termination.
- C. Raceways:
 - 1. Remove exposed abandoned conduits and raceways, including abandoned conduits and raceways above accessible ceilings.
 - 2. Conduits and raceways concealed in existing construction to remain shall be abandoned in place. Cut conduits and raceways such that finished surfaces can be patched smooth.
- D. Wiring Devices: Remove abandoned wiring devices. Provide blank device plate for outlet box not being removed.
- E. Electrical Distribution Equipment: Disconnect and remove abandoned panelboards and electrical distribution equipment.
- F. Lighting Fixtures: Disconnect and remove abandoned lighting fixtures, including brackets stems, hangers and other accessories not indicated to be re-used.
- G. Existing Installations to Remain: Maintain access to existing electrical installations which remain active.
- H. Modify installation or provide access panel as required.
- I. Extension of existing circuits: Extend existing installations as required to maintain service to items to remain using materials and methods, as specified that are compatible with original installation.
- J. Adjacent Construction: Repair adjacent construction and finishes damaged during demolition and extension work.
- K. Dispose of hazardous materials, such as fluorescent and H.I.D. lamps and PCB's in lamp ballasts, in accordance with all Local, State and Federal ordinances and regulations.

3.4 SALVAGED MATERIALS

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

3.5 CLEANING AND REPAIR

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

END OF SECTION

SECTION 26 05 19**LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

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

1.3 QUALITY ASSURANCE

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

1.4 REFERENCED STANDARDS

- A. ICEA 5-61-402 Thermoplastic Insulated Wire and Cable
- B. ICEA 5-66-524 Cross Linked Thermosetting Polyethylene Insulated Wires and Cables
- C. ICEA 5-68-516 Ethylene Propylene Rubber Insulated Wire and Cable
- D. ICEA 5-19-81 Rubber Insulated Wire and Cable
- E. ANSI 1581 Standard of Electrical Wires, Cables, and Flexible Cords.
- F. UL 83 Thermoplastic Insulated Wires and Cables
- G. UL 1569 Metal Clad Cables

- H. ASTM B3 Standard Specification for Soft or annealed Copper Wire
- I. ASTM B8 Standard Specification for Concentric Lay Standard Copper
Conductors

1.5 SUBMITTALS

- A. Submit manufacturer's product literature completely describing conductors, cable assemblies, and evidence of U.L. Listing.

1.6 DELIVERY, STORAGE AND HANDLING

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

1.7 MANUFACTURERS

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

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Copper Conductors

1. Conductors shall be copper unless specifically noted otherwise on the Drawings.
2. Copper conductors shall be soft drawn annealed copper, minimum conductivity 98% of pure copper per ASTM ASTM-B3.
3. Sizes No. 10 AWG and smaller shall be solid conductor, single strand.
4. Sizes No. 8 AWG and larger shall be concentric lay Class B stranding.
5. Shall conform to the Conductor Properties proscribed in the NEC.

B. Insulation

1. Type THHN: 600-volt moisture and heat resistant thermoplastic rated 75 Deg.C. in wet or dry locations.
2. Type THHN-2: 600-volt moisture and heat resistant thermoplastic rated 90 Deg.C. in wet or dry location.
3. Type THWN: 600-volt moisture and heat resistant thermoplastic rated 75 Deg.C. in wet or dry.
4. Type THWN-2: 600-volt moisture and heat resistant thermoplastic rated 90 Deg.C. in wet or dry locations.
5. Type XHHW-2: 600-volt moisture resistant cross-linked polyethylene rated 90 Deg.C. in wet or dry locations.

C. Cable Assemblies:

1. Type MC Branch Circuit Cable: 600-volt, Type THHN/THWN conductors size 12 AWG through 10 AWG, including a green insulated grounding conductor, with steel interlocked armor applied over the assembly.

PART 3 - EXECUTION

3.1 USES PERMITTED

- A. Unless specifically noted on the drawings, permitted by the NEC and local codes and ordinances, wiring shall be Types THHN, THHN-2, THWN, THWN-2 or XHHW-2 installed in metal raceways as specified in 26 05 32, Raceways.
- B. For final connections from junction boxes mounted on the building structure to recessed lighting fixtures, and devices recessed in walls. Type MC cable assemblies shall be permitted, with the cable assembly length not to exceed respective room boundaries, and with supports as required by the NEC.
- C. Where permitted by the NEC and local ordinances, Type MC Branch Circuit cable may be utilized for branch circuit wiring where concealed in stud spaces of dry wall partitions. NEC requirements for supporting cables from the structure, independent of ceiling systems or ceiling support wires will be strictly mandated. All home runs from the first box to the panelboard shall be in EMT.
- D. Type MC Cable shall not be utilized in exposed areas, wet locations, or as homerun wiring to any panel or switchboard. Use in corridors shall be limited to lighting fixture whips above ceiling, no more than 6 feet in length.

3.2 COLOR CODING

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

3.3 GROUNDING CONDUCTORS

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

3.4 MULTIWIRE BRANCH CIRCUITS

- A. Multiwire branch circuits shall not be permitted unless required by the device served, such as for connection to modular furniture systems or track lighting systems.
- B. Where multiwire branch circuits are required, branch circuit breakers shall be two or three pole with common trip and one handle.

3.5 MINIMUM SIZE

- A. Conductors shall be of the minimum size shown on the drawings, lighting and power branch circuit wiring shall be minimum No.12 AWG.
- B. Feeder circuit wiring shall be sized to limit the effect of voltage drop, based on the actual installed conductor length to limit voltage drop to 2% of nominal system voltage.

- C. Branch circuit wiring shall be size to limit the effect of voltage drop, based on the actual installed conductor length, to limit voltage drop to 3% or less of nominal system voltage.
- D. Circuits shall be grouped in raceways and grouped together when passing through enclosures to have phases and neutral grouped together to minimize circuit reactance.

3.6 INSTALLATION

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

3.7 FIELD QUALITY CONTROL

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

END OF SECTION

SECTION 26 05 20**CABLE CONNECTIONS****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

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

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Samples: Provide samples upon specific request.
- B. Product Data: Submit manufacturer's product data giving complete description for sizes employed, material types, and electrical ratings.

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 MANUFACTURERS

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 INSPECTION

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

3.2 PREPARATION

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

3.3 INSTALLATION

- A. No. 10 Wire and Smaller: Connect with spring connectors, terminate at terminal strips.
- B. No. 8 Wire and Larger: Connect and terminate with above specified tape half-lapped to produce a dielectric value equal to wire insulation.

- C. Train, hold, clamp, and tag wiring in cabinets, pull boxes, panels, and junction boxes with above specified devices.
- D. Splices in feeders and mains may only be made where designated on the drawings and where prior approval is obtained from the Architect.
- E. Install terminal strips in enclosures without means for termination of wiring.
- F. Install cable and cord grips on all cables and cords, entering enclosures. Use wire mesh grips where necessary for strain relief.

3.4 FIELD QUALITY CONTROL

- A. Test: Connections shall be resistance tested with megohm meter as specified for wire.

3.5 ADJUSTMENTS

- A. Assure that wire connections made by others in equipment furnished by others are mechanically and electrically sound prior to energization.

END OF SECTION

SECTION 26 05 23**CONTROL - VOLTAGE ELECTRICAL POWER CABLES****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Work Included: Provide power wiring, raceways, and connections for items of equipment and control systems.
- B. All wiring for every system shall be installed in metal conduit. Refer to Section 26 05 32 Raceways for conduit types and materials for specific locations and applications.
- C. Where wiring is installed in electrical metallic tubing, the conduit shall be factory color coded as follows:
 - 1. Clear Electrogalvanized - 120 volt and higher circuits
 - 2. Fire Alarm - Red
 - 3. Controls for HVAC - Green
 - 4. Lighting Control Systems - White
 - 5. Telecommunications - Blue
 - 6. Security and Access Control - Orange
 - 7. Audio Visual Systems - Black
 - 8. Electric Power Monitoring - Yellow
- D. Related work specified in other sections:
 - 1. 23 09 00 - Instrumentation and Controls for HVAC
 - 2. 26 00 00 - Electrical
 - 3. 26 05 19 - Low Voltage Electrical Power Conductors and Cables
 - 4. 26 05 32 - Raceways
 - 5. 26 28 16 - Enclosed Switches and Circuit Breakers

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Samples: Provide samples upon specific request.
- B. Product Data: Submit manufacturer's product data giving complete description for sizes employed, material types, and electrical ratings.

1.5 WARRANTY

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

1.6 COORDINATION

- A. For equipment furnished under other Divisions, obtain equipment supply and wiring requirements from the Contractor supplying the equipment.
- B. For equipment furnished under Division 23, obtain complete temperature control system drawings, and power supply and interlock wiring requirements from the Contractor furnishing the systems.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to related work specified in other sections for material requirements.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Work Included: The Electrical Contractor shall provide:
 - 1. Branch circuit and motor feeder circuit conductors, raceway, connections, and overcurrent protection for each motor or item of equipment furnished by the Owner or other Contractors.
 - 2. Motor Control Centers, where indicated on the drawings.
 - 3. Installation of motor controllers furnished by the Owner or other Contractors, along with branch circuit and motor feeder circuit conductors, raceway, and connections in accordance with the manufacturer's approved wiring diagrams.
 - 4. Disconnect switches and combination disconnect switches and motor controllers, where indicated on the drawings or required by codes, except as provided as an integral part of manufactured equipment.
 - 5. Power supply conductors, raceway, connections, and overcurrent protection for input power to HVAC Temperature Controls, HVAC Automation, and HVAC Energy Management Systems in accordance with approved rough-in and connection diagrams furnished by the system suppliers.

6. The above represents an outline of the work for the purpose of describing one division of the work which is acceptable to ensure that all work is contained within the General Contract. Nothing herein shall be construed to confine the General Contractor from assigning the work to any member or group of contractors deemed best suited to executing the work to effect the contract. Refer to specific bidding instructions of the General Contractor for the actual division of the work. The General Contractor is fully responsible for the installation of complete, operating systems in accordance with the functional intent of the specifications.
- B. Work Not Included: The Mechanical Contractor shall provide:
1. Motors and equipment, erected in place and ready for final connection of power supply wiring, along with manufacturer's approved wiring diagrams.
 2. Motor controllers, in suitable enclosures and of the type and size in accordance with the manufacturer's recommendations and NEMA requirements, along with properly sized overload elements and approved wiring diagrams.
 3. Disconnecting switches or devices which are normally provided as a part of manufactured equipment.
 4. Rough-in and connection diagrams for input power supply and connections for the HVAC Temperature Control, HVAC Automation, and HVAC Energy Management Systems.
 5. Conductors, raceways, devices, and connections for low voltage control, line voltage control, and signaling systems for the HVAC Temperature Control, HVAC Automation, and HVAC Energy Management Systems in accordance with the provisions of Division 26, and approved systems shop drawings to provide complete operating systems in accordance with the functional requirements of the specifications.
 6. The above represents an outline of the work for the purpose of describing one division of the work which is acceptable to ensure that all work is contained within the General Contract. Nothing herein shall be construed to confine the General Contractor from assigning the work to any member or group of contractors deemed best suited to executing the work to effect the contract. Refer the specific bidding instructions of the General Contractor for the actual division of work. The General Contractor is fully responsible for the installation of complete, operating systems in accordance with the functional intent of the specifications.
- C. Completely connect all electrical consuming items of mechanical equipment, kitchen equipment, shop equipment, etc., provided by the Owner or other trades. Outlets of various types have been indicated at equipment locations, but no indications or exact location or scope of work is indicated on the accompanying drawings.
- D. Refer to details and information furnished by the Owner and various equipment suppliers for equipment wiring requirements and to the Plumbing and Heating, Ventilating and Air Conditioning Specifications for the scope of the connections to equipment provided under those sections, and determine from the various trades by actual measurements at the site, and by direction from the Owner and the Architect the exact locations of all items. Roughing-in drawings, wiring diagrams, etc., required for

the proper installation of the electrical work will be furnished by applicable trades furnishing equipment. Request the drawings and information required in writing to the equipment supplier in ample time to permit preparation of the drawings and to permit proper installation of all wiring. Obtain from those furnishing equipment the size and type of service required for each motor or piece of electrical equipment and verify that the service to be installed is compatible.

3.2 INSTALLATION

- A. All conduits shall terminate in conduit boxes on motors where possible. When motors are direct-connected, the conduit may continue rigid into the box, but when motors drive through belts and have sliding bases, a piece of flexible liquid tight conduit not less than 12 inches long shall be connected between the rigid conduit and the motor terminal. Where motors are not provided with conduit boxes, terminate the conduit in a conduit at the motor.
- B. Where disconnecting switches are not provided integral with the control equipment for motors, provide and install a disconnect switch in the circuit to each motor where indicated and required by code. Switches shall be installed as close as possible to the motor or controls they serve and they shall be within sight of the motor or control circuit.
- C. Be responsible for installing all conductors and protective devices serving equipment motors furnished by others in strict conformance with all applicable codes, regardless of any discrepancy in plans and/or mechanical equipment sizes variations, unless covered by directives issued by the Architect.

END OF SECTION

SECTION 26 05 26**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Provide connections from the existing grounding electrode system to:
 - 1. The electric power system grounded circuit conductor (neutral).
 - 2. The electric power system non-current carrying enclosures and equipment ground conductors (equipment ground).
- B. Provide connections from the existing grounding electrode system to auxiliary ground conductors for data and voice communication systems.
- C. Repair or replace existing service entrance grounding electrode system if required for proper operation of electrical equipment per Code.

1.3 QUALITY ASSURANCE

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

1.4 REFERENCED STANDARDS

- A. National Electrical Code, NFPA 70.
- B. EIA/TIA Standard 607
- C. IEEE - Standard 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- D. IEEE Standard 81 - Guide for Measuring Earth Resistivity.

1.5 SUBMITTALS

- A. Submit manufacturer's product literature completely describing conductors and cable assemblies and evidence of U.L. Listing.

1.6 DELIVERY, STORAGE AND HANDLING

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

1.7 MANUFACTURERS

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

1.8 WARRANTY

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

PART 2 - PRODUCTS**2.1 GROUND RODS**

- A. Standard ground rods shall be 3/4-inch diameter, 10-foot length, copper clad steel, equal to Thompson Company.

2.2 CONDUCTORS

- A. Conductors buried in contact with the earth shall be bare copper, solid for sizes up to No. 6 AWG, concentric lay strand for sizes No. 8 AWG and larger.
- B. Conductors for installation below raised access floor systems shall be bare copper, solid for sizes up to No. 6 AWG, concentric lay strand for sizes No. 8 AWG and larger.
- C. All other grounding conductors shall be copper conductor, Type THWN 600 volt 90 Deg.C. thermoplastic insulation, green color where available.

2.3 CONNECTIONS

- A. All connections made below grade, in inaccessible locations, and all connections and splices in the grounding electrode conductor system shall be made by exothermic weld process equal to Cadweld. Provide polyethylene inspection well covers and lids equal to Erico #T416B.
- B. All other connections shall be hydraulically crimped irreversible connectors equal to Thomas and Betts 54000 Series.
- C. Connections to raised access floor system pedestals shall be Thomas and Betts 38268 malleable iron mechanical clamp.
- D. Connections to cable trays shall be Thomas and Betts 10105 malleable iron mechanical clamp.
- E. Connections to domestic cold-water piping shall be Thomas and Betts GUV Series copper alloy U-bolt and mechanical clamp.
- F. Connections to building structural steel shall be exothermic weld equal to Cadweld.
- G. Connections which require flexibility for movement, expansion, or vibration shall be made with flexible flat conductor, multiple strands of 30-gauge copper conductors or equivalent circular mil area to the primary ground conductor. Protect ends with copper bolt hole end pieces.

2.4 CONDUITS

- A. Provide malleable iron conduit grounding bushings where:
 - 1. Metallic raceways terminate at metal housings without mechanical and electrical connection to housing.
 - 2. At each end of metallic conductors for grounding conductors where conduits are electrically non-continuous.
 - 3. At the ends of service entrance conduit.

PART 3 - EXECUTION

3.1 GROUNDING ELECTRODE

- A. Grounding electrode shall be tested and certified to provide five ohms or less Earth resistivity.
- B. If necessary, provide one, or more, driven solid ground rods to serve as the grounding electrode for the facility. Additional rods shall be driven at not less than ten-foot separation and connected together until the specified resistance testing criteria can be met.

3.2 SUPPLEMENTARY GROUND ELECTRODES

- A. The following items, where they exist on the project, shall be bonded together with the main grounding electrode described above:
 - 1. Domestic cold water service entrance.
 - 2. Building structural steel frame.
 - 3. Minimum twenty feet of bare copper conductor, minimum No. 4 AWG, encased in a concrete footing along the exterior perimeter edge of the building.
 - 4. Lightning Protection System.
- B. Ground Electrode Bus:
 - 1. All grounding electrode conductors shall be the same size and shall be not less than the size required by NEC or the size shown on the Drawings.
 - 2. Connect the grounding electrode system to the main ground connection in the U.L. Listed Service Disconnecting means in the main switch or switchboard.

3.3 GROUNDED CIRCUIT CONDUCTOR

- A. Bond the grounding electrode system to the grounded circuit conductor (neutral conductor) at one location only, on the supply side of the service disconnecting means, with a neutral disconnecting link as required by the NEC.

3.4 EQUIPMENT GROUNDING CONDUCTORS

- A. Bond the non-current carrying parts of the electric power system to the grounding electrode conductor at the service disconnecting means. From this point forward, all non-current carrying parts of the electric power system shall be electrically connected and continuous by means of:
 - 1. Electrically continuous equipment enclosures, metallic boxes and metallic raceways connected with U.L. Listed connectors and couplings.
 - 2. Equipment grounding conductors supplementary to metallic raceway systems where shown on the Drawings.
 - 3. Equipment grounding conductors in non-metallic raceway systems and in flexible metal conduit systems.
 - 4. Where permitted under other sections of the Specification, the insulated grounding conductor provided in Type MC cable will be considered an acceptable equipment grounding conductor.
 - 5. Uninsulated grounding strips and spiral wrap provided in Type AC cable is not an acceptable grounding conductor.

3.5 SEPARATELY DERIVED SYSTEMS

- A. Separately derived systems include:
 - 1. Secondaries of dry type power transformer.

2. Outputs of uninterruptible power systems.
 3. Outputs of motor generator sets or frequency convertors.
- B. These systems shall be grounded in accordance with the NEC, similar to the service disconnecting means discussed above, and as shown on the Drawings.
- C. The grounding electrode conductor from a separately derived system shall be connected to the main ground electrode bus described above, or to one of the secondary ground electrode busses, if present.
- D. A second grounding electrode conductor shall connect to building structural steel frame at the nearest available location, if available.

3.6 TESTING

- A. Grounding Electrode:
1. The earth resistance of the main ground electrode shall be not more than 5 ohms.
 2. Perform a measurement of ground resistance by one of the means described in IEEE Standard 81, Guide for Measuring Earth Resistivity.
 3. Provide written certification of the ground resistance measurements upon request.
- B. Grounding Continuity:
1. Provide continuity tests and checks of equipment grounding and isolated grounding conductor systems to ensure electrical continuity.
 2. Provide written certification of continuity checks upon requests.

END OF SECTION

SECTION 26 05 29**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Work Included: Provide miscellaneous materials for the supporting of electrical material and equipment.
- B. Related work specified in other sections:
 - 1. 26 00 00 - Electrical
 - 2. 26 05 32 - Raceways
 - 3. 26 05 33 - Boxes for Electrical Systems
 - 4. 26 27 16 - Electrical Cabinets and Enclosures

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data giving complete description of all items to be installed.

1.5 MANUFACTURERS

- A. Listed with Materials.
- B. Acceptable Manufacturers
 - 1. Unistrut
 - 2. Caddy
 - 3. Thomas & Betts

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Continuous Slotted Channel: #12-gauge steel, electrogalvanized, with zinc chromate, bases and dimensions as required for application.
- B. Hanger Rods: Continuous thread, electrogalvanized, with zinc chromate, sizes as required for loads imposed.
- C. Hex Head Cap Screws and Nuts: No. H-113 and No. H-114, respectively.
- D. One-Hole Pipe Straps: Series HS-100, galvanized steel
- E. Single Bolt Channel Pipe Straps: Steel, with machine screws and nut, Series C-105 and Series C-106.
- F. Lay-In Pipe Hanger: Series C-149.
- G. Conduit and Pipe Hanger: Series 6H.
- H. Beam Clamps: Series 500, RC, EC, and PC for applications.
- I. Concrete Inserts, Spot: Series D-256 or No. D-255.
- J. Concrete Inserts, Channel: Series D-980 or Series D-986.
- K. Riser Clamps: Series C-210.
- L. Cable Supports: O-Z/Gedney Type S.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Carefully lay out and provide concrete inserts.
- B. Securely fasten and support conduits and raceways to the building structure.
- C. Suspend horizontal runs of conduit and raceways from the floor and roof construction by rod hangers spaced 10 feet or less on centers for sizes 2-1/2 inches and greater and 9 feet or less on centers for sizes 2 inch and smaller.
- D. Fasten single runs of conduit to the structure with one-hole pipe straps and beam clamps or hang on rod hangers.
- E. Support multiple runs of conduit and raceways from continuous channel inserts or from trapeze hangers constructed of rod hangers and channels.

- F. Fasten single conduits to rod hangers with adjustable lay-in pipe hangers or for 2 inches and smaller conduits with Series 6H pipe hangers.
- G. Fasten conduits to channels with pipe channel straps.
- H. Support conduits and raceways within 3 feet of each end of each bend, of each termination, and at other intervals to maintain horizontal and vertical alignment without sag and deformation.
- I. Do not use cable, strap, and wire hangers as fasteners.
- J. Provide riser clamps for conduits at floor lines. Provide wire and cable supports in pull boxes for risers in accordance with NEC Section 300-19 and Table 300-19 (a).
- K. Install supports to permit equally distributed expansion and contraction of conduits and raceways with expansion joints. Use guides or saddles and U-bolts and anchors designed for equal effectiveness for both longitudinal and transverse thrusts.
- L. Do not rigidly support flexible conduits and raceways for equipment connections.
- M. Provide special supports with vibration dampers to minimize transmission of vibrations and noises.
- N. Provide trapeze hangers for conduits and raceways where routing interferes with ductwork.
- O. Provide hangers, racks, cable cleats and supports for wires and cables in cable chambers and other locations to make a neat and substantial installation.
- P. Provide angle iron and channel supports to the floor and structure for panelboards, cabinets, pull and junction boxes. Support independently from entering conduits and raceways. Provide supports as specified for conduits and raceways for outlet boxes and pull boxes 100 cubic inches and smaller.
- Q. Provide supports sized for the ultimate loads to be imposed.

3.2 CLEANING

- A. Clean surfaces to be painted.

END OF SECTION

SECTION 26 05 32**RACEWAYS****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Work Included: Provide a mechanically and electrically complete conduit system.
- B. Related work specified in other sections:
 - 1. 26 00 00 - Electrical
 - 2. 26 05 19 - Low Voltage Electrical Power Conductors and Cables
 - 3. 26 05 29 - Hangers and Supports for Electrical Systems
 - 4. 26 05 23 - Control Voltage Electrical Power Cables

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Samples: Provide samples upon specific request.
- B. Product Data: Submit manufacturer's product data giving complete description for sizes employed, material types, and installation methods.
- C. Certificates:
 - 1. Labels of Underwriters' Laboratories, Inc. affixed to each item of material.
 - 2. If materials are by manufacturers other than those specified submit certification that material meets applicable Underwriters' Laboratories, Inc. Standards.
 - 3. Labels of ETL Verified PVC-001 affixed to each PVC Coated Galvanized Rigid Conduit.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect conduits and finishes from damage.

1.6 MANUFACTURER

- A. The materials shall be the products of a manufacturer with a minimum of ten years' experience in the manufacture of similar equipment.
- B. Acceptable Manufacturers
 - 1. Metallic Conduits: Allied, and Wheatland.
 - 2. Nonmetallic Conduits: Cantex, and SEDCO.
 - 3. PVC Coated Metallic Conduits: Plastibond, Permacote, and Korkap.
 - 4. Others: As listed with products.

1.7 WARRANTY

- A. The materials shall be warranted to be in proper working condition for a period of one year following the date of final acceptance.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Rigid Metal Electrical Conduit: Hot-dipped galvanized steel with zinc coated threads and an outer coating of zinc bichromate, complete with one coupling and one end thread protector. Intermediate metal conduit (IMC) is not allowed.
- B. Electrical Metallic Tubing: Welded, electro-galvanized thin wall steel tubing.
 - 1. Conduit for power wiring shall be natural electro galvanized.
 - 2. Conduit for other systems shall be color coded in accordance with Section 26 05 23 - Control Voltage Electrical Power Cables.
- C. Flexible Metal Electrical Conduit: Hot-dipped galvanized steel strip core with integral copper ground wire on sizes 1-1/4" and smaller.
- D. Liquidtight Flexible Metal Electrical Conduit: Hot-dipped galvanized steel strip core with extruded polyvinyl jacket.
- E. Rigid Nonmetallic Electrical Conduit: Schedule 40 heavy wall polyvinylchloride, high impact resistant.
- F. PVC Coated Galvanized Rigid Conduit: The PVC coated galvanized rigid conduit must be UL Listed. The PVC coating must have been investigated by UL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be UL Listed with PVC as the primary corrosion protection.

Hazardous location fittings, prior to plastic coating must be UL listed. All conduit and fittings must be new, unused material. Applicable UL standard may include: UL 6 Standard for Safety, Rigid Metal Conduit, UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.

G. Elbows and Bends:

1. All Types: Size 1-1/4 inch and larger shall be factory manufactured.

H. Bushings:

1. 1-1/4" and Smaller: Same material as the conduit with which they are installed.
2. 1-1/2" and Larger: Hot-dipped galvanized with thermosetting phenolic insulation, 150 Deg.C.

I. Locknuts:

1. 1-1/2" and Smaller: Zinc plated heavy stuck steel, O-Z/Gedney.
2. 2" and Larger: Cadmium plated malleable iron, O-Z/Gedney.

J. Hubs: Cadmium plated malleable iron, tapered threads, neoprene "O" ring, insulated throat, O-Z/Gedney.

K. E.M.T. Compression Connectors: Gland compression type, zinc plated steel body, cadmium plated, malleable iron nut, insulated throat, O-Z/Gedney.

L. E.M.T. Compression Couplings: Gland compression type, zinc plated steel body, cadmium plated malleable iron nut, O-Z/Gedney.

M. Liquidtight Conduit Connectors: Cadmium plated malleable iron body and nut, cadmium plated steel ferrule, insulated throat, integrally cast external ground lug, O-Z/Gedney.

N. Seals for Watertight Wall and Floor Penetrations: Malleable iron body, oversize sleeve, sealing ring, pressure clamp and rings and sealing grommet, hex head cap screws, O-Z/Gedney.

O. Seals for Penetrations through Existing Walls: Thunderline Corporation Link-Seal watertight sleeves, complete with wall and casing seals.

P. Fire Seals: Galvanized iron pipe sleeves sealed with approved foam type fireproofing.

Q. Expansion Fittings: Hot-dipped galvanized malleable iron with bonding jumpers selected for linear or linear with deflection, as required.

R. Escutcheons: Chrome plated sectional floor and ceiling plates, Crane No. 10.

S. Accessories: Reducers, bushings, washers, etc., shall be cadmium plated malleable iron on the forms and dimensions best suited for the application.

- T. Identifying Tape for Underground Conduits: Polyethylene tape, 6 inches wide, with continuous printing along length, Brady Identoline:
 - 1. For Electric Power Conduits: Yellow with black letters.
 - 2. For Other Services: Green with black letters.
- U. Sleeves: 22 gauge galvanized steel sleeves where conduits pass through walls and floors. Standard galvanized steel pipe where conduits pass through beams, outside walls, or structural members.
- V. Conduit Color Schedule: All EMT shall be color coded to easily identify which cable system is being served. All EMT shall be color coded as follows:
 - 1. BMS: Green
 - 2. Telecommunications: Blue
 - 3. Fire Alarm: Red
 - 4. Security: Orange
 - 5. Electrical: Silver / Natural
 - 6. Lighting Controls: White
 - 7. Sound Masking: Black
 - 8. EPMS: Yellow

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces to which conduits are to be secured for:
 - 1. Defects which will adversely affect the execution and quality of work.
 - 2. Deviations from allowable tolerances for the building material.
- B. Do not start work until defects and deviations are corrected.

3.2 INSTALLATION

- A. Size conduits as indicated on the drawings and as required by the NEC for the number and sizes of wires to be drawn into conduit. Do not use conduit sized less than 3/4" unless specified otherwise.
- B. Conceal conduits from view in all areas except mechanical and electrical equipment rooms and crawl spaces. Should it appear necessary to expose any conduit:
 - 1. Bring to the attention of the Architect, immediately, and
 - 2. Rearrange the work to facilitate an approved installation.
- C. Install all conduits at elevations and locations to avoid interference with grading of other work, the structure, finished ceilings, walls. Avoid causing cutting of masonry units.

- D. To prevent displacement, securely support and hold in place all conduits installed in advance of other work and to be concealed in the building structure.
- E. Carefully lay out conduits run within the structure, such as floors, beams, walls, to avoid densities excessive for the construction. Relocate those conduits when excessive densities occur.
- F. Ream, remove burrs, and swab inside conduits before conductors are pulled in.
- G. Cap or plug conduits with standard manufactured accessories as soon as the conduits have been permanently installed in place.
- H. Bends and offsets in 1" and smaller conduits may be done with approved bending devices. Do not install conduits which have had their walls crushed and deformed and their surface finish damaged due to bending.
- I. Where space conditions prohibit the use of standard ells, elbows, and conduits, use cast ferrous alloy fittings of such forms and dimensions as best required for the application.
- J. Make all conduit joints mechanically tight, electrically continuous, and watertight. Pitch conduits in a manner to avoid creating moisture traps.
- K. Install insulated throat threaded hubs on conduits entering enclosures without threaded hubs where exposed to damp or wet locations.
- L. Connect and couple E.M.T. with compression type fittings. Do not use indentor and set screw fittings.
- M. Install and neatly rack exposed conduits parallel with and perpendicular to the building walls. Do not install exposed diagonal conduit runs.
- N. Route and suspend conduits crossing expansion joints to permit expansion, contraction, and deflection utilizing approved fittings to prevent damage to the building, conduits, and supporting devices in accordance with the National Electrical Code.
- O. Do not run conduits exposed on the roof unless approval is obtained prior to installation.
- P. Do not place conduits in close proximity to equipment, systems, and service lines, such as hot water supply and return lines, which could be detrimental to the conduit and its contents. Maintain a minimum 3" separation, except in crossing, which shall be a minimum 1".
- Q. Connect motors, equipment containing motors, equipment mounted on an isolated foundation, and other equipment and devices which are subject to vibration and which require adjustment with flexible metallic conduit from the device to the conduit serving

it. Size the flexible conduit length more than 12 diameters, but less than 18 diameters. Rigidly support the points of attachment on each side of the connection.

- R. Install escutcheons on all exposed conduits passing through interior floors, walls, or ceilings. Install fire sealing materials on all conduits passing through fire rated partitions. Install wall and floor fire seals on all conduits passing through exterior walls and floors.
- S. Conduit sleeves shall be sized to permit insertion of conduit with adequate clearance for movement due to expansion and contraction. Where conduits pass through outside walls, watertight fittings, as specified herein, shall be used.
- T. Provide pullstring in each empty conduit. Label pullstring when conduit termination is not obvious.
- U. All stubups of PVC conduit runs shall be made with rigid galvanized steel conduit with protective wrapping. Provide corrosion resistant protective wrapping from where the galvanized conduit begins to 4" above the finished floor.

3.3 USES PERMITTED

- A. Rigid Metal Conduit:
 - 1. Exterior conditions above grade.
 - 2. Interior wet or damp locations.
 - 3. Hazardous locations.
 - 4. Central utility plant and mechanical equipment rooms.
 - 5. Lower Level of the building.
- B. Schedule 40 PVC with concrete encasement:
 - 1. Below grade exterior to the building.
 - a. Electric Services.
 - b. Communications Services.
- C. Schedule 40 PVC without concrete encasement:
 - 1. Below grade interior to the building.
 - a. Electric services below floor slab.
 - b. Communications services below floor slab.
 - 2. Below grade exterior to the building.
- D. Electrical Metallic Tubing:
 - 1. All uses above grade interior to the building, except as limited elsewhere in this section.
- E. Steel Armor Clad Cable:

1. Concealed in walls and above ceilings.
2. Final connection from junction boxes on structure to individual light fixtures.
Fixture-to-fixture wiring not permitted.
3. Home runs from first junction box to panelboards shall be EMT.

F. Flexible Metal Conduit:

1. Final connection to vibrating or adjustable equipment.
2. Connection to vibrating equipment shall contain one 90 degree bend.

G. Liquid tight Flexible Metal Conduit:

1. All uses permitted for flexible metal conduit.
 - a. In damp or wet locations.
 - b. Exterior to the building.
 - c. Food service areas.
 - d. Central plant equipment rooms.

END OF SECTION

SECTION 26 05 33**BOXES FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 REFERENCE DOCUMENTS**

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

1.2 DESCRIPTION

- A. Work Included: Provide outlet boxes for the installation of wiring devices, lighting fixtures, and power and control connections.
- B. Related work specified in other section:
 - 1. 26 00 00 - Electrical
 - 2. 26 27 26 - Wiring Devices
 - 3. 26 51 01 – Interior Lighting
 - 4. 26 05 23 - Control-Voltage Electrical Power Cables

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Samples: Provide samples upon specific request.
- B. Product Data: Submit manufacturer's product data giving complete description for sizes employed, material types, and electrical ratings.

1.5 MANUFACTURERS

- A. Listed with Materials.
 - 1. Appleton Electric Company
 - 2. Raco
 - 3. Steel City
 - 4. Crouse Hinds

5. Hubbell
6. Raceway Components
7. Legrand/Wiremold

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Flush Mounted Outlet Boxes: Standard, stamped galvanized steel with factory conduit knockouts, one piece and welded construction:
 1. Series 4S and 4S0 square boxes with covers.
 2. Series M1, M2, M3 - 250 and Series M1, M2, M3 - 350 masonry boxes with covers.
 3. Series 2G and GC-5075 switch boxes with covers.
 4. Series OCR concrete rings with Series OCP and OCP-3/8 back plates.
 5. Series 40 and 40D octagonal boxes with raised covers.
 6. Series SX expandable bar hangers.
- B. Surface Mounted Outlet Boxes: Cast metal with threaded hubs. Type FS and FD of form suited to the application.
- C. Fire Rated, Flush, Poke-Thru Devices: Legrand Evolution #6AT, #8AT, or #10AT.
- D. Floor Outlet Boxes: Legrand Evolution #EFB6, #EFB8, or #EFB10 cast flush floor boxes, fully adjustable with flush service fitting, and carpet flange (if required).

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine building structure to which outlet boxes are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

3.2 PREPARATION

- A. Carefully measure and lay out exact locations in conference with the Construction Manager.
- B. Owner may change outlet box locations a distance of 5 feet before rough-in without additional cost.

3.3 INSTALLATION

- A. In dry walls for single and two gang outlets provide 4S and 4D boxes; for 3 or more outlets use masonry boxes.

- B. In poured concrete floors, provide cast flush floor boxes complete with service fittings and carpet flanges (if required).
- C. In block and masonry walls provide masonry boxes of depths required for wall thickness.
- D. In poured concrete and plastered walls provide 4S and 4D boxes for single gauge outlets and 2G and 3G-5075 boxes for multiple ganged outlets.
- E. In concrete ceiling provide OCR rings.
- F. In other ceilings provide 40 and 40D boxes. Omit covers if standard canopy and device plates entirely cover the ceiling opening.
- G. In exposed work, exterior of the building, in wet locations, and flush in non-waterproofed walls below grade provide FS and FD boxes.
- H. Submit for approval special boxes for special devices and applications. Size according to device and application in accordance with NEC.
- I. Install outlet boxes finished to within 1/8 inch of finished surfaces.
- J. Install center of box at heights above finished floor:
 - 1. Wall Switches: 45 Inches
 - 2. Convenience Outlets: 18 Inches
 - 3. Telephone/Data Outlets: 18 Inches
 - 4. Wall Telephone Outlets: 45 Inches
 - 5. Boxes Indicated Above Counters: 4 Inches above backsplash and trim, unless otherwise indicated.
- K. Install wall switch outlet boxes on the strike side of doors as finally hung.
- L. Group outlet on circuits with homeruns as indicated on the Drawings.
- M. Do not provide through-the-wall and back-to-back boxes unless specifically noted on the drawings.
- N. Provide standard manufactured plugs in unused openings of boxes.
- O. Provide boxes at the terminal of conduit runs to outlets and devices.
- P. Provide plaster rings and covers where required by the building structure.
- Q. In brick finished walls, locate to work brick in a brick course where possible, and to permit conduits and raceways to enter from the rear without cutting brick, where possible.
- R. Provide 3/8-inch studs and lighting fixture outlet boxes where shop drawings of fixtures require and elsewhere as may be required for fixtures.

- S. Rigidly attach to structure and ceiling supporting members in suspended ceilings to avoid cutting mechanical ceiling members.
- T. Center outlet in paneling and in other Architectural features.
- U. Locate light fixture outlets in uniform relation with ceiling tiles.
- V. Label all junction boxes with circuit information as to its use for special system equipment. Use an indelible marker to mark information on cover.
- W. Floor boxes and Poke-Thru's shall be provided with a minimum of, one (1) 3/4" conduit for power, and (1) 1" conduit for data. Exact quantity of devices, conduits, and conduit dimensions shall be as required by the Owner, Technology, and A/V Consultants. Contractor shall select appropriate floor boxes and Poke-Thru's sized per the requirements of the Owner, Technology, and A/V Consultants, prior to purchase or installation, then furnish each item with all required accessories and conduits accordingly. Finish colors and materials shall be as selected by the Interior Designer and Architect.

3.4 CLEANING

- A. Clean surfaces to be painted.

END OF SECTION

SECTION 26 05 53**IDENTIFICATION FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 REFERENCE DOCUMENTS**

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

1.2 DESCRIPTION

- A. Provide identification of electrical equipment.
- B. Provide identification of over current devices.
- C. Provide identification of branch circuits, outlets, and wiring devices.
- D. Provide identification of required clear working spaces for electrical equipment.
- E. Provide identification of rooms and spaces for access by qualified personnel.
- F. Related work specified in other section:
 - 1. 26 05 33 - Boxes for Electrical Systems.

1.3 QUALITY ASSURANCE

- A. Signs and placards shall meet the requirements by OSHA.

1.4 SUBMITTALS

- A. Submit literature describing all electrical signage and marking materials for approval prior to installation.

PART 2 - PRODUCTS**2.1 PLACARDS**

- A. Placards shall be engraved phenolic name plates with engraved lettering engraved. Lettering shall be minimum 24-point type in basic block font.
- B. Placards shall be securely and permanently adhered to the equipment enclosures without fasteners or penetrations into the enclosures.

C. Placards shall be color coded for various systems as follows:

1. Utility Power Systems: White placard, black lettering.
2. Other Systems: As directed by Owner.

2.2 LABELS

A. Labels shall be typewritten, adhesive backed printed labels. Lettering shall be minimum 18-point type in basic black font.

2.3 MARKING MATERIALS

A. Materials for marking of required working clearance shall be adhesive backed yellow tape, equal to 3M Company 471 Series. Clean and prepare floor surface in accordance with manufacturer's instructions.

2.4 SIGNAGE

- A. Signage for electrical equipment rooms shall be preprinted manufactured sign units providing warning of the Danger of Electrical Equipment Hazards and limiting access to Qualified Personnel only.
- B. Signage shall be securely and permanently adhered to the door surface without fasteners or penetrations into the door surface.
- C. All signage shall be approved by the Architect prior to installation.

PART 3 - EXECUTION

3.1 SERVICE ENTRANCE EQUIPMENT

- A. Provide a placard for each service entrance equipment identifying
1. The name of the equipment.
 2. The data of installation.
 3. The utility company available fault current.
 4. The supply system voltage.
 5. The name of the engineering company of record for the project.
 6. The number of service disconnecting means associated with this service.
 7. The name and locations of any other service entrance equipment on the property.
- B. Provide each service disconnecting means, switch or circuit breaker with a placard identifying the device as "Service Disconnecting Means X of X Devices."
1. Utility source disconnecting means.
- C. Provide Feeder Protective Devices with a placard identifying the name of the device or circuit number and the name of the equipment or load served.

3.2 DISTRIBUTION SWITCHBOARDS AND PANELBOARDS

- A. Provide each switchboard and panelboard with a placard identifying.
 - 1. The name of the equipment.
 - 2. The supply system voltage.
 - 3. The name of the equipment supplying the switchboard or panelboard.
 - 4. The circuit number of the overcurrent device supplying the switchboard or panelboard.
- B. Provide each feeder protective device with a placard identifying the name of the device or circuit number and the name of the equipment or load served.

3.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. Provide each panelboard with a placard identifying:
 - 1. The name of the equipment.
 - 2. The supply system voltage.
 - 3. The name of the equipment supplying the switchboard or panelboard.
 - 4. The circuit number of the overcurrent device supplying the panelboard.
- B. Provide each panelboard with a typewritten circuit directing card describing the name of the load served and the room number (3) where the devices are located. Reference the room number(s) actually installed at the project, not the room numbers for Architectural construction documents.

3.4 LOW VOLTAGE DISTRIBUTION TRANSFORMERS

- A. Provide each transformer with a placard identifying:
 - 1. The name of the equipment.
 - 2. The name of the supply source equipment and protective device circuit number.
 - 3. The supply system voltage.
 - 4. The load systems voltage.
 - 5. The name of the equipment supplied from the load side of the transformer.

3.5 OTHER EQUIPMENT

- A. Provide other electrical and mechanical equipment with placards identifying.
 - 1. The name of the equipment.
 - 2. The name of the supply source equipment.
 - 3. The circuit number of the overcurrent device supplying the equipment.

3.6 OUTLET BOXES, JUNCTION BOXES AND WIRING DEVICES

- A. Provide labels affixed to the inside cover for each outlet box, junction box, and wiring device identifying the panel name and branch circuit numbers for the overcurrent devices supply the circuits.

3.7 REQUIRED WORKING CLEARANCES

- A. Provide marking on the floor around each item of equipment defining the required working clearances in accordance with the National Electrical Code.

3.8 ELECTRICAL EQUIPMENT ROOMS

- A. Provide each entry door into a room or space containing electrical power distribution equipment providing Warning of the Electrical Hazard and restricting entrance to Qualified Personnel only.

END OF SECTION

SECTION 26 27 16**ELECTRICAL CABINETS AND ENCLOSURES****PART 1 - GENERAL****1.1 REFERENCE DOCUMENTS**

- A. Conditions of the Contract and Division 01 - General Requirements are hereby made a part of this section.
- B. All sections of this specification.

1.2 DESCRIPTION

- A. Work Included: Provide cabinets for the installation of wiring and equipment.
- B. Related work specified in other section:
 - 1. 26 00 00 – Electrical
 - 2. 26 28 16 - Enclosed Switches and Circuit Breakers
 - 3. 26 05 23 - Control Voltage Electrical Power Cables

1.3 QUALITY ASSURANCE

- A. Source Quality Control: Tests to meet applicable Underwriters' Laboratories, Inc. Standards.
- B. Reference Standards:
 - 1. Underwriters' Laboratories, Inc. applicable Standards.
 - 2. National Electrical Code.
- C. Design Criteria: National Electrical Manufacturer's Association construction types based on environment.
 - 1. Indoor: NEMA Type 1
 - 2. Outdoor: NEMA Type 3R

1.4 SUBMITTALS

- A. Shop Drawings shall include dimensions, knockout sizes and locations, material types and gauges, finishes, and installation methods.
- B. Certificates shall include labels of Underwriters' Laboratories, Inc., and National Electrical Manufacturer's Association affixed to each item.

PART 2 - PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Square D Company.
- B. Eaton.

2.2 MATERIALS

- A. For Panelboards:
 - 1. Same manufacturer as panelboard, boxes of code gauge steel, welded with edges turned to receive trim, and galvanized.
 - 2. Trim and doors No. 12 gauge steel minimum, hinged door, flush tumbler lock and catch keyed alike throughout the work, factory enamel finish, suitable for field color coat.
 - a. Flush: Overlap minimum 3/4 inches top, bottom, and sides.
 - b. Surface: Same size as cabinet.

PART 3 - EXECUTION**3.1 INSPECTION**

- A. Examine structure to which cabinets are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

3.2 PREPARATION

- A. Carefully measure and lay out exact locations.
- B. Provide supports.

3.3 INSTALLATION

- A. Provide cabinets as indicated or where necessary.
- B. Provide flush type in finished areas centered in paneling and other Architectural features.
- C. Provide surface type in equipment rooms, above accessible finished ceilings, and in crawl spaces.
- D. Install lighting and power cabinets with tops 6 feet 6 inches above finished floor.
- E. Install cabinet trim and doors straight and plumb.

3.4 CABINET IDENTIFICATION

- A. Cabinets for all panelboards, switchboards, disconnect switches, transformers, motor starters, and electrical equipment furnished shall be provided with engraved phenolic lamacoid plastic name plates with 1/2-inch block engraving.
- B. Name plates shall give equipment designation as scheduled on the drawings, circuit number designation, and voltage and phase of service.

3.5 ADJUSTMENT AND CLEANING

- A. Adjust trims and doors for vertical and horizontal alignment.
- B. Clean surfaces to be painted.

END OF SECTION

SECTION 26 27 26**WIRING DEVICES****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Work Included: Provide wiring devices and cover plates for outlets designated to receive them.
- B. Related work specified in other section:
 - 1. 26 00 00 - Electrical
 - 2. 26 05 33 - Boxes for Electrical Systems

1.3 QUALITY ASSURANCE

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

1.4 REFERENCED STANDARDS

- A. U.L. 20 - General Use Snap Switches.
- B. U.L. 498 - Attachment Plugs and Receptacles.
- C. U.L. 1682 - Plugs, Receptacles and Cable Connectors of the Pin and Sleeve Type.
- D. U.L. 1686 - Pin and Sleeve Configurations.
- E. NEMA WD-1 General Color Requirements for Wiring Devices.
- F. NEMA WD-6 Configurations for Specific Purpose Plugs and Receptacles.
- G. Federal Specification WS-896 Switches, Toggle, Flush mounted.
- H. Federal Specification WC-596 Connector, Electrical Power.
- I. IEC 309-1 Pin and Sleeve Devices.

- J. IEC 309-2 Pin and Sleeve Devices.

1.5 SUBMITTALS

- A. Samples: Provide samples upon specific request for typical NEMA devices.
- B. Product Data: Submit manufacturer's product data describing materials and electrical ratings.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver devices and cover plates in manufacturer's sealed unopened packages and protect from the introduction of dust and moisture.
- B. Do not install wiring devices and cover plate until adjacent finishes are complete and the area has been cleaned to a dust free dry environment.

1.7 MANUFACTURER

- A. The equipment shall be the product of a manufacturer with at least ten years' experience in the manufacture of similar equipment.
- B. All wiring devices on the project shall be of the same manufacturer where rated 50 amperes or less.
- C. Acceptable manufacturers:
 - 1. Leviton.
 - 2. Hubbell.
 - 3. Legrand.
 - 4. Cooper.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Unless noted otherwise, wiring devices shall be standard industrial grade devices, white color, with Type 302 stainless steel covers.
- B. Where specifically noted on the drawings or required by the Architect, wiring devices in finished areas shall be Decora commercial grade devices, white color, with commercial grade thermoplastic matching cover plate.
- C. Where required by the National Electrical code or local codes and ordinances, receptacles shall be commercial grade GFCI type, matching color with other wiring devices in the area, with matching thermoplastic or stainless steel cover plate.

- D. Where required by the National Electrical Code or local codes and ordinances, receptacles shall be commercial grade tamper proof design, including any educational occupancy with child occupants seven years old or younger including day care, churches, community centers and elementary schools.

2.2 INDUSTRIAL GRADE DEVICES

- A. Shall be equal to the devices listed below.

B. Switches

1. Single pole wall toggle, Leviton 1221-2. P&S PS20AC1.
2. Three-way wall toggle, Leviton 1223-2. P&S PS20AC3.
3. Four-way wall toggle, Leviton 1224-2. P&S PS20AC4.
4. Single pole key toggle, Leviton 1221-2KL. P&S PS20AC1KL.
5. Three-way key toggle, Leviton 1223-2KL. P&S PS20AC3KL.
6. Four-way key toggle, Leviton 1224-2KL. P&S PS20AC4KL.
7. Single pole, double throw, center off maintained contact, Leviton 1285. P&S 1225.
8. Single pole, double throw, center off momentary contact, Leviton 1257. P&S 1251.
9. Single pole, pilot light, Leviton 1221-PL. P&S PS20AC1CPL.
10. Single pole, lighted handle, Leviton 1221-LH. P&S PS20AC15L.

C. Straight Blade Receptacles

1. 125V, 20A, 5-20R, Simplex, Leviton 5361, P&S 5361.
2. 125V, 20A, 5-20R, Duplex, Leviton 5362, P&S 5362.
3. 125V, 20A, 5-20R, Duplex, Tamper Resistant, Leviton M5362-SGG, P & S TR26362.
4. 250V, 20A, 6-20R, Simplex, Leviton 5461, P&S 5871.
5. 250V, 20A, 6-20R, Duplex, Leviton 5462, P&S 5862.
6. 125V, 30A, 5-30R, Simplex, Leviton 5371, P&S 3802.
7. 250V, 30A, 6-30R, Simplex, Leviton 5372, P&S 3801.
8. 277V, 30A, 7-30R, Simplex, Leviton 9730-A, P&S L730R.
9. 125/250V, 10-30R, Simplex, Leviton 5207, P&S 3860.
10. 125/250V, 30A, 14-30R, Simplex, Leviton 278, P&S 3864.
11. 125/250V, 5-20R, Simplex Clock Hanger, Leviton 5361-CH. 5-15R P&S S3713.

D. Locking Type Receptacles

1. 125V, 20A, L5-20R, Simplex, Leviton 2310. P&S L520R.
2. 250V, 20A, L6-20R, Simplex, Leviton 2320. P&S L620R.
3. 277V, 20A, L7-20R, Simplex, Leviton 2330. P&S L720R.
4. 125/250V, 20A, L10-20R, Simplex, Leviton 2360. P&S L1020R.
5. 125/250V, 20A, L14-20R, Simplex, Leviton 2410. P&S L1420R.
6. 125V, 30A, L5-30R, Simplex, Leviton 2610. P&S L530R.
7. 250V, 30A, L6-30R, Simplex, Leviton 2620. P&S L630R.
8. 277V, 30A, L7-30R, Simplex, Leviton 2630. P&S L730R.
9. 125/250V, 30A, L10-30R, Simplex, Leviton 2660. P&S L1030R.

10. 125/250V, 30A, L14-30R, Simplex, Leviton 2710. P&S L1430R.

E. GFCI Receptacles

1. 125V, 20A, 5-20R, Duplex, Commercial Grade, Leviton 7599. P&S 1595.
2. 125V, 20A, 5-20R, Duplex, Hospital Grade, Leviton 7599-HG. P&S 2095HG.

2.3 DECORA DEVICES

A. Shall be equal to the devices listed below.

B. Switches

1. Single pole wall toggle, Leviton 5621-2. P&S 2621.
2. Three-way wall toggle, Leviton 5623-2. P&S 2623.
3. Four-way wall toggle, Leviton 5624-2. P&S 2624.
4. Single pole, double throw, center off maintained contact, Leviton 5685-2. P&S TM811DTMA.
5. Single pole, double throw, center off momentary contact, Leviton 5657-2. P&S TM811DTMO.
6. Single pole, pilot light, Leviton 5628-2. P&S 2629.
7. Single pole, lighted handle, Leviton 5631-2. P&S 2625.

C. Straight Blade Receptacles

1. 125V, 20A, 5-20R, Simplex, Leviton 16351. P&S 26361.
2. 125V, 20A, 5-20R, Duplex, Leviton 16362. P&S 26352.
3. 125V, 15A, 5-15R, Duplex, Tamper Resistant, Leviton DR15-SG. P&S TR26362.

2.4 WEATHER RESISTANT DEVICES

- A. Where noted on the drawings or located exterior to the building, wall switches shall be provided with die cast zinc weatherproof, gasketed cover plate with NEMA 3R classification in wet locations.
- B. Where noted on the drawings or located exterior to the building, wall receptacles shall be provided with die cast zinc weatherproof gasketed cover plates with NEMA 3R classification, listed for in use unattended plugs in wet locations.

2.5 MOTOR RATED SWITCHES

- A. Fractional horsepower motors with internal overload protection shall be provided with double pole or three pole manual motor starting switches equal to Leviton MS series.

2.6 COMBINATION SWITCH AND RECEPTACLE OUTLETS

- A. Where shown on the drawings provide combination disconnect switches and pin and sleeve power receptacles of the voltage, phase, and ampacity noted, equal to Leviton Power Switch.

- B. Switches shall be fused or non-fused as shown on the drawings, with Class J time delay fuses where required.
- C. Switches and receptacles shall be interlocked so that the switch cannot be closed without the plug-in place and the plug cannot be removed with the switch in the on position.
- D. Switch shall be equipped with provisions for pad locking in the off position.
- E. Provide one mating plug for each receptacle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Align wiring device covers vertically and horizontally and assure flush fit to wall surface.
- B. Surface mounted devices in cast ferrous boxes shall be furnished with stamped steel galvanized face plates.

3.2 IDENTIFICATION

- A. Each receptacle shall be provided with a permanently affixed name plate giving the panelboard and branch circuit number supplying the outlet.
- B. Identification shall be on the inside or outside of the cover plate as directed by the Architect.
- C. Manual Motor Rated Switches and Combination Switch and Receptacle Outlets shall be provided with permanently attached engraved phenolic name plates giving the panel and branch circuit source of supply and the name of the device controlled.
- D. Unless noted otherwise, all receptacles connected to a supply from a standby generator source shall be red color.
- E. Unless noted otherwise all receptacles connected to a supply from an uninterruptible power system source shall be orange color.

END OF SECTION

SECTION 26 28 13**FUSES****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Work Included: Provide low voltage fuses for overcurrent protection in fusible devices.
- B. Related Work specified in other sections:
 - 1. 26 00 00 – Electrical
 - 2. 26 28 16 - Enclosed Switches and Circuit Breakers

1.3 QUALITY ASSURANCE

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

1.4 REFERENCE STANDARDS

- A. NEMA FU1 Low Voltage Cartridge Fuses
- B. UL 248 Low Voltage Fuses

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's product data, including minimum melting and total clearing time charts for each type of fuse.

1.6 JOB CONDITIONS

- A. Deliver fuses to the project in the manufacturers new unopened shipping containers.
- B. Store fuses in a clean, dust free, cool environment until required for installation to energize equipment.

1.7 MANUFACTURER

- A. The equipment shall be the product of a manufacturer with a minimum of ten years' experience with the manufacture of similar equipment.
- B. Acceptable Manufacturers
 - 1. Bussman
 - 2. Littlefuse
 - 3. Ferraz - Shawmut

1.8 WARRANTY

- A. Fuses shall be warranted to be in proper working order for a period of one year following the date of final acceptance.

PART 2 - PRODUCTS

2.1 FUSES - ABOVE 600A

- A. Fuses shall be time-delay and shall hold 500% of rated current for a minimum of 4 seconds, clear 20 times rated current in .01 seconds or less, with an interrupting rating of 300,000 amperes RMS symmetrical, and be listed by a nationally recognized testing laboratory.
- B. Peak let-through currents and I^2t let-through energies shall not exceed the values established by UL for Class L fuses.

2.2 FUSES - 600A AND BELOW

- A. All fuses shall have a separate overload and short-circuit elements. Fuses shall incorporate a spring activated thermal overload element that has a 284 degrees Fahrenheit melting point alloy.
- B. The fuses shall have time-delay capabilities in accordance with UL standards for Class RK1, J, or CC fuses and an interrupting rating of 300,000 amperes RMS symmetrical, listed by a nationally recognized testing laboratory.
- C. Peak let-through currents and I^2t let-through energies shall not exceed the values established by UL for Class RK1 or J fuses.

2.3 MOTOR CIRCUITS

- A. The fuses shall be applied for all motors protected by properly sized overload relays:
 - 1. Class RK1 fuses shall be installed in ratings of 130%, or 150% for Class J fuses, of motor full-load current (or next size larger if this does not correspond to a fuse

size), except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuses may be sized at 175% of the motor full-load current, or the next standard size larger if 175% does not correspond to a standard fuse size.

2. Class L fuses shall be installed in ratings of 175% of motor full-load current (or next size larger if this does not correspond to a fuse size), except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuses may be sized up to 300% (or next size smaller).
3. Class CC fuses shall be installed in ratings of 200% of motor full-load current (or next size larger if this does not correspond to a fuse size), except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuses may be sized up to 400% (or next size smaller).
4. Fuses shall be tested and have documentation verifying compliance of Type 2 protection requirements for motor starters per UL508E or IEC 60947-4 for motor controllers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment for the manufacturer to the job site, or from water that may contact the fuse before the equipment is installed.
- B. Final tests and inspections shall be made prior to energizing the equipment. This shall include a thorough cleansing, tightening, and review of all electrical connections and inspection of all grounding conductors.

3.2 SPARES

- A. In addition to fuses consumed during testing, furnish 10%, but not less than three of each, of each size and type fuse used for the project, and store in a spare fuse cabinet.
- B. If required, provide cabinet equal to Bussman SFC in location acceptable to the Owner. Field verify location with Owner prior to installation.

END OF SECTION

SECTION 26 28 16**ENCLOSED SWITCHES AND CIRCUIT BREAKERS****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Work Included: Provide disconnect switches and enclosed circuit breakers for branch circuit, motor circuits, and items of equipment.
- B. Related work specified in other sections:
 - 1. Division 23
 - 2. 26 00 00 - Electrical
 - 3. 26 28 13 - Fuses

1.3 QUALITY ASSURANCE

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

1.4 REFERENCED STANDARDS

- A. UL 50 Cabinets and Boxes
- B. UL 98 Enclosed and Dead front Switches
- C. UL 489 Molded Case Circuit Breakers
- D. UL 977 Fused Power Circuit Devices
- E. NEMA AB1 Molded Case Circuit Breakers and Molded Case Switches
- F. NEMA KS1 Enclosed Switches

1.5 SUBMITTALS

- A. Submit shop drawings including:

1. Enclosure outline drawings and dimensions.
2. Nameplate schedule.
3. Assembly ratings including:
 - a. Main lug ratings and location.
 - b. Voltage ratings.
 - c. Short circuit ratings.
4. Conduit entry and exit locations, dimensions, and knock-outs.
5. Cable terminal sizes.
6. Fuse types and ratings.
7. Manufacturer's literature describing circuit breakers and trip units.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and off loaded in accordance with the manufacturer's published instructions.
- B. Upon arrival, inspect equipment for damage insured in shipping.
- C. Store and protect equipment from moisture and dust by storing in a clean, dry, heated space. Provide additional heavy plastic cover to protect the equipment and components. Provide auxiliary heating in the sections in accordance with the manufacturer's recommendations.

1.7 MANUFACTURER

- A. The equipment shall be the product of a manufacturer with a minimum of ten years' experience with the manufacture of similar equipment.
- B. Acceptable Manufacturers:
 1. Square D Company.
 2. Eaton.

1.8 WARRANTY

- A. The equipment shall be warranted to be in proper working order for a period of one year following the date of final acceptance.

PART 2 - PRODUCTS

2.1 FABRICATION

- A. Enclosed Switches
 1. Provide enclosed switches where indicated on the drawings or required by NEC.
 2. Switches shall be NEMA Type HD, heavy duty, rated 600 volts, with quick-make, quick break switch units and external operator, rated 100,000 A.I.C.

3. Switches shall be fused or unfused as shown on the drawings and as required by NEC, capacity and number of poles as indicate don the drawings.
4. Enclosures shall be provided with interlocks to prevent opening the enclosure without first opening the switch and to prevent operating the switch with the enclosure open.
5. Enclosures shall be provided with a means for pad locking in the open position.
6. Enclosures shall be provided with an equipment grounding lug.
7. Enclosures for use on four wire shall be provided with an insulated neutral bus.
8. Line side and load side terminals shall be provided with insulating cover to prevent accidental contact.
9. Indoor locations shall be provided with NEMA Type 1 Enclosures.
10. Outdoor locations shall be provided with NEMA Type 3R Enclosures and water tight threaded hubs for conduit entry.

B. Enclosed Circuit Breakers

1. Provide enclosed circuit breakers or molded case switches where indicated on the drawings or required by the NEC.
2. Circuit breaker for rating 250 amperes or less shall be thermal magnetic molded case circuit breakers.
3. Circuit breakers 300 amperes through 1200 amperes shall be molded case, 100% rated, electronic trip, microprocessor based, true RMS sensing, with adjustable, defeatable instantaneous pickup.
4. Units shall be 600 volt or 250 volts as required and unless noted otherwise shall be 42,000 A.I.C.
5. Enclosures shall be provided with a means for pad locking in the open position.
6. Enclosures shall be provided with and equipment ground bus.
7. Enclosures for use on four wire systems shall be provided with an insulated neutral bus.
8. Line side and load side terminals shall be provided with insulating covers to prevent accidental contact.
9. Indoor locations shall be NEMA Type 1 Enclosures.
10. Outdoor locations shall be NEMA Type 3R enclosures and watertight hubs for threaded conduit entry.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect building structure to which disconnects are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

3.2 PREPARATION

- A. Carefully measure and lay out exact locations maintaining working clearances required by the National Electrical Code.

3.3 INSTALLATION

- A. Provide disconnects where indicated and where required by the National Electrical Code and all equipment where integral disconnects are not provided by the manufacturers.
- B. Provide disconnects mounted to building structure ahead of flexible conduit final connection to each fan powered terminal box.
- C. Install within sight of equipment served.
- D. Provide final connection to equipment served.
- E. Provide engraved lamacoid name plate secured to cabinet with designation of equipment served, operating voltage, and circuit designation.

END OF SECTION

SECTION 26 29 13**ENCLOSED CONTROLLERS****PART 1 - GENERAL****1.1 REFERENCED DOCUMENTS**

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

1.2 DESCRIPTION

- A. Work Included: Provide and coordinate motor control centers, and the devices for each starter unit.

1.3 QUALITY ASSURANCE

- A. Source Quality Control:
 - 1. Manufacturer's tests to meet applicable Underwriters' Laboratories, Inc., Standards.
 - 2. Equipment designed and manufactured to meet applicable ANSI, NEMA, and IEEE Standards.

1.4 SUBMITTALS

- A. Manufacturer's Data: Submit copies of the manufacturer's literature, completely describing the motor controller, motor starter units, and controls.
- B. Shop Drawings: Submit copies of shop drawings completely describing motor controller dimensions, motor starter units, interconnecting wiring, fuses, and capacities.

PART 2 - PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Square D Company.
- B. Eaton.

2.2 PRODUCTS

- A. Furnish and install Combination motor starter and disconnect switches in NEMA Type 1 enclosures.

- B. Combination motor controller and disconnect units shall be equipped with individual control power transformers with one secondary control fuse. The other secondary lead shall be grounded. Starter units shall contain two spare auxiliary contacts, one N.C. and one N.O. in addition to those required for equipment interlock and temperature control wiring systems; and unit-mounted pilot devices and indicating lights.
- C. Padlocking arrangements shall permit locking the disconnect device OFF with padlocks. Unit disconnect operating handle shall be mounted on the disconnect, not on the unit door and shall indicate ON and OFF. Overload relays shall be reset from outside the enclosure by means of an insulated bar or button.
- D. All starters shall be full voltage, non-reversing type, single or two speed, as scheduled and as required by the load served. Coordinate with manufacturer's data for the equipment actually installed. Motor starter contactors shall be NEMA horsepower rated to meet or exceed the horsepower rating of the motors installed.
- E. Each starter unit shall be provided with quick-make, quick-break fusible switch unit disconnect, properly sized fuses, magnetic contactor with replaceable operating coil, overload relay with replaceable thermal elements, control power transformer with fuse, and hand-off-auto switch with on/off pilot lights or high-low-off-auto switch with high/low/off pilot lights. Two-speed relays shall be provided with adjustable time interval decelerating relays.
- F. Disconnect units shall be fusible switch quick-make, quick-break units with rejection type Fuse clips and provisions for padlocking on or off.

PART 3 - EXECUTION

3.1 COORDINATION

- A. This Contractor shall verify at the job site the voltage, phase, horsepower and number of speeds characteristic of each load item of equipment and furnish the proper size and type of starter required, fused as recommended by the manufacturer for the load and as required by the National Electrical Code.

3.2 NAME PLATES

- A. Provide engraved lamacoid plastic name plates with the designation of each motor control center and the service voltage, and for each control unit with the circuit designation and the name of the item served.
- B. Designations shall be in 3/4" letters, and name plates shall be permanently secured to control center enclosures.

END OF SECTION