CONTRACT CONDITIONS

FOR

CHILLER REPLACEMENT

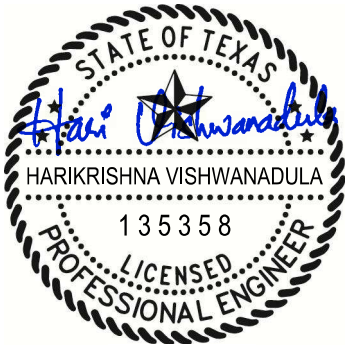
AT

WALNUT GROVE MIDDLE SCHOOL
MIDLOTHIAN, TEXAS

CSP 2425-01

MIDLOTHIAN
INDEPENDENT SCHOOL DISTRICT

Project Manual



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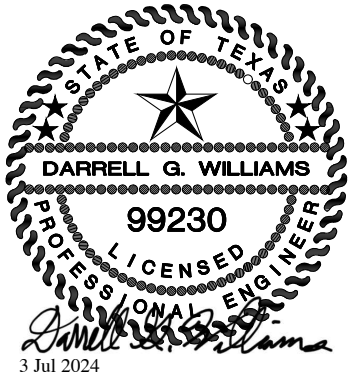

3 Jul 2024

ENGINEER
RWB CONSULTING ENGINEERS
12222 MERIT DR. SUITE 400
DALLAS, TEXAS 75251

RWB Project No. 24040.00
July 3, 2024

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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

MIDLOTHIAN ISD
INSPIRING EXCELLENCE

Request for COMPETITIVE SEALED PROPOSALS

CSP 2425-01
Walnut Grove Middle School
Chiller Project

Date	Event
July 3, 2024	Issue Date
July 16, 2024	Pre-Bid Conference – 11:00 A.M. (CST) @ WGMS
July 12, 2024	Addendum 1
July 19, 2024	Last day to submit questions - 12:00 P.M. (CST)
July 23, 2024	Final Addendum Posted
August 1, 2024	Proposals Due – 2:00 P.M. (CST)
August 19, 2024	Recommendation to MISD Board of Trustees

** The District will make every effort to adhere to this schedule; however, dates are subject to change. Any changes will be posted in the form of an addendum on the MISD website. Additional addendums may be posted at the discretion of MISD. Potential respondents are responsible for watching the website for such publications.*

Deliver Sealed Responses to:
Midlothian ISD Administration Building
Purchasing Department
100 Walter Stephenson RD
Midlothian, Texas 76065

Midlothian ISD Purchasing Department:
Shana Volentine, RTSBA
Director of Purchasing
469-856-5032
shana.volentine@midlothianisd.org

Midlothian ISD Operations Department:
Jose Martinez
469-856-5386
jose.martinez@midlothianisd.org

Pre-Bid Information:
July 16, 2024 – 11:00 AM
Walnut Grove MS
990 N. Walnut Grove Rd,
Midlothian

NOTICE

The Midlothian Independent School District (MISD) is soliciting proposals for WGMS Chiller Project per the specifications stated elsewhere in this solicitation document. A response to this solicitation is an offer to contract with Midlothian ISD and its members based on the specifications and standard terms and conditions contained in the bid document.

Respondents are cautioned to read this document completely and submit all documents. Each respondent, by submitting a response, represents that he/she has read and understands the proposal. Failure to examine the documents will be at the vendor's risk.

Respondents shall familiarize themselves with existing conditions in the material and labor markets prior to submission of an offer. The fact that an offer is submitted will be construed by the MISD Board of Trustees to indicate that the respondent agrees to carry out the furnishing of products and services in full accordance with the specifications and other contract documents not withstanding existing material and labor market conditions. A signed, submitted proposal constitutes an offer to perform the work and/or deliver the product(s) and/or services specified in the solicitation.

The vendor should propose his/her lowest and best price. All pricing information shall be entered on the proposal in ink or typewritten. Pricing should include labor and materials unless otherwise noted by the vendor.

If the vendor is awarded a contract under this solicitation, the prices proposed by the vendor shall remain fixed and firm during the term of the contract, provided, however that the vendor may offer incentive discounts from this fixed price to the District at any time during the contractual term.

Shana Volentine
Director of Purchasing

July 3, 2024
Date

DISTRICT OVERVIEW

Midlothian is a fast-growing city in Northwest Ellis County, Texas with a population of more than 31,500. The city is 25 miles (40 km) southwest of Dallas. It is the hub for the cement industry in North Texas, as it is home to three separate cement production facilities, as well as a steel mill.

The District currently has 14 campuses comprised of 8 elementary schools, 3 middle schools, 2 high schools, and a CTE center. The District currently serves approximately 11,100 students and employs approximately 1100 employees.

Midlothian ISD has grown by more than 3,000 over the last decade and is expected to grow by nearly 4,500 students by 2030.

Midlothian ISD's mission is to educate students by empowering them to maximize their potential and inspiring excellence today to change the world tomorrow.

We believe that:

- Safe, engaging, rigorous, and diverse leaning environments provide the best opportunity for student to reach their fullest potential.
- A high-quality staff with appropriate resources is essential to creating educational experiences that promote student success.
- Effective communication, purposeful collaboration, and strong partnerships create an atmosphere of trust and a strong sense of community vital to student achievement.

Cultural Tenants

- We Are Family
- Celebrate the Power of Diversity
- Honor Relationships
- Unlimited Potential
- Excellence Through Purpose
- We Are Midlothian Strong

MIDLOTHIAN ISD
INSPIRING EXCELLENCE

Additional information about Midlothian ISD can be obtained on its website: www.midlothianisd.org

CODE OF CONDUCT

Vendors and their suppliers, installers and all others working on Midlothian ISD facilities are required to understand and adhere to the following rules and responsibilities. Failure to comply with the following rules and responsibilities may result in a work's removal from the facilities and/or the termination of all subcontractor's contract. Vendors are responsible for the suppliers and installers adherence to these policies. All personnel working on MISD facilities will indicate their understanding and agreement to comply with these rules and responsibilities by submitting a response to this solicitation.

1. Vendor's employees, installers and suppliers who will be entering the district should check in with the Midlothian ISD designated representative.
2. Vendor's employees, installers and suppliers must wear picture ID badges while on Midlothian ISD property.
3. The use of any tobacco products is prohibited on district property. These prohibited items include but are not limited to cigarettes, cigars, vapes and smokeless tobacco.
4. Drugs and alcoholic beverages are prohibited.
5. The use of vulgar or improper language is prohibited.
6. Unacceptable behavior including physical or verbal intimidation, horseplay, or fighting by any individual on district property will result in immediate remove from property.
7. School requirements may occasionally result in the untimely termination of a subcontractor's daily activities. Vendors are expected to anticipate and understand these circumstances and work with MISD to make-up any scheduling.
8. All contact with student is strictly prohibited.
9. Vendor's employees, installers and suppliers must be properly dressed in work attire which includes the use of proper work shoes and personal protection equipment (as needed).
10. Vendor's employees, installers and suppliers will promptly leave the premises at the end of each work shift or once business purpose has been served.
11. Vendor's employees, installers and suppliers will comply with all state and district rules regarding weapon free zones.
12. Vendor's employees, installers and suppliers shall submit such background information as may be requested by Midlothian ISD to perform criminal background evaluations/ investigations.
13. No person who has charges pending or who has been convicted, received probation or deferred adjudication for the following shall be engaged to work on MISD property where students are present: Any offense against a child, any sex offense, any crimes against persons involving weapons or violence, any felony offense against property; or any offense that Midlothian ISD determines to compromise the safety and well- being of staff, students and/or property.

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STANDARD TERMS AND CONDITIONS

The following instructions by the Midlothian Independent School District are intended to afford potential respondents an equal opportunity to participate in the solicitation process. The following Terms and Conditions are standard for the District and apply to all types of purchasing, including this solicitation. In these Terms and Conditions, the terms *respondent, contractor*, *proposer*, *vendor*, and/or *bidder* refer to the person/firm that submits the offer to this solicitation document. The terms *MISD*, *owner*, *district*, and/or *government entity* refer to Midlothian Independent School District.

The documents contained in this solicitation represent the potential agreement between the successful respondent and the school district and supersedes any prior discussions, negotiations, representations, agreements, written or oral.

Any specifications, details, or specific instructions for this solicitation will be found following these Standard Terms and Conditions. Some of the Standard Terms and Conditions may not be applicable to a specific bid or proposal. To the extent each of the terms and conditions is applicable, these shall be deemed to be part of the vendor's bid or proposal documents. If there are specific terms and conditions contained in the bid or proposal documents which are inconsistent with the Standard Terms and Conditions, the specific terms and conditions in the bid and solicitation documents shall control. By submitting a bid or proposal, each vendor or proposer agrees to waive any claims it has or may have against the Owner, the Architect, and their respective officers, trustees, employees, agents, or representatives, arising out of or in connection with the administration, evaluation, recommendation, or selection of any bid or proposal; waiver of any requirements under the bid or proposal documents or contract documents; acceptance or rejection of any bid or proposal; and award of the contract.

The district guarantees no minimum dollar amount in purchase orders against this contract. The scope of this request and requirements of the District as shown in the specifications shall not be considered as binding on the District, and the work actually may be less than or greater than projected.

The MISD can terminate any resulting award for this request with thirty (30) calendar day notice, in the event no funds or insufficient funds are appropriated and budgeted or are otherwise not available in the next fiscal year for obligations herein provided, however, this provision shall not be construed so as to permit MISD to terminate this request in order to enter other contracts or make other arrangements for essentially the same services made the subject of this solicitation.

All bids and proposals from the vendor must remain open for acceptance for sixty (60) days after submittal.

AUTHORITY

The Board of Trustees has delegated to the superintendent the authority to make budgeted purchases for goods and services. Functional area experts, day-to-day contract administrators/ managers, teachers, principals, and/or other district employees are not authorized to substantially amend this solicitation document or to substantially modify the subsequent contract. Substantially includes, but is not limited to, changes to delivery dates, place of delivery, and/or specifications that significantly alter the form, fit, and function of a product or the scope of work of a service. Amendments to solicitation documents may be made by the Director of Purchasing. Modifications to contracts/agreements will be made by the Director of Purchasing in accordance with the MISD Board of Trustee guidance, policies, and/or procedures. If a vendor acts on the guidance of a district employee that is not authorized to make changes, the vendor does so at his or her own risk or peril. Also, if a vendor attempts, or gains, a modification/amendment from a district employee that is not authorized to make changes, the vendor does this at his or her own risk or peril and risks the termination of his or her contract/agreement. The functional administrator for this contract is Jose Martinez, Executive Director of Operations.

CONTACT

Contact between soliciting vendors and user departments during this solicitation process or evaluation process is prohibited. Any attempt by a soliciting firm to contact the department may result in disqualification.

VENDOR QUESTIONS

Any explanation desired or questions by a vendor regarding the meaning or interpretation of these instructions or any other documents included in this solicitation must be requested in writing to MISD, Director of Purchasing, 100 Walter Stephenson Rd, Midlothian, TX 76065 (shana.volentine@midlothianisd.org) with sufficient time allowed for a reply to reach vendors before the submission of their offers. The email subject line for questions should read: "Questions" followed by the solicitation number and title. The deadline for questions regarding this solicitation is July 19, 2024.

ADDENDA

Written responses to vendor questions shall be presented in the form of an Addendum and posted on the District's website at https://www.midlothianisd.org/departments/finance/ purchasing/bids-rfps-csps-rfqs. Respondents should monitor the Purchasing page on the MISD website for such postings. Oral explanations or instructions will not be binding. Midlothian ISD reserves the right to post addendums up to, and including, the business day prior to the deadline. Vendors who submit a bid or proposal without acknowledging receipt of all addenda issued may be deemed to have submitted a bid or proposal not responsive to the solicitation. Failure to receive such addenda does not relieve the vendor from any obligation under the bid or proposal submitted. All formal written addenda become a part of the vendor bid or proposal documents.

PRE-BID MEETING

Any scheduled pre-bid meeting, will be noted on the cover page of this document. In the event a pre-bid meeting is held, attendance is highly recommended to all potential responders. The purpose of this meeting will be to answer any questions regarding the proposal specifications. Proposers are reminded, however, that verbal responses are not binding – only questions answered by formal written agenda will be binding and will be made part of the proposal documents. Proposers must satisfy themselves, upon examination of these specifications in the pre-bid conference, as to the intent of the specifications. After submission of the proposal, no complaint or claim that there was any misunderstanding in regard to items listed for proposal will be entertained from either party.

SUBMISSION

The responsibility for compliance with this solicitation and the subsequent contract shall be with the bidder/respondent. In submitting a response to this solicitation, respondent understands and agrees to be bound by the terms and conditions, provided in this document, which shall be incorporated into any future contracts, agreements, or purchase orders relating to any resulting agreement between the vendor and Midlothian ISD.

Submissions to this request are due by: August 1, 2024 – 2:00 P.M. (CST)

Responses must be plainly marked on the outside with the vendor's name and address and the solicitation number. A shipping label has been provided in this packet and its use is highly encouraged. Respondents are instructed to submit (1) one original and (1) one copy. The original copy must be plainly marked "ORIGINAL". ***Please also include one full "original" copy (in searchable PDF format) on a flash drive.***

Responses must be delivered in a sealed envelope or container and submitted to the Purchasing Department at the MISD Administration Building in sufficient time to be received and time-stamped on or before the published date and time shown within this document or on any subsequent addenda. No other published dates will be binding. Late submissions will not be accepted. Unsigned, unsealed, faxed or late responses will not be accepted. Midlothian ISD will not be responsible for mail delivered from the post office. No oral, telegraphic, telephonic, electronic mail or facsimile transmitted responses will be considered. MISD Purchasing personnel will be the official time keeper for all submissions.

Each vendor shall furnish the information required by the solicitation documents. Proposals should provide straightforward, concise information that satisfies the requirements of this solicitation. Emphasis should be placed on conformity to the instructions and requirements of this solicitation and the completeness and clarity of content. Links to web sites for supporting documentation are not acceptable. Expensive bindings, color displays, and advertising materials are not necessary or desired.

Offers submitted on other than authorized forms or with different terms or provisions may be considered to be non-responsive. The vendor must sign the Offer Form and return with the other certifications provided herein. Failure to manually sign the offer may disqualify it from being considered. The person signing the documents must initial erasures or other changes. Signatures by an agent are to be accompanied with evidence of his authority unless such evidence has been previously furnished to MISD.

EXCEPTIONS/MODIFICATIONS/WITHDRAWAL

Responses deposited with Midlothian ISD may be withdrawn prior to the time set for opening. A response may not be withdrawn after the submittal deadline. By submitting a response, the proposer warrants and guarantees that the document has been carefully reviewed and checked and that it is in all things true and accurate and free of mistakes. If any exceptions are taken to any portion of the bid or proposal, the vendor must clearly indicate the exceptions taken and include a full explanation. Vendor's failure to identify exceptions or proposed changes will constitute acceptance by the vendor of the bid or proposal as proposed by the District. The District reserves the right to reject a bid or proposal containing exceptions, additions, qualifications, or conditions. Any bid or proposal to the District by the vendor, or contract between the District and the vendor, can be modified or withdrawn only by written agreement between Midlothian ISD and the vendor.

BID OPENING

Submittals may be publicly opened immediately after the response deadline on the same day. Responses received by hand delivery or mail after the stated due date and time will remain unopened. Trade secrets and confidential information contained in response shall not generally be open for public inspection, but MISD's records are a matter of public record.

DISQUALIFICATION

Any bid or proposal that does not contain all required contents required by District may be disqualified. Vendor is strongly encouraged to carefully review its bid or proposal documents prior to submitting their response to ensure all requirements are met. Failure to provide the information requested, in its entirety, may be grounds for disqualification of the bid or proposal. Bidders or proposers may also be disqualified and their bids or proposals not considered, among other reasons, for any of of the following specific reasons:

a. Reason for believing collusion exists among respondents
b. Reasonable grounds for believing that any respondent is interested in more than one solicitation for the work contemplated
c. Where the respondent, any sub-contractor or supplier, or the surety on any bond given, or to be given, is in litigation with the District or where such litigation is contemplated or imminent, in the sole opinion of the District
d. Respondent being in arrears on any existing contract/purchase order or having defaulted or failed to perform in a satisfactory manner on a previous purchase order

e. Lack of competency as revealed by pertinent facts, including but not necessarily limited to, experience and equipment, financial statement and questionnaires
f. Uncompleted work that, in the judgement of the District, will prevent or hinder the prompt completion of addition work if awarded.
g. Where the bidder or proposer has failed to perform in a satisfactory manner on a previous purchase order or contract.

MISD expressly reserves the right to:

a. Reject any or all proposals
b. Consider a response irregular if it shows any omissions, alterations of form, additions, or conditions not called for; failure to return all forms and copies; or irregularities of any kind.
c. Waive any minor informality or deficiency in a bid or proposal if it is determined to be in the best interest of MISD
d. Award to a single vendor, multiple vendors, each line item separately, or in any combination it determines to be in the best interest of the District. If the Respondent chooses to propose "All or None" or is not agreeable to multiple or split awards, it must be noted as a deviation and included with the response.
e. Reissue a request
f. Consider and accept an alternate proposal as provided herein when most advantageous to MISD, including the utilization of other District contracts, contracts awarded by other governmental agencies, other school boards, or cooperative agreements in lieu of any offer received or award made as a result of this proposal, if it is in the best interest to do so.
g. Cancel the contract with a thirty-day written notice, without prejudice, for factors including, but not limited to, non-availability or non-appropriation of funds
h. Procure any item or services by other means to meet time-sensitive requirements
i. As part of the evaluation process, seek additional information from bidders or proposers, interview bidders or proposers, and negotiate the terms of a proposal as allowed by Texas law.
j. Negotiate price/delivery for service(s)/products(s) identified by this request. The District reserves the right to reject any and all bids that comply with the specifications or to accept a higher bid that complies, when, in judgment of the District, such proposal offers additional value or function, which justifies the difference in price.
k. Make an award without discussion with any proposer.
l. Be the sole judge of acceptable proposal responses.
m. Cancel part or this entire contract at any time during the term without cause. Notification will be submitted in writing no less than thirty (30) days prior to the effective date. Upon receipt of such notice from the District, vendor shall not thereafter incur, and MISD shall have no liability for, any costs under this solicitation that are not necessary for actual performance of the request between the date of the notice of termination for convenience and the effective date of that termination

for convenience. In the event of a termination for convenience hereunder, MISD shall have no liability to vendor for lost or anticipated profit resulting there from.

n. Terminate for default all or any part of this contract if vendor breaches any of the terms hereof or if the vendor becomes insolvent or files any petition in bankruptcy. Such right of termination is in addition to and not in lieu of any other remedies which MISD may have in law or equity, specifically including, but not limited to, the right to collect for damages or demand specific performance. MISD may terminate the contract and debar the vendor for future "bidding" for violations of the federal requirements including, but not limited to, "Contract Work Hours and Safety Standards Act", "Equal Employment Opportunity Act", and "Energy Policy and Conservation Act".

Purchases of service or equipment from a business owned in whole or in part by a Midlothian ISD employee shall be permitted only when approved by the Director of Purchasing and when determination has been made that such equipment or service is not an extension of the employee's regular job responsibility at the District. Failure on part of Proposer to disclose ownership by the District employee may be grounds for disqualification.

EVALUATION

Proposals may be evaluated by an Evaluation Committee comprised of key Midlothian ISD personnel in order to fairly evaluate all qualified proposals. Evaluation by committee members will be combined into one score, which will be compared to the other proposals.

To the extent allowed by law, discussions/negotiations may be conducted with vendors who are deemed to be within the competitive range. If discussions/negotiations are conducted, respondents may be required to submit a best and final offer. The best and final offer may be required as early as 24 hours after completion of discussions/negotiations.

The solicitation process seeks to find the best overall solution to Midlothian ISD. While it is the intent of the school district to obtain the best quality products and/or services at the lowest prices possible, cost is not the only factor in making the determination of best value. Award shall be made to the qualified respondent(s) whose response is most advantageous to Midlothian ISD. In determining to whom to award a contract and per the Texas Education Code 44.031 (b), the district considers (at a minimum) the following criteria. At the discretion of the district and in evaluation of this solicitation, point values are indicated where applicable.

EVALUATION 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.
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.

LOBBYING

In order to ensure the integrity of the selection process, the vendor's employees, officers, agents, or other representatives shall not lobby or attempt to influence a vote or recommendation related to the vendor's response, directly or indirectly, through any contact with school board members or other district officials involved in the solicitation from the date it is released until the award.

AWARD

Successful vendor(s) may be notified in writing of District's award. No assignment of a bid, proposal, or resulting contract is permitted without the prior notice to and written consent of Midlothian ISD by means of a Notice to Proceed and/or Authorized Purchase Order or signed contract after a recommendation has been accepted by the MISD Board of Trustees. If respondent requires any other agreement, a draft document must be provided with the proposal. No work shall begin, goods procured or delivered, or costs incurred by vendor until the notice is received. Any cost incurred by the vendor prior to the notice shall not be reimbursed by the District.

Tabulations may be requested by contacting the Director of Purchasing via email upon award of a contract based upon approval by the MISD Board of Trustees, if required. Otherwise, information may be released after award of the contract by the Superintendent or designee.

TERM

If this solicitation is for a set time period only, or a single purchase, the award will last until the goods or services have been delivered, completed and accepted by the District. Renewing the contract would imply doing so under the same terms and conditions. The District reserves the right to acquire reasonable amounts of additional goods/services, as listed in the bid or proposal, subject to verification of the same or lower prices and conditions of the bid or proposal and consistent with Texas law. After the initial contract term, the District reserves the right to extend the contract as indicated in this request.

PRICING

All prices proposed by the vendor, and accepted by the District, shall remain in effect throughout the term of the bid proposal, award, contract, or purchaser order, and cannot be increased during that term without written agreement between the vendor and the Midlothian ISD Board of Trustees or its designee. Midlothian

ISD reserves the right to show a preference to any bid or proposal that provides a standard discount percentage for goods or services, or a discount for early payment of any bill to the vendor for its goods or services.

BILLING AND PAYMENTS

Per CH Local of District Policy - The District limits its purchases through the use of properly drawn and authorized purchase orders. Consequently, the District is not responsible for items not ordered via this method. The purchase order number shall appear on all itemized invoices to ensure payment. District employees shall not be permitted to purchase supplies or equipment for personal use through the District's business office without an authorized purchase order. Completing work or providing product without a purchase order may result in non-payment by the district and/or termination of awarded contract.

The District is a tax-exempt entity under Texas law. Vendor should not include tax on its bid, proposal, quote or invoice to the District. Vendor shall submit itemized invoices on each purchase order in a timely manner following delivery.

Invoices shall indicate the purchase order number and be submitted to MISD Business Office, Attn: Accounts Payable, 100 Walter Stephenson Rd, Midlothian TX 76065 or emailed to accounts_payable@midlothianisd.org.

The vendor shall make no charge or addition to the accepted price for delivering, placing, or invoicing product(s). Payment shall not be due until all items on the purchase order have been received by MISD (unless specified in the specifications) and the above instruments are submitted and the invoice has been accepted by MISD. All prices shall be F.O.B. destination.

District shall make all payments under this Agreement from current revenues available. In the event no funds, or insufficient funds due to non-appropriation, are available at any time or during any fiscal period when such payment is due, in accordance with Local Government Code Ann. §271.903, District shall notify vendor of such occurrence and this Agreement shall terminate on the last day of the fiscal period for which payment was received without penalty or expense to District of any kind whatsoever. However, District shall be responsible to remit payment for all services provided by the Vendor to the District prior to the termination date.

GOODS

The vendor warrants that it owns and is legally able to transfer ownership of the goods or materials that are the basis of the solicitation to Midlothian ISD. The vendor warrants that it owns a clear title free of any materialman's, suppliers, or other type of liens, mortgage, encumbrance, or other security interest in the goods or materials supplied to Midlothian ISD. Any breach to this warranty of title shall be considered a default by the vendor and good cause for termination of the award, contract, or purchase order.

Strict conformance with the standards, specifications, and requirements of the bid or proposal is required by Midlothian ISD. Unless otherwise stated in the specifications, all supplies and components to be provided shall be new (not used or reconditioned, and not of such age or so deteriorated as to impair their usefulness or safety), of current production, and of the most suitable grade for the purpose intended. If at any time during the term of an awarded agreement the vendor believes the furnishings of supplies or components which are not new is necessary or desirable, it shall notify the District immediately, in writing, including the reasons and proposing any consideration which will flow to the District if authorization to use such supplies or components is granted.

If a brand name or specific model name is shown in the proposed specifications or bid form, such usage is to indicate an acceptable standard which must be considered if bidding better or equivalent products. Any bid or proposal for such better or equivalent products shall provide significant information on the products to allow the District to determine whether or not they are acceptable.

Any proposed substitution of goods or services to be supplied by the vendor shall require prior written acceptance by the District, unless stated otherwise. The vendor shall be bound to provide all proposed goods or services if its bid or proposal is accepted and awarded by Midlothian ISD, and no changes shall be acceptable unless agreed to in writing by the District.

Vendor assumes all liability for delivering non-compliant goods. The District reserves the right to reject any tender of non-compliant goods and shall require the vendor to take possession of such defective goods at no cost to District, and replace them with compliant goods at no cost to District, unless Midlothian ISD elects, in writing, to accept such non-compliant goods. Such non- confirming goods shall constitute good cause for termination of the contract, purchase order, or award, if not accepted by written agreement by Midlothian ISD or cured by the vendor.

Respondent agrees to ascertain whether goods manufactured in accordance with the specifications will give rise to the rightful claim of any third person by way of infringement or the like. If vendor is of the opinion that an infringement or the like will result, he/she will notify MISD to this effect in writing within two weeks after the signing of this a contract. If MISD does not receive notice and is subsequently held liable for the infringement or the like, vendor will indemnify MISD for any damages due to such claim. If vendor, in good faith, ascertains that production of the goods in accordance with the specifications will result in infringement or the like, this document shall be null and void. MISD may pay vendor for the reasonable cost (as determined by MISD) of his/her search as to infringements.

Respondent warrants that the product sold to MISD shall conform to the standards promulgated by the federal government including, but not limited to, the U.S. Department of Labor under the Occupational Safety and Health Act (OSHA) and the Consumer Product Safety Commission (CPSC). In the event the product does not conform to applicable safety standards, MISD may return the product for correction or replacements at the vendor's expense.

In the event vendor fails to make the appropriate correction within a reasonable time (i.e., 2 weeks) correction may be made by MISD at vendor's expense.

The terms of the agreement are "no arrival, no sale". The title and risk of loss of the goods shall not pass to the District until the District actually receives and takes possession of the goods/ services at the point or points of delivery. The District shall have the right to inspect the goods at delivery before accepting them. The vendor shall be responsible for replacing or correcting any defective product or service supplied to the District in response to the Solicitation at no cost to Midlothian ISD.

DELIVERY

Performance of service/delivery of goods shall be made to the location identified on each purchase order or resulting contract. All work performed, as herein shown under the specifications, shall be of the highest quality workmanship and shall in every respect meet or exceed the industry standards for this type of good/service. Every tender or delivery of goods must fully comply with all provisions of this contract as to time of delivery, quality and the like. All delivered equipment, materials or merchandise must be new, unused, free of liens, and in the manufacturer's original packing unless otherwise specified. If a tender is made which does not fully conform, this shall constitute a breach of the contract, purchase order, and award, and the vendor shall not have the right to substitute a conforming tender, provided, where the time for performance has not yet expired, the vendor may reasonably notify the district of his intention to cure and may then make a conforming tender within the contract time but not afterward.

The vendor will package goods in accordance with good commercial practice. Each shipping container shall be clearly and permanently packed as follows: (a) vendor's name and address; (b) Consignee's name, address and purchase order or purchase release number and the supply agreement number if applicable; (c) Container number and total number of containers, e.g., box 1 of 4 boxes; and (d) the number of the container bearing the packing slip. The vendor shall bear the costs of packaging and delivery at reasonable costs unless otherwise provided. Acceptance by the District of any delivery shall not relieve the vendor of any guarantee or warranty, express or implied, nor shall it be considered an acceptance of material not in accordance with the specifications and shall not waive the District's right to request replacement of defective material.

NOTICE OF DELAYS

Whenever the vendor encounters any difficulty which delays or threatens to delay timely performance, the vendor shall immediately give notice, in writing, to the District, including all relevant information. Such notice shall not in any way constitute a basis for an extension of the delivery or performance schedule or be construed as a waiver by Midlothian ISD of any right or remedies to which it is entitled by law or pursuant to provisions herein. Failure to give such notice, however, may be grounds for denial of any request for an extension of the delivery or performance schedule because of such delay.

SAFETY DATA SHEET (SDS)

The vendor shall provide, at no cost to DISTRICT, at least one (1) copy of any Safety Data Sheet (SDS) applicable to any goods or materials to be supplied by the vendor in response to this solicitation.

WARRANTIES

Warranties for goods and services shall be a minimum of one (1) year from completion of the bid or proposal. If goods or services to be provided are of comparable quality, the District may give preference to longer warranties when evaluating the bid or proposal.

The price to be paid by Midlothian ISD shall be that contained in vendor's response, which the vendor warrants to be no higher than the vendor's current prices on orders by others for products of the kind and specification covered by the agreement for similar quantities under similar or like conditions and methods of purchase. In the event the vendor breaches this warranty, the prices of the items shall be reduced to the vendor's current prices on orders by others or, in the alternative, Midlothian ISD may cancel this contract without liability to the vendor for breach or the vendor's actual expense.

The vendor warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for commission, percentage, brokerage, or contingent fee excepting bona fide employees of bona fide established commercial or selling agencies maintained by the vendor for the purpose of securing business. For breach or violation of this warranty, Midlothian ISD shall have the right in addition to any other right or rights to cancel this contract without liability and to deduct from the contract price, or otherwise recover the full amount of such commission, percentage, brokerage or contingent fee.

The vendor shall not limit or exclude any implied warranties and any attempt to do so shall render this contract voidable at the option of the District. The vendor warrants that the goods furnished will conform to the specifications, drawings and descriptions listed in the bid invitation and to the sample(s) furnished by the vendor, if any. In the event of a conflict between the specifications, drawings and descriptions, the specifications shall govern. All equipment items awarded as a result of the bid will be covered by an all parts and labor warranty, including any/all transportation charges, for a minimum period of one (1) year.

CONTRACTORS

Persons providing services on a project ("subcontractor" in Texas Labor Code 406.096) include all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity that furnishes persons to provide services on the project.

Services include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. Services do not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

The proposer declares that in the event of the award of a contract to the undersigned to this offer will comply with the Immigration Reform & Control Act of 1986.

Respondents will provide their own tools/equipment required/expected of their craft/trade. The contractor is responsible for permits and fees required and compliance with all local, state, and federal rules, regulations, and statutes. The job site shall be in a clean, safe and orderly condition at all times. It shall be the contractor's responsibility to remove all debris, materials, and equipment from the job site upon completion of the work specified.

The contractor shall agree to waive all right of subrogation against the District, its officials, employees and volunteers for losses from work performed by contractor for the District.

The contractor shall hold the District harmless from and indemnify it against all liability, including attorney's fees, which may arise from and accrue directly from the performance of the work or any obligation of Contractor or failure of Contractor to perform any work or obligation provided for in this Agreement.

INSURANCE

The successful respondent, at his/her own expense, shall provide and maintain insurance with fiscally sound firms (at least an AM Best rating of A-) authorized to do business in Texas. Insurance requirements also apply to any sub-contractor(s) in the event that any work is sublet. The contractor is responsible for making sure the sub-contractor(s) meets the minimum insurance requirement limits as by law.

Insurance must remain in effect for the duration of this contract. Should any policy be canceled before the expiration date, the issuing company will mail thirty (30) days written notice to the certificate holder, MISD. The contractor shall notify the district in writing by certified mail or personal delivery, within ten days after the contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project. If the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the district showing that coverage has been extended.

Vendor may be required to provide a copy of insurance coverage to MISD. If the district is to be named as an additional insured on the vendor's insurance coverage, the certificate indicating this should be provided within ten (10) calendar days from date of award. The bid/proposal number and title should be noted in the "Description of Operations/Locations/Vehicles/Special Items" block of the certificate and the "Certificate Holder" block of the certificate should read, Midlothian ISD, Attn: Director of Purchasing, 100 Walter Stephenson Rd, Midlothian, TX 76065."

Additional insurance requirements may be required for construction and/or services projects and will be identified elsewhere in this document.

The contractor represents to the district that all employees of the contractor who will provide services on the project will be covered by statutory workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code 401.011 (44) for all employees of the contractor, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance regulation. Providing false or misleading information may subject the contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

The contractor shall post on each project site a notice, in the text, form, and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project is required for the duration of the project. Duration of the project includes the time from the beginning of the work on the project until the project has been completed and accepted by the district.

The contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter. The contractor's failure to comply with any of these provisions is a breach of contract by the contractor that entitled the governmental entity to declare the contract void if the contractor does not remedy the breach within ten days after receipt of notice of breach from the governmental entity.

TERMINATION

Vendor shall be considered in default, and such default shall be grounds for the District to terminate any resulting award for this solicitation and/or pursue any and all relief, at law or in equity, to which it may be entitled by reason of such default, in the presence of a failure to perform any of its obligations under any resulting agreement and fails to correct such non- performance within ten (10) calendar days of written notice from the District to do so. In case of default of the vendor, MISD reserves the right to terminate the purchase order. In case of default of three (3) purchase orders, the district reserves the right to terminate the contract and suspend future business with the vendor.

Midlothian ISD shall have the right to terminate any purchase order to, contract with, or awarded to the vendor, in whole or in part, for cause (including breach of the proposal warranties, or contract by the vendor, or because of loss of federal funding) or for the District's convenience at any time. Any award, contract or purchase order is subject to termination by the District if any person significantly involved in initiating, negotiating, securing, drafting, or creating the solicitation on behalf of the District, is at any time while the solicitation is in effect, an employee of the vendor in any capacity or as a consultant to the District with respect to the subject matter of the Solicitation.

If deemed necessary, inspections will be made by authorized District personnel on a routine basis. Any deficiencies in the work performance disclosed during such inspections must be corrected following receipt of notification by the Vendor. Continued failure to take such corrective actions could, at the District's discretion, lead to termination of any resulting award.

FORCE MAJEURE

Neither the District nor the vendor shall be responsible or deemed to be in default of its obligations to the other to the extent any failure to perform or delay in performing its obligations under the bid or proposal is caused by events or conditions beyond the reasonable control of that party, and are not due to the negligence or willful misconduct of such party (hereinafter, "Force Majeure events"). For purposes of the bid or proposal, Force Majeure events shall include, but not be limited to, acts of God or public enemy, war, riot or civil commotion, strikes, epidemic, fire, earthquake, tornado, hurricane, flood, explosion, weather-related emergencies, or other catastrophes, or events or conditions due to law, regulations, ordinances, order of a court of competent jurisdiction, or executive decree or order. However, in the event of such delayed non-performance or nonperformance, the party so delayed shall furnish prompt written notice to the other party
(including the date of inception of the Force Majeure event and the extent to which it will affect performance) and shall undertake all efforts reasonably possible to cure the delay or nonperformance and mitigate its effects, or to otherwise perform. The District shall not be responsible for payment for any product or service delayed or foreclosed by any Force Majeure event unless and until such delayed or foreclosed product or service is provided. These provisions shall not preclude the District from canceling or terminating any resulting award (or any order for any goods or services included herein), or from revising the scope of the work, as otherwise permitted under the bid or proposal.

CONFLICTS

Effective January 1, 2006 and pursuant to Texas H.B. No. 914 and in accordance with Chapter 176 of the Texas Local Government Code, Section 176.006, any person or entity who contracts or seeks to contract with MISD for the sale or purchase of property, goods, or services (as well as agents of such persons, hereafter referred to as Vendors) are required to file, on an annual basis, a Conflict of Interest Questionnaire with the District. Each covered person or entity who seeks to or who contracts with MISD is responsible for complying with any applicable disclosure requirements. MISD will post the completed questionnaires on its website. Information regarding H.B. No. 914 may be obtained from the Texas Ethics Commission's website at http://www.ethics.state.tx.us.

Any board member who has any substantial interest, either direct or indirect, in any business entity seeking to contract with the District, shall, before any vote or decision on any matter involving the business entity, file an affidavit stating the nature and extent of interest and shall abstain from any participation in the matter. This is not required if the vote or decision will not have any special effect on the entity other than its effect on the public. However, if a majority of the governing body are also required to file, and do file similar affidavits, then the member is not required to abstain from further participation.
Local Government Code Chapter 171

In 2015, the Texas Legislature adopted House Bill 1295, which added section 2252.908 of the Government Code. The laws states that a governmental entity or state agency may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties (Form 1295) to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency. The business entity is responsible for first electronically filing Form 1295 with the Ethics Commission. This filing process creates a certification of filing and a completed Form 1295 must be printed, signed by an authorized agent of the business entity and submitted to the school district.

GRATUITIES
Please note that a "gift to a public servant" is a Class A misdemeanor offense if the recipient is a government employee who exercise some influences 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.

The District may, by written notice to the vendor, cancel this solicitation, its contract, purchase order, or award without liability to the vendor if it is determined by the District that gratuities, in the form of entertainment, compensation, gifts, or otherwise were offered or given by the vendor, or any agent or representative of the vendor, to any Board of Trustee member, officer, or employee of the Midlothian Independent School District with an intent to secure favorable treatment with respect to the awarding or amending, or the making of any determinations with respect to the performing of such an agreement. In the event this contract is canceled by the District pursuant to this provision, Midlothian ISD shall be entitled, in addition to any other rights and remedies, to recover or withhold the amount used by the vendor to provide such gratuities.

FACILITIES
Midlothian ISD is a tobacco-free, drug-free, weapon-free and alcohol-free environment. No one may use, consume, carry, transport or exchange alcohol beverages, tobacco, cigarettes, electronic cigarettes, controlled substances and/ or illegal drugs while in a school district building or while on school district property. It is the responsibility of the vendor to ensure that its employees, agents, and subcontractors are not under the influence of drugs or alcohol and/or in possession of drugs, tobacco, alcohol, or weapons. If an employee, agent, or subcontractor of vendor is found to be under the influence and/or in possession of drugs/tobacco, alcohol, or weapons at the time of service, the vendor will be notified at once by District that the individual(s) must be

immediately restricted from all Midlothian ISD campuses/departments. Repeated offenses by vendor could result in contract termination for default.

For the safety of students, all vendor personnel will sign visitor log in the office at the campus. An identification badge will be worn as required by the campus administrator. Vendor personnel are expected to maintain proper dress and exhibit a vendor badge or wear vendor issued shirts displaying the vendor logo. All contractors must also be in a uniform that identifies them at all times.

All vendor personnel are required to stay within the designated installation areas and may only enter a teacher's classroom when accompanied by District personnel.

At the time of offer submission, the person or entity submitting an offer must give notice to the district if the person or an 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 this conviction of a felony. The District may terminate a contract with a person or business if the District determines that the person or business failed to give such notice or misrepresented the conduct resulting in the conviction. This requirement does not apply to a publicly held corporation.

Texas Education Code Chapter 22 requires service contractors to obtain criminal history record information regarding covered employees and to certify to the District that they have done so. Covered employees with disqualifying convictions are prohibited from serving at a school district. Covered employees are all employees of a contractor who have or will have continuing duties related to the service to be performed at the District and have or will have direct contact with students. The District will be the final arbiter of what constitutes direct contact with students.

Vendors (owners, officers, employees, volunteers, etc.) may not work on District property where students may or may not be present when they have charges pending, have been convicted, received probation or deferred adjudication for the following:

- Any offense against a child
- Any sex offense
- Any crimes against persons involving weapons or violence
- Any felony offense involving controlled substances
- Any felony offense against property
- Any other offense the District believes might compromise the safety of students, staff, or property.

ASBESTOS

Vendors who perform work inside the MISD facilities are hereby notified that buildings may contain asbestos containing materials. This notification is required by both the State of Texas Department of State Health Services and the Federal EPA Asbestos regulations. These guidelines cover both MISD's responsibilities and the Employer's responsibility to their employees. As a vendor, it is your

responsibility to check each building prior to performing any work in that facility. These building materials may include but are not limited to: ceiling tile, floor tile and mastic, sheetrock, tape and bed compound, thermal pipe insulation, spray-on ceiling material, calks, and roofing products. As there have been numerous asbestos containing products manufactured over the years, you must check each building's Asbestos Management Plan. This plan is normally kept in the main office. Check with the school secretary and she will allow you to look at it. It is the vendor's responsibility to notify all employees working for them that MISD facilities may contain asbestos and where their employees may find the facility's Asbestos Management Plan.

Products and/or services procured under this agreement may be of a construction nature and will require certification that materials utilized and installed in conjunction with any project involving construction, be it new, renovation or contracted trade services, are free of asbestos and lead.

PUBLIC INFORMATION ACT (PIA) / FREEDOM OF INFORMATION ACT (FOIA)

By entering into a contract, pursuant to Texas Government Code Ann. Chapter 552, Subchapter J, the vendor agrees to be bound by the following terms if the contract has a stated expenditure of at least $1,000,000 for the purchase of goods or services by the District or if the contract results in the expenditure of at least $1,000,000 in public funds for the purchase of goods or services by the District in a fiscal year of the Midlothian ISD. If the district receives a written request for public information related to this Contract that is in the possession or custody of the vendor and not in the possession or custody of the District, Midlothian ISD shall send, not later than the third business day after the date the District receives the written request, a written request to the vendor that vendor provide that information to the District.

The vendor must:

- Preserve all contracting information related to the contract as provided by the records retention requirements applicable to the District for the duration of the contract;

- Promptly, within four business days, provide to the District any requested contracting information that is in the custody or possession of the vendor upon request of the Midlothian ISD; and,

On completion of the contract, either:

- Provide to the District at no cost all contracting information related to the contract that is in the custody or possession of the vendor; or
- Preserve the contracting information related to the contract as provided by the records retention requirements applicable to the District.

If the requirements of Subchapter J, Chapter 552, Texas Government Code Ann. apply to this Solicitation or Contract, the vendor agrees that the contract can be terminated if the vendor knowingly or intentionally fails to comply with the requirements of that subchapter. Texas Government Code Ann. Chapter 552.374.

Further, under Texas Government Code Ann. Chapter 552.372(c), Midlothian ISD may not accept a bid from or award a contract to an entity that the District has determined has knowingly or intentionally failed in a previous bid or contract to comply with Subchapter J, unless the District determines and documents that the entity has taken adequate steps to ensure future compliance. If a vendor fails to provide the requested information to the District, Texas Government Code Ann. §552.373 requires the District to notify the vendor in writing of the failure and allow 10 business days to cure the violation. Midlothian ISD may terminate the contract if vendor fails to remedy the failure, the District determines the failure was knowing and intentional, and steps have not been taken to ensure future compliance.

INDEMNITY

Except as otherwise expressly provided or prohibited by law, respondent shall defend, indemnify, and hold MISD harmless from and against all claims, liability, loss and expenses, including reasonable costs, collection expenses, and attorneys' fees incurred, which arise by reason of the acts or omissions of respondent, its agents or employees in the performance of its obligations under this contract. This clause shall survive termination of this contract.

ANTI-TRUST

Successful respondent shall assign to MISD any and all claims for overcharges associated with this contract which arise under the antitrust laws of the United States, 15 USCA, Section 1 et seq., and which arise under the antitrust laws of the State of Texas, Tex. Bus. & Com. Code, Section 15.01, et seq.

MEDIATION

In the event of any dispute arising out of, related to, or regarding vendor's bid or proposal, or charges for goods or services provided by the vendor, those disputes will be resolved under the terms of Texas Government Code Ann. Chapter 2251. The vendor further agrees that any dispute regarding the sufficiency of the goods or services supplied by the vendor that is not resolved by discussion with the District, will be submitted to mediation in Midlothian County, Texas, with a mutually-agreed mediator, before either party may file suit. The costs of the mediator will be divided equally between the parties. In the event of any litigation between the parties, the prevailing party shall be entitled to recover reasonable and necessary attorneys' fees from the other party.

LITIGATION

This procurement, and any resulting award, contract, purchase order, or other agreement arising out of or related to it, shall be governed and interpreted by the laws of the State of Texas, and any litigation shall be conducted in state district court. Mandatory and exclusive venue shall be in Ellis County, Texas, or, if no county is specified, then in the county in which the Owner's main administrative office is located.

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.

SUBMITTAL

Submit proposals in accordance with the Request for Proposals.

Enclose proposal in sealed envelope, clearly marked on the outside with the following:

- Project name and CSP Number
- Name of Proposer
- Midlothian Independent School District

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.

Proposer Identification: Contractor shall add a Cover Sheet/Proposer Identification Form that includes the following information: Date, Company Name, Full Address, Phone number and Email address.

OFFER FORM

This form should serve as the cover to all responses; failure to sign may result in disqualification.

Bid Number and Title:	CSP 2425-01 WGMS Chiller Project August 1,
Submittal Due Date and Time:	2024 - 2:00 P.M. (CST)
Submittal Address:	Midlothian Independent School District Shana Volentine, Director of Purchasing 100 Walter Stephenson Rd Midlothian, Texas 76065

The undersigned authorized representative of the responding company indicated below hereby acknowledges;

- They are authorized to enter into contractual relationship on behalf of the responding company;
- They have carefully examined this document in its entirety;
- They propose to supply any products/services submitted under this solicitation at the prices quoted and in strict compliance with all terms, policies and procedures, unless any exceptions are noted;
- Any and all exceptions have been noted in writing in the response and that no other exception will be claimed;
- The accuracy of all certifications which accompany this offer;
- The stated organization is an equal opportunity employer;
- The organization has not been a party to any collusion among offer/vendors in restraint of freedom of competition by agreement to offer at a fixed price or to refrain from offering; or with any MISD employee, Board Trustee, or consultant as to quantity, quality, or price in the prospective contract, or in any terms of the prospective contract except in any authorized discussion(s) with MISD's Purchasing personnel; or in any discussions or actions between offer/vendors and any MISD employee, Board Trustee, or consultant concerning exchange of money or other things of value for special consideration in the award of this contract.
- The prices in this offer have been determined independently, without consultation, communication, or agreement for the purpose of restricting competition, as to any matter related to such prices, with any other vendor or with any competitor;
- Notice of award and/or any communication regarding an award will be submitted via MISD and not by any consultant, contractor or other party involved in this solicitation.
- Receipt of Addenda, or lack thereof:

None: _____(initial)

#1: _____(initial) #3: _____(initial)

#2: _____(initial) #4: _____(initial)

Name of Company:	Date:
Signature of Authorized Rep:	Printed Name:
Position or Title:	Phone:
Email:	Fax:

PROPOSAL FORM

The undersigned, has carefully examined the Request for Proposals, Contract Documents, Conditions of the Contract, the Specifications, the Drawings and any addenda to the Drawings and Specifications, the site, premises and all conditions affecting the work on the project listed above as prepared by Midlothian ISD. The undersigned proposes to furnish all labor, materials, services and equipment necessary to complete the entire work in strict accordance with the above documents.

Respectfully submitted by:

Company: _____

Printed Name: _____

Signature: _____

Date: _____

VENDOR DATA

FOR PURCHASE ORDER: ORDERING ADDRESS INFORMATION	
Company Name:	
Address:	
City, State, Zip:	
Contact Person:	
Title:	
Phone:	
Fax:	
Email address:	
May we submit orders via email:	
Email address, if different:	

FOR PAYMENTS: REMITTANCE ADDRESS INFORMATION	
Company Name:	
Address:	
City, State, Zip:	
Contact Person:	
Title:	
Phone:	
Fax:	
Email address:	

COOPERATIVE AGREEMENTS												
If the vendor holds a contract with any of the following, please circle and provide contract number(s) as applicable.												
Allied States	Choice Partners	CTPA	DIR	EPCNT	Omnia Partners	PACE	REGION 18	Sourcewell	TASB Buy Board	TIPS		
Contract Number(s):												

REFERENCE SHEET

Reference 1

Name: (School District/	
Company) Contact Name:	
Address:	
Phone Number:	
Email Address:	

Reference 2

Name: (School District/	
Company) Contact Name:	
Address:	
Phone Number:	
Email Address:	

Reference 3

Name: (School District/	
Company) Contact Name:	
Address:	
Phone Number:	
Email Address:	

**Please note: Some projects may require more attention to be given to historical projects of like scope, type, location, institute, etc. While it is not a requirement, the District prefers references be given for school districts of similar size to Midlothian ISD and the district may evaluate responses as a whole, based on references provided.*

VENDOR ACKNOWLEDGEMENTS

RESIDENT BIDDER

Governmental contract

A contract awarded by a governmental entity for general construction, an improvement, a service or a public works project, purchase of supplies, materials or equipment. (Texas Government Code Section 2252.001(1))

Governmental entity

- The state.
- A board, commission, department, office or other agency in the executive branch of state government, including an institution of higher education as defined by Texas Education Code Section 61.003.
- The Legislature or a legislative agency.
- The Supreme Court, the Court of Criminal Appeals, a court of appeals, the State Bar of Texas

Nonresident bidder

A person whose principal place of business is not in Texas. (Texas Government Code Section 2252.001(3))

Resident bidder

A person whose principal place of business is in Texas, including a contractor whose ultimate parent company or majority has its principal place of business in this state. (Texas Government Code Section 2252.001(4))

Check only one: _____Resident Bidder _____Non-Resident Bidder of Texas

FELONY CONVICTION AND CRIMINAL HISTORY NOTICE

Texas Education Code, 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. Vendor is responsible for the performance of the persons, employees and/or sub-contractors. Vendor assigns to provide services for Midlothian ISD pursuant to this proposal on any and all Midlothian ISD campus or facilities. Vendor will not assign individuals to provide services at a Midlothian ISD campus or facility who have a history of violent, unacceptable, or grossly negligent behavior or who have a felony conviction, without the prior written consent of the Midlothian ISD Purchasing Department. Please select the statement that applies to your company regarding the Felony Conviction Notification.

_____Publicly-Held Corporation (Notice Not Required)
_____Firm is NOT owned or operated by convicted felon
_____Firm IS owned or operated by convicted felon

CONFIDENTIALITY DECLARATION

Any portion of the response considered to be confidential or contain proprietary information, or to contain trade secrets, must be marked accordingly. This designation may not necessarily guarantee the non-release of the information under the Public Information Act or as otherwise required by law, but does provide the District with a means to review the issues thoroughly and, if justified, request an opinion by the Attorney General's office prior to releasing any information requested under the Public Information Act.

_____Packet DOES contain confidential information, as marked
_____Packet DOES NOT contain confidential information

INTERLOCAL AGREMEENTS WITH OTHER SCHOOL DISTRICTS

Midlothian ISD is a member of the Central Texas Purchasing Alliance (CTPA) and the Education Purchasing Cooperative of North Texas (EPCNT), each serving as an alliance of over 100 school districts in Texas representing millions of students, sharing information, services and contractual opportunities. A list of member districts can be found on the respective cooperative's webpage.

In support of this collaborative effort, all awards made by Midlothian ISD may be adopted by other active member districts in either (or both) of the identified entities. By adopting a contract from another member district, the adopting district has met the competitive bidding requirements established by the Texas Education Code, Section 44.031 (a)(4). While there is no obligation to participate, doing so will streamline the public purchasing process and cut costs to the public. It will also keep vendors from having to answer multiple bids for many school districts for the same product(s) or services, thereby saving the vendors resources.

All purchases by members and participants other than Midlothian ISD will be billed directly to that entity and paid by that entity. Midlothian ISD will not be responsible for another entity's debts. Each governmental entity will order its own materials/services as necessary and according their policies.

Does vendor agree: _____Yes _____No

COMMITMENT TO PROVIDE INSURANCE

Bidder will be able to furnish a valid insurance certificate reflecting as Certificate Holder: Midlothian ISD, 100 Walter Stephenson Rd, Midlothian TX 76065. The vendor shall provide and maintain insurance in a company rated no less than an "A" by A.M. Best Company.

Vendor is aware of all costs to provide insurance, will do so pending contract award, and will provide a valid insurance certificate as describe within this solicitation.

Does vendor agree: _____Yes _____No

DEBARMENT OR SUSPENSION CERTIFICATION

This firm nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency. *(Non-Federal entities are prohibited from contracting with or making sub-awards under covered transaction to parties that are suspended or debarred or whose principals are suspended or debarred. Covered transactions include procurement of goods or services equal to or in excess of $100,000. Vendors receiving individual awards of $100,000 or more and all sub-recipients must certify that the organizations and its principals are not suspended or debarred.)*

Does vendor affirm non-debarment/suspension: _____Yes_____ No

INDEMNIFICATION AND HOLD HARMLESS

Except as otherwise expressly provided, respondent shall defend, indemnify and hold MISD harmless from and against all claims, liability, loss and expenses, including reasonable costs, collection expenses, and attorney's fees incurred, which arise by reason of the acts or omissions of respondent, its agents or employees in the performance of its obligation under this contract.

Does vendor affirm: _____Yes _____No

STATEMENT OF COMPLIANCE/DEVIATION

Unless otherwise stated, this proposal complies with all specifications and/or scope of work contained in the solicitation document. Any deviations from any part of this solicitation shall be listed on a separate page as provided by the respondent with detailed conditions and information. MISD will consider any deviations in its evaluation, and reserves the right to accept or reject any bid based upon any deviations.

Response is in full compliance: _____Yes _____No (Deviations must be detailed on a separate page)

CONTRACTOR CERTIFICATION

If an employee of a contractor is covered under SB 9 the contractor must bear the burden of obtaining a national, fingerprint- based criminal history check. Under Section 22.0834 of the Education Code, the contractor is then required to certify to the district that the criminal history check has been performed. Under the statute SB 9, a contractor is required to conduct a criminal history review on an employee only when the following criteria has been met: 1) The employer has contracted with the district to provide services. 2) The particular employee will have continuing duties relating to the contract with the district. 3) The particular employee will have contact with students.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

TOXIC CONTROL COMPLIANCE

Midlothian Independent School District has established Management Plans for ensuring a high level of environmental air quality through its Operations Department. All contractors performing construction projects for MISD must familiarize themselves with these Management Plans and comply prior to the beginning of any awarded construction project. MISD employees are available to review such Plans and assist in interpretation and understanding its Asbestos Management Plans at any time prior to beginning construction.

Certification of non-use of Asbestos and Lead Containing Materials is required by all General and Sub-Contractors for all construction projects, by State and Federal regulations which MISD is subject to. Completion of this Affidavit is mandatory before final payment on a project will be made. Complete this certificate, have it notarized and submit it with your application for final payment, certifying that no materials used in conjunction with this project contain asbestos or lead in any form and that all Material Safety Data Sheets (MSDS) have been supplied to Owner before submitting application for final payment.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

MWBE/HUB CERTIFICATION

A bidder/proposer that has been certified as a Minority/Women Business Enterprise (also known as "Historically Underutilized Business" or "HUB") is encouraged to indicate its MWBE certification status when responding to this Bid/Proposal. If so, please provide the Certificate Number and Name of Certifying Agency.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

CERTIFICATION OF EQUAL EMPLOYMENT STATEMENT

It is the policy of the District not to discriminate on the basis of race, color, national origin, gender, limited English proficiency or handicapping conditions in its programs. Vendor agrees not to discriminate against any employee or applicant for employment to be employed in the performance of this Contract, with respect to hire, tenure, terms, conditions and privileges of employment, or a matter directly or indirectly related to employment, because of age (except where based on a bona fide occupational qualification), sex (except where based on a bona fide occupational qualification) or race, color, religion, national origin, or ancestry. Vendor further agrees that every subcontract entered into for the performance of this Contract shall contain a provision requiring non-discrimination in employment herein specified, binding upon each subcontractor. Breach of this covenant may be regarded as a material breach of the Contract.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

CERTIFICATION OF SECTION 2271.002 TEXAS GOVERNMENT CODE

This section applies to a contract that: (1) is between a governmental entity and a company with 10 or more full-time employees; and (2) has a value of $100,000 or more that is to be paid wholly or partly from public funds of the governmental entity. A governmental entity may not enter into a contract with a company for goods or services unless the contract contains a written verification from the company that it: (1) does not boycott Israel; and (2) will not boycott Israel during the term of the contract.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

CERTIFICATION OF SECTION 2252 TEXAS GOVERNMENT CODE

This section applies to contracts with companies engaged in business with Iran, Sudan, or foreign terrorist organization is prohibited. A governmental entity may not enter into a governmental contract with a company that is identified on a list prepared and maintained under Section 806.051, 807.051 or 2252.153. The comptroller shall prepare and maintain, and make available to each governmental entity, a list of companies known to have contracts with or provide supplies and services to a foreign terrorist organization.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

CERTIFICATION OF SECTION 2274 TEXAS GOVERNMENT CODE

If (a) vendor is not a sole proprietorship; (b) vendor has ten (10) or more full-time employees; and (c) this agreement has a value of $100,000 or more that is to be paid wholly or partly from public funds, the following certification shall apply; otherwise, this certification is not required. Pursuant to TEX. GOV'T CODE Ch. 2274 of SB 13 (87th session), vendor hereby certifies and verifies that vendor, or any wholly owned subsidiary, majority- owned subsidiary, parent company, or affiliate of these entities or business associations, if any, does not boycott energy companies and will not boycott energy companies during the term of the agreement. For purposes of this agreement, the term "company" shall mean an organization, association, corporation, partnership, joint venture, limited partnership, limited liability partnership, or limited liability company, that exists to make a profit. The term "boycott energy company" shall mean "without an ordinary business purpose, refusing to deal with, terminating business activities with, or otherwise taking any action intended to penalize, inflict economic harm on, or limit commercial relations with a company because the company (a) engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy and does not commit or pledge to meet environmental standards beyond applicable federal and state law, or (b) does business with a company described by paragraph (a)." See TEX. GOV'T CODE § 809.001(1).

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

CERTIFICATION OF SECTION 2274 TEXAS GOVERNMENT CODE

This section applies only to a contract that: (1) is between a governmental entity and a company with at least 10 full-time employees: and (2) has a value of at least $100,000 that is paid wholly or partly from public funds of the governmental entity. Except as provided by Subsection (c) and Section 2274.003, a governmental entity may not enter into a contract with a company for the purchase of goods or services unless the contract contains a written verification from the company that it: (1) does not have a practice, policy, guidance, or direction that discriminates against a firearm entity or firearm trade association; and (2) will not discriminate during the term of the contract against a firearm entity or firearm trade association. Subsection (b) does not apply to a governmental entity that (1) contracts with a sole-source provider; or (2) does not receive any bids from a company that is able to provide the written verification required by that subsection.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

CERTIFICATION OF SECTION 2274 TEXAS GOVERNMENT CODE

Pursuant to Texas Government Code Chapter 2272, Midlothian ISD is prohibited from contracting with any abortion provider or an affiliate of an abortion provider whereby the provider or affiliate receives something of value derived from state or local tax revenue. Any contract entered into by Midlothian ISD is void if the prospective vendor has such a prohibited affiliation or contractual relationship. By submitting a bid or contracting with Midlothian ISD, you are certifying to Midlothian ISD that you do not have such an affiliation or contractual relationship.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

CERTIFICATION OF SECTION 2274 TEXAS GOVERNMENT CODE

Vendor is prohibited from entering into a contract or other agreement relating to critical infrastructure that would grant direct or remote access to or control of critical infrastructure in this state, excluding access specifically allowed by the vendor for product warranty and support purposes. Vendor, certifies that neither it nor its parent company nor any affiliate of vendor or its parent company, is (1) owned by or the majority of stock or other ownership interest of the company is held or controlled by individuals who are citizens of China, Iran, North Korea, Russia, or a designated country; (2) a company or other entity, including governmental entity, that is owned or controlled by citizens of or is directly controlled by the government of China, Iran, North Korea, Russia, or a designated country; or (3) headquartered in China, Iran, North Korea, Russia, or a designated country. For purposes of this contract, "critical infrastructure" means "a communication infrastructure system, cybersecurity system, electric grid, hazardous waste treatment system, or water treatment facility." *See* TEX. GOV'T CODE § 2274.0101(2) of SB 1226 (87th leg.). The vendor verifies and certifies that vendor will not grant direct or remote access to or control of critical infrastructure, except for product warranty and support purposes, to prohibited individuals, companies, or entities, including governmental entities, owned, controlled, or headquartered in China, Iran, North Korea, Russia, or a designated country, as determined by the Governor.

VENDOR ACKNOWLEDGEMENT: _____Authorized Representative of Vendor

Vendor agrees to comply with all federal, state, and local laws, rules, regulations and ordinanc applicable. It is further acknowledged that vendor certifies compliance with all provisions, law regulations, etc. as specifically noted above.

Company Name:	
Federal Tax ID #:	
City, State, Zip:	
Phone Number:	
Printed Name of Authorized Representative	:
Title of Authorized Representative:	
Email Address:	
Signature of Authorized Representative:	
Date Signed:	

CONFLICT OF INTEREST

Effective January 1, 2006, any person or entity who contracts or seeks to contract with MISD for the sale or purchase of property, goods, or services (as well as agents of such persons) (hereafter referred to as Vendors) are required to file a Conflict of Interest Questionnaire with the District. Each covered person or entity who seeks to or who contracts with MISD is responsible for complying with any applicable disclosure requirements. Forms received by the District become public records immediately and the law requires school districts that maintain web sites to place these records on the District's web site.

The Conflict of Questionnaire must be filed no later than the seventh business day after the date that the vendor begins contract discussions or negotiations with the government entity, or submits to the entity an application, response to a request for proposal or bid, correspondence, or other writing related to a potential agreement with the entity.

The vendor also shall file an updated questionnaire not later than September 1 of each year in which a covered transaction is pending, and the seventh day after the date of an event that would make a statement in the questionnaire incomplete and inaccurate.

Note: A vendor is not required to file an updated questionnaire if the person had filed an updated statement on or after June 1, but before September 1 of the year.

Completed forms should be sent to Midlothian Independent School District Purchasing Department, 100 Walter Stephenson Rd, Midlothian, Texas 76065. Forms are available from the Texas Ethics Commission website.

The Midlothian ISD website provides a list of Local Government Officers, Superintendent and other Personnel

IRS FORM W9

This is a required form by the IRS for government entities that pay vendors in excess of $600.00 annually in order to issue a 1099 form and is required in conjunction with the reporting requirements by the Internal Revenue Service. Please include a current W9 with vendor's response.

MIDLOTHIAN ISD
INSPIRING EXCELLENCE

MIDLOTHIAN INDEPENDENT SCHOOL DISTRICT PROPOSER/VENDOR CERTIFICATION FORMS FEDERAL REGULATIONS FOR CONTRACTS, UNITED STATES DEPARTMENT OF AGRICULTURE

CFR 200 Federal Purchase Notice: Required Federal contract provisions of Federal Regulations for Contracts with Midlothian ISD (MISD) for purchases under USDA for purchases in conjunction with the National School Lunch Program, School Breakfast Program, and Summer Feeding Program. The following provisions are required to be in place and agreed if the procurement is funded with federal funds. MISD is the sub grantee or sub recipient. In addition to other provisions required by the Federal agency or non-Federal agency, all contracts made by the non-Federal entity under the Federal award must contain provisions covering the following, as applicable.

(A) Contracts for more than the simplified acquisition threshold, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate. *Pursuant to Federal Rule, when federal funds are expended by Midlothian ISD. Midlothian ISD reserves all rights and privileges under the applicable laws and regulations with respect to this procurement in the event of breach of contract by either party.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(B) Termination for cause and for convenience by the grantee or sub-grantee including the manner by which it will be affected and the basis for settlement. (All contracts in excess of $10,000). *Pursuant to Federal Rule, when federal funds are expended by Midlothian ISD, Midlothian ISD reserves the right to immediately terminate any agreement in excess of $10,000 resulting from this procurement process in the event of a breach or default of the agreement by Vendor, in the event vendor fails to: (1) meet schedules, deadlines, and/or delivery dates within the time specified in the procurement solicitation, contract, and/or a purchase order; (2) make any payments owed; or (3) otherwise perform in accordance with the contract and/or the procurement solicitation. Midlothian ISD also reserves the right to terminate the contract immediately, with written notice to vendor, for convenience, if Midlothian ISD believes, in its sole discretion that it is in the best interest of Midlothian ISD to do so. The vendor will be compensated for work performed and accepted and goods accepted by Midlothian ISD as of the termination date if the contract is terminated for convenience of Midlothian ISD. Any award under this procurement process is not exclusive and Midlothian ISD reserves the right to purchase goods and services from other vendors when it is in the best interest of Midlothian ISD.*

Does vendor agree? YES _____Initials of Authorized representative of vendor

(C) Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity"(30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor." Pursuant to Federal Rule when federal funds are expended by Midlothian ISD on any federally assisted construction contract, the equal opportunity clause *is incorporated by reference herein.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(D) Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of $2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or sub-recipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violation to the Federal awarding agency. *Pursuant to Federal Rule, when federal funds are expended by Midlothian ISD, during the term of an award for all contracts and sub-grants for construction or repair, the vendor will be in compliance with all applicable Davis-Bacon Act provisions.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(E) Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence. *Pursuant to Federal Rule, when federal funds are expended by Midlothian ISD, the vendor certifies that during the term of an award for all contracts by Midlothian ISD resulting from this procurement process, the vendor will be in compliance with all applicable provisions of the Contract Work Hours and Safety Standards Act.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(F) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of "funding agreement" under 37 CFR §401.2 (a) and the recipient or sub-recipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that "funding agreement," the recipient or sub-recipient must comply with the requirements of 37 CFR Part 401, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency. *Pursuant to Federal Rule, when federal funds are expended by Midlothian ISD, the vendor certifies that during the term of an award for all contracts by Midlothian ISD resulting from this procurement process, the vendor agrees to comply with all applicable requirements as reference in the Federal Rule above.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(G) Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended. Contracts and sub-grants of amounts in excess of $150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251- 1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA). *Pursuant to Federal Rule, when federal funds are expended by Midlothian ISD, the vendor certifies that during the term of an award for all contracts by Midlothian ISD resulting from this procurement process, the vendor agrees to comply with all applicable requirements as referenced in Federal Rule.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(H) 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. *Pursuant to Federal Rule, when federal funds are expended by Midlothian ISD, the vendor certifies that during the term of an award for all contracts by Midlothian ISD resulting from this procurement process, the vendor certifies that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation by any federal department or agency.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(I) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352). Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier-to-tier up to the non-Federal award. *Pursuant to Federal Rule, when federal funds are expended by Midlothian ISD, the vendor certifies that during the term and after the awarded term of an award for all contracts by Midlothian ISD resulting from this procurement process, the vendor certifies that it is in compliance with all applicable provisions of the Byrd Anti-Lobbying Amendment (31 U.S.C. 1352). The undersigned further certifies that:*

(1) No Federal appropriated funds have been paid or will be paid for on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of congress, or an employee of a Member of Congress in connection with the awarding of a Federal contract, the making of a Federal grant, the making of a Federal loan, the entering into a cooperative agreement, and the extension, continuation, renewal, amendment, or modification of a Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL "Disclosure Form to Report Lobbying", in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all covered sub-awards exceeding $100,000 in Federal funds at all appropriate tiers and that all sub-recipients shall certify and disclose accordingly.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(J) Civil Rights/Discrimination. When federal funds are expended by MISD requires that the proposer certify that during the term of an award by the MISD resulting for this procurement process the vendor will be in compliance with mandatory standards and policies relating to Title VI of the Education Amendments of 1972; Section 504 of the Rehabilitation Act of 1973; the Age Discrimination Act of 1975; Title 7 CFR Parts 15, 15a, and 15b; the Americans with Disabilities Act; and FNS Instruction 113-1, Civil Rights Compliance and Enforcement – Nutrition Programs and Activities.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(K) Procurement of Recovered Materials. When federal funds are expended, the District and its contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include: (1) procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; (2) procuring solid waste management services in a manner that maximizes energy and resource recovery; and (3) establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(L) Domestic preferences for procurements. (a) As appropriate and to the extent consistent with law, the non-Federal entity should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all sub-awards including all contracts and purchase orders for work or products under this award. (b) For purposes of this section: (1) "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States. (2) "Manufactured products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber. *Pursuant to the Federal Rule, vendor certifies that it will, to the greatest extent practicable, enter into contracts with the District with items produced within the United States, as outlined above, and will include this requirement in any sub-awards for any District contract that is entered into.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

(M) Prohibition on certain telecommunications and video surveillance services or equipment. Federal grant funds may not be used to purchase equipment, services, or systems that use "covered telecommunications" equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. "Covered telecommunications" means purchases from Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities), and video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities). *Pursuant to Federal Rule, when federal funds are expended by the District, vendor certifies, by signing this document, vendor will not purchase equipment, services, or systems that use "covered telecommunications", as defined by 2 CFR §200.216, equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.*

Does vendor agree? YES _____Initials of Authorized Representative of vendor

CERTIFICATION OF COMPLIANCE WITH S/B/WBE/LABOR SURPLUS

Contracting with small and minority businesses, women's business enterprises, and labor surplus area firms. The non-federal entity and contractor must take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

CERTIFICATION OF COMPLIANCE WITH TEXAS FAMILY CODE

Pursuant to Texas Family Code, Section 231.006, a child support obligor who is more than thirty (30) days delinquent in paying child support or a business entity in which the child support obligor is a sole proprietor, partner, shareholder, or owner with an ownership interest of at least twenty-five percent (25%) is not eligible to receive payments from State funds under a contract to provide property, materials, or services until all arrearages have been paid; the obligor is in compliance with a written repayment agreement or court order as to existing delinquency; or a court of continuing jurisdiction over the child support order has granted the obligor an exemption as part of a court-supervised effort to improve earnings and child support payments. The undersigned proposer certifies that he or she, as the proposing individual, or the proposing business entity named in this contract, bid or application, is not ineligible under Section 231.006 of the Texas Family Code, to receive the specified grant, loan or payment, and acknowledges that a contract resulting from this solicitation may be terminated and payment may be withheld if the certification provided herein is found to be inaccurate. NOTE: Owners not owing at least twenty-five (25%) of the business entity submitting this proposal need not exclude this certification and acknowledgement.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

CERTIFICATION OF COMPLIANCE WITH BUY AMERICA PROVISIONS

MISD has a preference for domestic end products for supplies acquired for use in the United States when spending federal funds (purchases that are made with non-federal funds or grants are excluded from the Buy America Act). Vendor certifies that it is in compliance with all applicable provisions of the Buy America Act.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

CERTIFICATION OF ACCESS TO RECORDS – 2 C.F.R. § 200.337

Vendor agrees that the District's Inspector General or any of their duly authorized representatives shall have access to any books, documents, papers and records of Vendor that are directly pertinent to Vendor's discharge of its obligations under the Contract for the purpose of making audits, examinations, excerpts, and transcriptions. The right also includes timely and reasonable access to Vendor's personnel for the purpose of interview and discussion relating to such documents.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

CERTIFICATION OF HEALTH AND SAFETY CERTIFICATIONS, LICENSING OR REGULATIONS

When federal funds are expended by MISD requires proposers to certify that during the term of an award by the MISD resulting from this procurement process, the vendor will follow mandatory standards and policies elating to observance of applicable local, state, or federal health and safety certifications, licensing, or regulations.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

RECORD RETENTION REQUIREMENTS FOR CONTRACTS PAID FOR WITH FEDERAL FUNDS – 2 CFR § 200.333

When federal funds are expended by Midlothian ISD for any contract resulting from this procurement process, the vendor certifies that it will comply with the record retention requirements detailed in 2 CFR § 200.333. The vendor further certifies that vendor will retain all records as required by 2 CFR § 200.333 for a period of three years after grantees or sub-grantees submit final expenditure reports or quarterly or annual financial reports, as applicable, and all other pending matters are closed.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

CERTIFICATION OF COMPLIANCE WITH THE ENERGY POLICY AND CONSERVATION ACT

When federal funds are expended by Midlothian ISD for any contract resulting from this procurement process, the vendor certifies that the vendor will be in compliance with mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Pub. L. 94-163, 89 Stat. 871).

Does vendor agree? YES _____Initials of Authorized Representative of vendor

CERTIFICATION OF NON-COLLUSION STATEMENT

Vendor certifies under penalty of perjury that its response to this procurement solicitation is in all respects bona fide, fair, and made without collusion or fraud with any person, joint venture, partnership, corporation or other business or legal entity.

Does vendor agree? YES _____Initials of Authorized Representative of vendor

Vendor agrees to comply with all federal, state, and local laws, rules, regulations and ordinances, as applicable. It is further acknowledged that vendor certifies compliance with all provisions, laws, acts, regulations, etc. as specifically noted above.

Company Name:	
Federal Tax ID #:	
City, State, Zip:	
Phone Number:	
Printed Name of Authorized Representative:	
Title of Authorized Representative:	
Email Address:	
Signature of Authorized Representative:	
Date Signed:	

SECTION 00 06 00

MIDLOTHIAN ISD ACADEMIC CALENDAR

The following calendar was provided by the Midlothian Independent School District for the 2024-2025 academic year.

END OF SECTION

MIDLOTHIAN ISD
INSPIRING EXCELLENCE

2024-2025 Learning Calendar

JULY 2024

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

AUGUST 2024

SU	M	TU	WE	TH	FR	SA
				1	2	3
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25	26	27	28	29	30	31

SEPTEMBER 2024

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22	(23	24	25	26	27	28
29	30					

OCTOBER 2024

SU	M	TU	WE	TH	FR	SA
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13	14	15	[16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31)		

NOVEMBER 2024

SU	M	TU	WE	TH	FR	SA
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3	(4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

DECEMBER 2024

SU	M	TU	WE	TH	FR	SA
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8	9	10	11	12	13	14
15	16	17	18	19)[	20	21
22	23	24	25	26	27	28
29	30	31				

JANUARY 2025

SU	M	TU	WE	TH	FR	SA
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12	13	14	15	16	17	18
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26	27	28	29	30	31	

FEBRUARY 2025

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9	10	11	12	13)	14	15
16	17	(18	19	20	21	22
23	24	25	26	27	28	

MARCH 2025

SU	M	TU	WE	TH	FR	SA
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2	3	4	5	6]	7	8
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16	[17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL 2025

SU	M	TU	WE	TH	FR	SA
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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY 2025

SU	M	TU	WE	TH	FR	SA
				1	2	3
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11	12	13	14	15	16	
18	19	20	21	22)[	23	24
25	26	27	28	29	30	31

JUNE 2025

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

- New Teacher Orientation (No school for students)
- Teacher Work Day (No school for students)
- Professional Development Day (No school for students)
- Teacher Exchange Day (No school for students)
- Student & Staff Holiday
- Professional Learning Day (No school for students) 8:30-noon PLC + 3 hr Teacher Planning
- Student Early Release Day
- [ ] Elementary Grading Periods
- ( ) Secondary Grading Periods

ATTENDANCE TIMES

Elementary 7:30a-3:15p

Secondary 8:30a-4:15p

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

DATES TO REMEMBER

Jul 4-5	Staff Holiday	Dec 20	Student Holiday/Teacher Exchange Day
Jul 29-Aug 1	New Teacher Orientation	Dec 23-Jan 3	Student/Staff Holiday
Aug 2, 8, 13	Teacher Work Day	Jan 6	Student Holiday/Teacher Work Day
Aug 5-7, 9, 12	Professional Development	Jan 7	Student Holiday/Professional Learning
Aug 14	First Day of School	Jan 20	Student/Staff Holiday
Aug 30	Student Holiday/Professional Learning	Feb 14	Student Holiday/Professional Development
Sep 2	Student/Staff Holiday	Feb 17	Student/Staff Holiday
Sep 20	Student Holiday/Professional Learning	Mar 7	Student Holiday/Professional Learning
Oct 11	Student Holiday/Professional Learning	Mar 10-14	Student/Staff Holiday
Oct 14	Student/Staff Holiday	April 4	Student Holiday/Professional Learning
Oct 15	Student Holiday/Professional Development	April 18	Student Holiday/Teacher Exchange Day
Nov 1	Student Holiday/Teacher Work Day	May 17	Graduation Day (subject to change)
Nov 22	Student Holiday/Professional Learning	May 22	Student Early Release Day/Last Day of School
Nov 25-29	Student/Staff Holiday	May 23	Teacher Work Day
Dec 19	Student Early Release Day	May 26	Staff Holiday

INSTRUCTIONAL TIME

1st Semester
36,535 minutes
78.5 days

2nd Semester
39,790 minutes
85.5 days

Professional Development
2,100 minutes

GRADING PERIODS

Elementary (9-Week)
1st: Aug 14-Oct 10
2nd: Oct 16-Dec 19
3rd: Jan 8-Mar 6
4th: Mar 17-May 22

Secondary (6-Week)
1st: Aug 14-Sep 19
2nd: Sep 23-Oct 31
3rd: Nov 4-Dec 19
4th: Jan 8-Feb 13
5th: Feb 18-Apr 3
6th: Apr 7-May 22

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

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 Chiller Replacement at Walnut Grove Middle School, in accordance with the drawings and project manual prepared by RWB Consulting Engineers for the lump sum of:

BASE PROPOSAL amount of:

_____

_____Dollars ($_____).

Under ALTERNATE NO. 1, Provide the added cost to provide replacement Variable Frequency Drives (VFDs) for all VFDs noted in the contract documents. This cost shall include the equipment cost only and shall NOT include any associated cost to remove and install the new VFDs or any associated labor or other cost.

ALTERNATE NO. 1 amount of:

_____

_____ Dollars ($_____).

Under ALTERNATE NO. 2, Provide the added cost to provide an extended four (4) year compressor warranty for the centrifugal chiller, which will result in a total of five (5) years from the date of substantial completion.

ALTERNATE NO. 2 amount of:

_____

_____ Dollars ($_____).

Under ALTERNATE NO. 3, Provide the added cost to provide a five (5) year maintenance contract on the entire Central Plant, to include all associated mechanical and plumbing equipment in the central plant. This will include all annual inspections required to be conducted on all equipment as well. Refer to Section 01 01 01 Annual Maintenance Service Scope, for scope of work to be included in this maintenance contract. This maintenance contract shall start at the conclusion of the required one (1) year warranty for the scope of work for the base proposal work.

ALTERNATE NO. 3 amount of:

_____

_____ Dollars ($_____).

Provide Unit Pricing to install the following Variable Frequency Drives (VFD), which are all located indoors in mechanical rooms and serve either pumps or air handlers:

VFD Size	Unit Pricing to Install One (1) VFD of this associated HP at either an indoor AHU or Pump ($)
1 HP	
2 HP	
3 HP	
5 HP	
10 HP	

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

Equipment Type	Manufacturer	Equipment Lead Time (Months)
Centrifugal Chiller		
Variable Frequency Drive		

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 Thanksgiving or Winter Break. Thanksgiving Break starts Tuesday November 26, 2024 at noon and ends December 1, 2024 at 11:59PM. Phased work will need to be coordinated with the district. Winter Break starts 5:00PM on December 20, 2024 and ends January 5, 2025 at 11:59PM.
7. All Base and Alternate Proposal work shall be substantially completed by 11:00PM January 5, 2025, unless the VFD lead time does not allow for work to be done over Winter Break. If VFD lead time is extended, then ONLY work for VFD replacement scope can be extended to be completed during Spring Break. Spring Break is from Friday March 7, 2025 at 5:00PM until Sunday March 16 at 11:59PM.
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: July 16, 2024 @ 11am CST @ WGMS.
    b. Questions Due: July 19, 2024 by 12:00pm CST.
    c. Final Addenda: July 23, 2024, posted by 4pm CST.
    d. Proposals Due: August 1, 2024 by 2pm CST.

e. Board Meeting: August 19, 2024
f. Notice to Proceed: August 20, 2024.

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 CHILLER REPLACEMENT AT WALNUT GROVE MIDDLE 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.

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 Chiller Replacement at Walnut Grove Middle 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 01 01

ANNUAL MAINTENANCE SERVICE SCOPE

1.1 WORK COVERED

A. **The Work included in this section shall be provided as part of the Base Proposal scope of work for one (1) year** and as the Alternate No. 3 scope of work for an additional five (5) years at Walnut Grove Middle School (Midlothian, Texas) for the Midlothian Independent School District.

B. The scope listed covers the equipment housed in the Central Utility Plant and Equipment Yard.

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. Contractor shall schedule all associated maintenance work and annual equipment service and maintenance so as not to affect the operation of the facility. This may require certain pieces of equipment to be serviced one at a time or to be serviced when the facility is not in use, which may require after hours, weekend or Holiday servicing and maintenance of equipment.

B. The contractor should review the typical district calendar to familiarize themselves with the standard break periods, early release, partial use and other schedule dates that the District has. Refer to Section 00 06 00.

C. 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 access to the facility for service and maintenance, but will be required to check-in at the front office when the school is in use and to check-in with the facilities department for access to the facility when the facility is not in use.

B. 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. 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.

E. Parking areas for Contractor's personnel shall be as acceptable to Owner.

1.5 OWNER OCCUPANCY

A. Contractor shall at all times conduct his operations as to ensure least inconvenience to general public.

B. Maintain at all times safe access and egress from existing building. Maintain safe exit paths from building for emergency egress.

C. 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.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 EQUIPMENT SUMMARY CHART

A. The following equipment chart provides a general summary of the main equipment in the central utility plant that will need to be maintained (the Screw Chiller will be replaced by the new Centrifugal Chiller installed in this project). The contractor should also include maintenance on the centrifugal separators for condenser water system (two total) and the associated air separators for each of the chilled and heating water systems:

Equipment Type	TAG#	Make	Model	Serial
Boiler	B-1	Burnham Commercial	V1113	64736785
Boiler	B-2	Burnham Commercial	V1113	64773209
Water Heater	WH1	PVI	20 P 119A-MXL	205115125
Water Heater	WH2	PVI	20 P 119A-MXL	205115124
Chiller Centrifugal	CH1	YORK (Johnson Controls)	YKACASQ3-EHG	SFBM-979090
Chiller Screw	CH2	YORK	YR VB VC TO 46 BS	SBPM-683610
Pump	PHWP-2	Bell & Gossett	1510 BF 6500	CT6780-01 A50
Pump	PHWP-1	Bell & Gossett	1510 BF 6500	CT6780-02 A50
Pump	CHP1	Bell & Gossett	1510 BF 10000	CT6768-02 A50
Pump	CHP2	Bell & Gossett	1510 BF 10000	CT5768-01-A50
Pump	PCHP-1	Bell & Gossett	1510 BF 8500	CT6769-02-A50
Pump	PCHP-2	Bell & Gossett	1510 BF 8500	CT6769-01-A50
Hot Water Pump	HWP-1	Bell & Gossett	1510 BF 10500	CT6773-02 B50
Hot Water Pump	HWP-2	Bell & Gossett	1510 BF 10500	CT6770-02-A50
Chilled Water Pump	CWP-1	Bell & Gossett	1510 BF 9000	CT6770-01-A50
Chilled Water Pump	CWP-2	Bell & Gossett	1510 BF 9000	CT6770-02-A50
Cooling Tower	CT-1	BAC	3240-2	U041791501MAD
Cooling Tower	CT-2	BAC	3240-2	?

3.2 EQUIPMENT MAINTENANCE SCOPE OF WORK

A. The following provides a summary of the tasks that should be included in the annual service and maintenance of the associated equipment in the central utility plant.

B. Boiler

1. Annual Inspection:

   a. Inspect safety and operating controls
   b. Inspect condensate drain
   c. Inspect/clean main burner assembly
   d. Inspect condition of spark electrode and flame rod
   e. Inspect/clean flower assembly as required
   f. Inspect condition of flue
   g. Inspect refractory and firebrick for defects
   h. Inspect/check expansion tank
   i. Inspect/check air separator
   j. Inspect all electrical components
   k. Verify boiler room supply vents are free from obstructions

l. Verify accuracy of pressure gauges/thermometers
m. Inspect/clean heat exchanger
n. Exercise isolation valves
o. Inspect/check boiler pump and lubricate as required
p. Perform combustion analysis and adjust fuel and combustion air ratio as needed
q. Inspect/clean air filter as required
r. Inspect the boiler for gasket leaks
s. Inspect safety and operating controls for proper operations

2. Operating Inspection:

a. Inspect safety and operating controls
b. Inspect condensate drain
c. Inspect condition of spark electrode and flame rod
d. Inspect condition of flue
e. Inspect/check expansion tank and air separator
f. Inspect all electrical components
g. Verify boiler room supply vents are free from obstructions
h. Verify accuracy of pressure gauges/thermometers
i. Exercise isolation valves
j. Inspect/check boiler pump and lubricate as required
k. Perform combustion analysis
l. Inspect/clean air filter as required
m. Inspect the boiler for gasket leaks
n. Inspect safety and operating controls for proper operation
o. De-soot the heat exchanger and flue

C. Gas Water Heater

1. Major Inspection:

a. Inspect safety and operating controls
b. Inspect condensate drain as required
c. Inspect/clean main burner assembly as required
d. Inspect condition of spark electrode and flame rod
e. Inspect/clean blower as required
f. Inspect condition of flue
g. Check expansion tank
h. Inspect water heater electrical components
i. Verify room supply vents are free from obstruction
j. Verify accuracy of pressure gauges/thermometers
k. Flush debris from water heater tank
l. Check gas/air supply for proper pressure

m. Exercise isolation valves
n. Inspect the water heater for leaks
o. Inspect safety and operation controls
p. Conduct a combustion analysis and adjust blower/fuel mixture ratio as needed
q. Remove/inspect anode rod

D. High-Pressure Centrifugal Chiller

1. Annual Inspection:

a. Lubrication System
b. Close oil filter isolation valves
c. Install new oil filter and gasket (if required)
d. Clean oil strainer (if required)
e. Calibrate oil heater temperature control
f. Inspect oil heater leads
g. Oil sample analysis for wear metals, acid content, and moisture
h. Electrical systems
i. Inspect and calibrate all safety and operating controls
j. Inspect and calibrate operation of electrical pre-rotation guide vane controls
k. Inspect operation of hot-gas bypass valve (if required)
l. Inspect condition of compressor contactors for wear and pitting
m. Meg compressor motor and oil pump motor, record data
n. Inspect all electrical connections in the starter and control panel
o. Overall system review
p. Log chiller operating conditions
q. Review customer operating logs for trends
r. Record operating and safety control settings
s. Check operation of VFD cooling fans or water-cooled system, if applicable
t. Check and record lubrication system
u. Check approach temperature on condenser and evaporator
v. Record pressure and temperature differential across evaporator and condenser, if applicable
w. Remove condenser head and brush clean tubes
x. Remove evaporator head and brush clean tubes
y. Change coolant in VFD
z. Perform vibration analysis
aa. Every two (2) years provide eddy current testing of condenser tubes
bb. Every two (2) years provide eddy current testing of evaporator tubes

2. Operating Inspection

a. Log chiller operating conditions
b. Review customer operating logs for trends

c. Record operating and safety control settings
d. Check operation of VFD cooling fans or water-cooled systems, if applicable
e. Check and record lubrication system
f. Check approach temperature on condenser and evaporator
g. Record pressure and temperature differential across evaporator and condenser, if accessible

E. Cooling Tower

1. Annual Inspection:

a. Clean flat valve assembly and adjust for proper operation
b. Check and clean bleed-off line and overflow
c. Check sump heater and thermostats for calibration and operation
d. Check condition of drive pulleys (if applicable)
e. Check and adjust fan belts (if applicable)
f. Check oil level in gearbox (if appliable)
g. Check derive shaft couplings (if applicable)
h. Lubricate fan and motor bearings per manufacturer's recommendation
i. Check and record volts and amperage on motors
j. Inspect electrical connections, contractors, relays
k. Check and calibrate operating and safety controls
l. Check and adjust condenser water temperature regulator system
m. Check and adjust bypass valve
n. Inspect vibration switch
o. Inspect operation of mechanical spray nozzles
p. Verify water treatment plan in place
q. Clean tower strainers once per year
r. Clean water sump basin and check condition once per year
s. Rinse fill and drift eliminators
t. Check side steam separators in central plant and clean and backwash and replace filters as needed
u. Change fan drive belts once per year
v. Descale tower fill and drift eliminators
w. Provide scissor lift to access fill as needed

2. Operating Inspection

a. Verify fan operation
b. Check sump strainer, bleed, and overflow
c. Check operating conditions, adjust as required
d. Check and record volts and amperage on motors

F. Pumps

1. Lubricate pump bearings per manufacturer’s recommendations
2. Lubricate motor bearings per manufacturer’s recommendations
3. Check suction and discharge pressures
4. Visually inspect packing or mechanical seals
5. Check motor voltage and amperage
6. Check motor operating conditions
7. Inspect electrical connections and conductors
8. Check operation of isolation valves
9. Check pump starter or VFD.
10. Check pump alignment
11. Remove and clean pump strainers.

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 ALLOWANCES

A. Include in Base proposal Contract Sum lump-sum general Contingency Allowances in the amount of:

1. Sixty Thousand Dollars ($60,000.00).
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. Testing, Adjusting and Balancing (TAB) Allowance:

1. Include in the Base Proposal Contract Sum lump-sum TAB Allowance for chiller, pumps and cooling towers in the amount of Seven Thousand Five Hundred Dollars ($7,500.00).
2. Include in the Unit Cost for VFD Installation, the lump-sum TAB allowance per VFD installation of Five Hundred Dollars ($500.00) per VFD.
3. 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.
4. Change orders will include such additional costs as provided in the Conditions of the Contract.

C. Monies in contingency allowance will be used only on issuance of contingency allowance expenditure authorization or change order.

D. 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 03 00

ALTERNATES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. This Section identifies each Alternate by number, and describes the basic changes to be incorporated into the Work, only when that Alternate is made a part of the Work by specific provisions in the Owner-Contractor Agreement.

1.2 RELATED REQUIREMENTS

A. Owner-Contractor Agreement: Incorporation of Alternates accepted by Owner into the Work.

B. Sections of the Specifications as listed under the respective Alternates.

C. Referenced sections of specifications stipulate pertinent requirements for products and methods to achieve the work stipulated under each Alternate.

D. Coordinate pertinent related work and modify surrounding work as required to properly integrate the work under each Alternate, and to provide the complete construction required by Contract Documents.

1.3 DESCRIPTION

A. Alternates will be accepted and executed at Owner's option.

B. This Section identifies each Alternate by number, and describes the basic changes to be incorporated into the Work, only when that Alternate is made a part of the Work by specified provisions in the Owner-Contractor Agreement.

C. Related Requirements in other Sections:

1. Sections of Specifications as listed under the respective Alternatives.

D. Referenced Sections of Specifications stipulate pertinent requirements for products and methods to achieve the work stipulated under each Alternative.

E. Coordinate pertinent related work and modify surrounding work as necessary to properly integrate work under each Alternative, and to provide complete construction required by Contract Documents.

1.4 DESCRIPTION OF ALTERNATES

A. Alternate Proposal No. 1: Provide the added cost to provide replacement Variable Frequency Drives (VFDs) for all VFDs noted in the contract documents. This cost shall include the equipment cost only and shall NOT include any associated cost to remove and install the new VFDs or any associated labor or other cost.

B. Alternate Proposal No. 2: Provide the added cost to provide an extended four (4) year compressor warranty for the centrifugal chiller, which will result in a total of five (5) years from the date of substantial completion.

C. Alternate Proposal No. 3: Provide the added cost to provide a five (5) year maintenance contract on the entire Central Plant, to include all associated mechanical and plumbing equipment in the central plant. This will include all annual inspections required to be conducted on all equipment as well. Refer to Section 01 01 01 Annual Maintenance Service Scope, for scope of work to be included in this maintenance contract. This maintenance contract shall start at the conclusion of the required one (1) year warranty for the scope of work for the base proposal work.

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.

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 – Pluming & 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 reproducable 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 Engineer, 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 Engineer.

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 Engineer.

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 Engineer. 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 Engineer 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 contaminates 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 Engineer.
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 Engineer.
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.

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 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 (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 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 33 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 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.

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, horsepowers 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 30 00, Submittals.

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. All concrete work shall conform to the requirements of Division 03, Cast-in-Place Concrete.

G. 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 05 01

PLUMBING DEMOLITION

PART 1 - GENERAL

1.1 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. 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.

C. Refer to Division 1, Section 01 01 00 for "Summary of Work".

1.2 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 heating, air conditioning, plumbing, fire protection, 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, even where not specifically shown.

1.3 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. Plumbing 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. All piping that is to be removed shall be completely removed back to the point noted. Demolished piping shall not be abandoned in place.

D. 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.

E. 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.

F. 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.

1.4 CLEAN UP

A. Remove all debris, rubbish, and materials resulting from cutting, demolition, or patching operations from the work area on a daily basis.

B. Transport materials and legally dispose of off-site.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING 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 22 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 valve identification by the use of tags as described herein.

C. 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 22 05 00.

B. Shop Drawings:

1. Submit a list of all piping systems to be identified, color of background to be used, legend or wording to be displayed for each system, and the intended location of all markers to be displayed.
2. Submit a list of equipment to receive identification tags, cut sheets and proof copies of tags which indicate location of tag and wording to be engraved thereon.

3. Submit a list of valves with location, indicate type of service, type of tag, tag number and proposed valve tag chart as specified herein.

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 22 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. Domestic Cold Water (Green background)
2. Domestic Hot Water (Yellow background)
3. 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.
4. Non-Potable Water (Blue background)

2.2 EQUIPMENT IDENTIFICATION

A. This Contractor shall provide identification plates similar and equal to Seton Name Plates, Style 2060.

B. Name plates shall be a minimum of 1/16" thick and 1" X 3" in size with beveled edges. The surface shall be a black satin with a white core for lettering. 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. Lettering shall be cut through the black surface to the white core. 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. Easy Water System.

D. Name plates shall have complete words describing equipment type, use and service. As an example, air handlers shall be designated "AHU-S-X MEP Shop" to designate the equipment as an air handler, number of air handler and area served. Use multiple or larger name plates as required to fulfill this requirement.

2.3 VALVE TAGS

A. Wire onto the handle of each valve installed a 19 gauge brass disc not under one and one-half inches (1-1/2") in diameter stamped with 1/4" high black paint filled letters over 1/2" high black paint filled numbers. Use "PLBG" as letters for Plumbing Valves, "AC" or "HVAC" for Air Conditioning System Water Valves or "FP" for Fire Protection Valves, followed by an identifying number. Tags shall be equivalent to Seton Style 250-BL.

B. Secure valve tags to valves by use of brass "S" hooks or brass jack chains.

C. The number, location, and purpose corresponding to each valve shall be listed in sequence, properly typewritten on a schedule sheet to be turned over to the Owner.

D. Provide two (2) framed valve tag charts with typed schedule sheets contained therein. Charts shall have an aluminum frame with clear plastic or Lexan window.

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 22 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.

3.3 VALVE TAGS

A. Secure Valve tags to each valve with Brass "S" hooks or jack chains on each valve stem corresponding to the valve tag chart list.

B. Secure Valve Tag Chart List to Central Mechanical Room wall near the main entry at 60" above finished floor or where otherwise directed by the Engineer. Provide second chart to Owner for their disposition.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Comply with Division 1 - General Requirements and referenced documents.

B. Comply with all other Division 22 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 22 05 53, Identification for Plumbing Piping and Equipment.

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, 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 in accordance with Section 22 05 00.

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 22 05 00.

PART 2 - PRODUCTS

2.1 PIPING AND EQUIPMENT INSULATION MATERIALS

A. Domestic Cold Supply and Non-Potable Water Piping Insulation:

1. Insulation shall be approximately 4 lb. or heavier in density, molded sectional glass fiber pipe covering with factory applied, white FRG, fire resistant, vapor barrier jacket.
2. Insulate valves and fittings with pre-molded glass fiber fitting covers equal in thickness to the adjoining pipe covering. In lieu of pre-molded fitting covers, for welded pipe fittings only, insulate with field fabricated mitered segments of pipe covering equal in density and thickness to the adjoining pipe covering. Use loose low density glass fiber insulation compressed tightly and equal to thickness of adjoining straight pipe sections for screwed fittings; vapor sealed with one 1/8" thick wet coat of water based Foster 30-33, Childers CP-33 vapor barrier coating, or approved equivalent. Vapor barriers- coatings shall have a maximum permeance rating of 0.07 at 43 mils dry film thickness per ASTM E-96, or equivalent adhesive, and imbedded in a glass fabric tape which has an emulsion imbedded in it and a coating on it; apply a second 1/8" thick coat of Foster No. 30-33, Childers CP-33 vapor barrier coating, or equivalent adhesive and apply a PVC jacketing as specified elsewhere herein.
3. Finish entire installation with PVC sheet jacketing where exposed from the finished floor up to 12'-0" above the finished floor including all portions of horizontal piping that occurs at and extends above 12'-0". Jacketing shall be applied to all straight piping sections, as well as all elbows, tees, valves, and fittings. Use "smoke-safe" PVC fitting covers, similar to Speedline 1, Knauf “Proto” or John Manville “Zeston 2000". Suitably seal all jacketing seams with tape, or other approved means, along the entire length of seams.
4. Loose "Diaper" inserts at fittings shall not be allowed.
5. Insulation thickness shall be as follows:

PIPING SYSTEMS	INSULATION THICKNESS - INCHES P I P E S I Z E S				
	RUNOUTS 3/4" & SMALLER	LESS THAN 1"	1" TO 1-1/4"	1-1/2" TO 3"	4" & OVER
Domestic Cold Water	1.00	1.00	1.00	1.00	1.00

B. Plenum Safe Jacketing:

1. Where non-plenum rated piping (such as PVC, FRPP, PE, PP, etc.) is installed in return air plenums cover all exposed portions of this piping with a plenum safe jacketing, or wrap, system that is a factory manufactured and tested non-combustible barrier, to flame and smoke spread, designed to encapsulate non-rated or combustible items located in return air plenums, in accordance with the most recent additions of the International Building and Plumbing Codes.
2. Plenum safe jacketing shall be covered with a light weight fiberglass reinforced foil scrim finished high temperature rated insulation with an approximate density of 6 pounds per cubic foot. Jacketing shall have a Flame Spread and Smoke Developed rating of 0 for the unfaced blanket and be under 25 and 50 respectively for these items as tested in accordance with U.L. 723 and ASTM E-84. Maximum Flame Spread in accordance with U.L.1887 shall be 0 feet. Maximum smoke/optical density and Average Smoke per U.L.1887 testing shall not exceed 01 and 0 respectively. U.L. 1887 test procedure is a modified tunnel test which provides test data for flame spread and smoke density using a single plastic pipe and a bundle of plastic pipes of various sizes subjected to a fire test.
3. Thermal resistance of the barrier system shall be 4.2 as tested in accordance with ASTM C518. The Barrier System shall be able to withstand an operating temperature up to 2,300 Deg.F. and have a melting point of no lower than 3,100 Deg.F.
4. Plenum safe jacketing shall be a minimum 1/2 inch thick and have at least one side covered with a foil skin which must face the outer, or exposed, side. All joints in each direction shall be overlapped a minimum of one inch (1"). Jacket shall be secured tightly around the piping with either stainless steel banding or stainless steel tie wire. Use stainless steel crimp clamps on banding fasteners. Tie wires shall be secured using twist tensioning. Seal all cut edges with aluminum foil tape to ensure there is no exposed fiber.
5. Plenum safe jacketing shall be as manufactured by:
    a. Great Lakes Textiles, Inc. or approved equals by;
    b. 3M Corporation.
    c. Thermal Ceramics.
    d. FryeWrap by Unifrax.

PART 3 - EXECUTION

3.1 GENERAL

A. Apply insulation and pipe covering after all of the piping system to be insulated has been pressure tested, found to be completely tight (without leaks), and accepted as such. All extended handles and caps should be installed prior to commencing with insulation. 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. For operational systems, perform work after operational hours and only during periods of scheduled equipment shutdown. During this period water flow to the piping segments to be insulated shall be stopped and the water and piping shall have equalized in temperature with the average ambient temperature of the space in which the piping is installed. If time does not permit this to occur then apply heat to the piping in a controlled, suitable manner, to warm the water and pipe sufficient to prevent any condensation from occurring during the insulation process. For any segments to be left uninsulated until the next system shutdown, mastic seal the ends and penetrations through of the installed insulation and allow sealant to dry prior to re-energizing the water system. Continue to insulate the piping system in small enough portions after-hours, or as required, to insure no insulation is applied over a wet surface.

C. In the covering of surfaces subject to low temperatures (below 60 Deg. F.), take extreme precautions to secure a complete vapor seal and avoid air pockets of any kind within the insulation. All insulation shall be tightly fitted to the piping system and all systems shall have an equal thickness and density of insulation around all piping, valves, strainers, accessories, etc. Where fiberglass insulation is cut to contour insulation around valves or strainers add additional insulation to obtain the overall insulation thickness specified. Where vapor barrier jackets are lapped at seams and joints, paste such flaps carefully to assure no break in the vapor seal. Seal around butt joints with strips of vapor barrier jacket. Use self-sealing laps on all insulation for pipes carrying a medium below 60 Deg.F. Stapling will not be permitted where vapor barrier jackets are specified. Vapor barriers for these systems shall have a perm rating not to exceed 0.05.

D. On glass fiber pipe covering with factory applied vapor barrier jacket, lap the jacket on the longitudinal seams and seal with vapor barrier lap adhesive equivalent to water based Foster 30-33, Childers CP-33 vapor barrier coating, or approved equivalent. Vapor barriers - coatings shall adhere to a maximum permeance rating of 0.07 at 43 mils dry film thickness per ASTM E-96. Tightly butt the ends and cover butt joints with a 4" wide band of vapor barrier jacket secured with the same adhesive. At all run-

out piping to water equipment mastic seal the ends of the branch piping insulation where it meets the main piping insulation to prevent the migration of moisture should it ever become trapped in the insulation system. Generally, mastic seal the ends of butt joints in water piping systems every 50 feet for the entire system.

E. Where jacketing systems are specified, use standard weight, PVC sheet rolls. Exercise care to locate seams in an inconspicuous place and apply all jacketing neatly, including that on valves and fittings. Unsightly work will be considered a justifiable basis for rejection. Adhere the jacketing in all cases with a lagging adhesive, Foster 30-36 A F (Anti-Fungal) or Childers CP-137 AF, or other approved methods. Lagging adhesives shall meet ASTM D 5590 with a “0" growth rating.

F. All insulation shall be continuous through wall and ceiling openings and sleeves.

G. 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

H. No insulation shall be applied to the bodies of all valves, unions, joints and flanges on domestic hot, domestic cold and domestic hot water return valves. Terminate the insulation short of the valves, unions, joints or flanges at this equipment, and bevel off at a forty five degree angle to permit "breaking" the union, joint or removal of the flange bolts without damaging the insulation. Bevel the insulation off also at caps on scale pockets, and blow-off connections on strainers, and at valve bonnets on these same systems.

I. Unsightly work shall be cause for rejection, including poor application of adhesives and coatings beyond the insulation which coats valves or other piping specialties.

J. 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.

K. Miscellaneous Lines: Piping connected to 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.

L. 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.

M. 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.

N. The following describes materials, thickness and finishes for insulation on piping. In the following "exposed" shall mean any pipe exposed below the finished ceiling and structure where no ceiling is installed, in any room space, area, mechanical rooms, closets, and any pump run exterior to the building, including above the roof. "Concealed" shall mean any pipe located above ceilings, in furrings, in chases, in crawl spaces, and buried in direct contact with the soil.

O. In all "exposed" areas, up to 12'-0" above the finished floor, insulation shall receive a PVC jacketing system. Neatly install all jacketing for finish painting.

P. 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 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"

B. Provide inserts of calcium silicate on hot piping and cellular glass or 7#/Cu.Ft. fiber glass pipe insulation on cold piping at hangers except pipes 1-1/2" or smaller in size. Inserts between the pipe and pipe hangers shall consist of rigid pipe insulation of a thickness equal to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall not be less than the following lengths:

Pipe Size	Insert Length
3/4" to 3"	12"
4" to 6"	12" - 18"
8" to 10"	24"
12" & Larger	24"

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Comply with Division 01 - 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.

1.2 SYSTEM DESCRIPTION

A. Provide a complete system of domestic cold water supply as indicated herein and as illustrated on the contract drawings.

B. Provide isolation of systems through valving as shown or indicated herein.

C. Provide a system free of water hammer.

D. Isolate all piping components to eliminate all audible vibration and noise.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 30 00.

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. Shock arrestors.
5. Hose bibbs.
6. Hydrants.
7. Backflow preventers.
8. Trap Primer.

D. Certification: Submit certification that completed system complies with sterilization procedures and test requirements of municipality, State, and other public authorities having jurisdiction over system sterilization.

E. Submit copies of pressure test data of water systems to Owner prior to time of final completion of construction work.

F. Provide closeout documents as required in Division 1, Section 01 70 00.

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.
2. Provisions specified in this Section.
3. International Plumbing Code.

B. Installer shall have been doing related work as described herein for a minimum of 5 years.

C. Unless otherwise noted for specific products, all material shall be manufactured in the United States and/or shall comply with the most current “Buy America” Act formally known as the North America Free Trade Agreement, NAFTA.

1. Trap Primer manufacturers do not need to comply with the most current “Buy America” Act.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Above ground:

1. 3 Inch and Smaller:

a. Pipe: Hard drawn copper water tube, ASTM B88, Type "L".

b. Fittings:

1) 3 Inch and smaller, wrought copper solder joint fittings, ANSI B16.22.

c. Joint solder:

1) 95% tin - 5% antimony for pipe sizes 2" and less.
2) Or 95.5% tin, 4% copper and 0.5% silver based for pipe sizes 2" and less.
3) "Silfos" for pipe sizes 2-1/2" and larger.
4) No lead containing solder is allowed.

d. Alternative jointing method for pipes 2 ½" and smaller.

1) Type L copper pressed end fitting conforming to ASTM B88/B16.22 and NSF 61 Annex G.

2) Acceptable manufactures: Viega “Pro-Press” or equal by Nibco or Apollo
3) At completion of the project the contractor shall provide Owner with complete set of clamping jaws and driver”.

B. Unions:

1. 3 Inch and Smaller: ANSI B16.22 wrought copper; solder end fittings.

C. Valves and Supports: Provide lead-free bronze full-port ball valves with stainless steel trim for pipe sizes 2" and smaller. Provide flanged lead-free bronze or epoxy coated full port valves with stainless steel trim from pipe sizes 2-1/2” or larger. Butterfly valve are not allowed. Refer to Section 22 05 00 and 22 21 13, Basic Materials and Methods.

2.2 SPECIALTIES

A. Access Doors:

1. Milcor "Style K, M, or DW", stainless steel to suit surface application.
2. Panels to have cam locks and door sized 18 inches by 18 inches
3. All restroom/toilets and kitchen areas shall have stainless steel access doors.

B. Shock Arrestors:

1. Acceptable manufacturer: Sioux Chief Manufacturing Co., Precision Plumbing Products (PPP), Josam, Jay R. Smith.
2. One piece, seamless copper construction.
3. Piston type, triple "O" ring copper construction.
4. Factory charged.
5. Plumbing Drainage Institute (PDI) certified.
6. ASSE 1010 approved with lifetime warranty, not requiring access.
7. Size as shown on drawings or as recommended by manufacturer.
8. Acceptable product: "Hydra-Rester", Sioux Chief Manufacturing Co.

C. Air Chambers: Same material and size as pipe branch or riser; minimum of 18" long.

D. Vacuum Breakers:

1. Acceptable manufacturer:
   a. Watts.
   b. Wilkins.
   c. Apollo.
2. Atmospheric, check valve type.
3. Bronze body construction with polished chrome finish.

E. Spill -Resistant Vacuum Breakers:

1. Acceptable manufacturer:

a. Watts.
b. Wilkins.
c. Apollo.

2. Anti-Siphon
3. Testable, check valve type.
4. Lead Free Bronze body construction with polished chrome finish.
5. Equal to Watts LF008PCQT

F. Reduced Pressure Type Backflow Preventer Assembly:

1. Acceptable manufacturers:

a. Watts.
b. Wilkins
c. Ames.

2. Double check valve type with shutoff valves.

a. Quarter turn ball shut-off valves up to 2-1/2 Inches.
b. Outside stem and yoke gate shut-off valves 3 Inches and over.

3. Differential pressure type relief valve with air gap fitting.
4. Bronze body construction up to 2-1/2 Inches.
5. Cast iron body construction 3 Inches and over with stainless steel internal ports and FDA approved fused epoxy coating.
6. Provide in-line upstream y-type strainer.

a. 20 mesh strainer 2 Inches and below.
b. 0.125 perforated screen mesh 2-1/2 Inches and over.

7. Acceptable Product: Watts No. LF909S (FDA)-QT.

G. Double Check Backflow Preventer Assembly:

1. Acceptable manufacturers:

a. Watts.
b. Wilkins
c. Ames.

2. Double check valve type with shutoff valves.

a. Quarter turn ball shut-off valves up to 2-1/2 Inches.
b. Outside stem and yoke gate shut-off valves 3 Inches and over.

3. Bronze body construction up to 2-1/2 Inches.
4. Cast iron body construction 3 Inches and over with stainless steel internal ports and FDA approved fused epoxy coating.
5. Provide in-line upstream y-type strainer.

a. 20 mesh strainer 2 Inches and below.
b. 0.125 perforated screen mesh 2-1/2 Inches and over.

6. Acceptable Product: Watts No. LF709S (FDA)-QT.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations.

B. All piping shall be properly cleaned and reamed to the full inside diameter of the pipe size prior to joining.

C. Connections to Equipment:

1. Install necessary pipe connections and fittings required to connect equipment.
2. No rough-in shall be done before drawings of equipment are received.
3. Make all final connections to include unions or flanges to facilitate future removal.
4. Install cutoff valves on equipment connections.

D. Install shock arrestor ahead of each quick closing valve, at top of each riser and on pipe run to water closets as recommended by manufacturer. Shock arrestors shall be accessible as required by Local Codes.

E. Install backflow preventers at connections to closed mechanical water system makeup such as unit humidifiers, chilled water and hot water systems, and beverage dispenser connections as required by Local Codes.

F. Pressure reducing valve assembly shall be installed as required when city water supply pressure exceeds 80 psig at the building domestic water header.

G. Strictly coordinate locations of wall clean out cover plates and access doors. Submit locations to the Architect prior to installation for final approval.

3.2 FIELD QUALITY CONTROL

A. Testing:

1. Furnish instruments, equipment, and labor necessary to conduct tests.
2. Methods of sampling, inspecting, and testing shall conform to local codes.
3. Tests of plumbing systems:
    a. Plumbing piping systems shall be pressure tested.
    b. Underground piping shall be tested and successfully repaired prior to backfilling.
4. Water Systems:
    a. When rough-in is completed and before fixtures are set, entire hot and cold water and piping systems shall be tested at hydrostatic pressure of not less than 100 psig, and approved tight at this pressure for not less than 30 minutes.

b. Where portion of water piping system is to be concealed before completion, portion shall be tested separately as specified for entire system.

5. Defective work:

a. If inspection or test shows defects, defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated.
b. Repairs to piping shall be made with new materials.
c. No caulking of screwed joints or holes will be acceptable.

B. Disinfection:

1. After pressure tests have been made and leaks repaired, flush entire domestic water distribution system with water until entrained dirt and mud have been removed.
2. On the building side of each water meter assembly, provide a minimum 3/4 inch connection for injection of sterilizing fluid to disinfect the piping system chlorinating materials utilizing liquid chlorine or calcium hypochlorite shall be used.
3. Provide dosage of not less than 50 parts per million.
4. Retain treated water in pipe long enough to destroy all non-spore forming bacteria.
5. Retention time shall be at least 24 hrs. and shall produce not less than 10 ppm of chlorine at extreme end of system at end of retention period.
6. Open and close valves in system being disinfected several times during contact period.
7. Flush system with clean water until residual chlorine is reduced to less than 1.0 ppm versus 0.2 at the most remote fixture.
8. During flushing period, open and close valves and faucets several times at several locations.
9. From several points in system, take samples of water in properly disinfected containers for bacterial examination.
10. Repeat disinfecting until satisfactory bacteriological results have been obtained and City Health Dept. has made final approval of test.

3.3 ADJUSTING AND CLEANING

A. Equipment, pipes, and valves shall be cleaned of grease, metal cuttings, and sludge that may have accumulated from operation of system during test.

B. Stoppage, discoloration, or other damage to finish, furnishing, or parts of building, due to failure to properly clean piping system, shall be repaired.

C. When work is complete, adjust hot water systems for uniform circulation.

D. Adjust flush valves and automatic control devices for proper operation.

END OF SECTION

SECTION 22 21 13

PLUMBING PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Comply with Division 1 - General Requirements and referenced documents.

B. Comply with all other Division 22 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 22. 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. Valves or cocks shall be installed to control the flow of water to each of the various systems, to segregate individual items of equipment and parts of fluid circulating or supply systems, and to permit draining of systems or portions thereof, to blow-off strainers, etc., as directed on the Drawings and specified.

D. The work shall include the furnishing and installing of all supporting structures and members for pipes, ducts, and equipment.

E. Support devices and members shall include vibration and noise isolating devices and assemblies. Penetrations of walls to structure shall be sealed off to limit noise transmission through sleeves.

F. All piping material shall be manufactured in the United States and/or shall comply with the most current North America Free Trade Agreement, USMCA.

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 Section 01 33 00 for all piping materials to be used for each system, valves and plumbing specialties as specified herein.

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 22 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, boilers, pumps, valves and other heat exchangers shall be covered during the construction period to protect the interior accumulation of dirt and debris in these systems until immediately prior to connection to these components to similarly protected systems.

PART 2 - PRODUCTS

2.1 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.

2.2 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.

2.3 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.

2.4 VALVES

A. All valves of any one type shall be of the same make throughout and insofar as practicable all valves in a given category shall be of the same make.

B. All valves shall be so located as to be readily accessible for operation and maintenance.

C. Furnish and install all valves indicated on the Drawings, specified herein, and required to control the flow of water to and from various parts of the systems and to isolate various pieces of machinery and equipment and to isolate various parts of the systems.

D. Each valve for installation in a line to be insulated shall have sufficient clearance between the valve body and the operating handle or device to accommodate the insulation.

E. All valves shall be designed for re-packing under pressure when fully opened and shall be equipped with packing suitable for the service.

F. Valves shall generally be installed with stems up; but, in no case, less than horizontal and whenever possible shall be grouped together in a uniform manner.

G. Except where special valves are specified elsewhere herein or as required by special conditions or class of work, valves shall be equivalent to the following Nibco Co.valve numbers listed herein.

H. All valves used for domestic water service shall be Lead-Free per the “Safe Drinking Water Act”. U.S. Senate Bill S. 3874.

I. Bronze Full Port Lead-Free Ball valves: 2” and Smaller:

1. Ball valves shall be on the following products:
    a. Nibco T-585-66-LF or S-585-66-LF.
    b. Apollo 77CLF-140 Series.
    c. Hammond UP8301A or 8311A.
2. Ball valves shall be full port design with stainless steel ball and stem.
3. All ball valves shall be manufactured from a dezincification resistant material with less than 15% zinc.
4. Provide extended lever handles for all valves installed in insulated lines where insulation is not chamfered as detailed in the documents.

2.5 PIPE HANGERS

A. Pipe hangers, except for fire protection types, shall be as manufactured by Anvil International, Inc. and be of a type suitable for each use. Approved equals by Mason Industries, Inc., B-Line, 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. For PVC, CPVC, PVDF, Polyproplene pipe sizes up to three inches (3") ini size, use Anvil FIG. 104 malleable iron, adjustable, split ring, swivel hanger, or Anvil FIG. 590 Steel Clevis hanger. For sizes four inches (4") and larger, use only Anvil FIG. 590 Steel Clevis hanger.

D. Domestic cold and hot water piping 3/4" in size up to and including twelve inches (12"), shall be Anvil Fig. 260, adjustable clevis hangers. Hangers shall be sized to be on the outside of the insulation.

E. 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.

F. 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.

G. Hanger rod sizes shall conform to the following schedule:

Pipe up to, and including 2"	3/8" rods
Pipe 2-1/2", 3", and 3-1/2"	1/2" rods
Pipe 4" and 5"	5/8" rods
Pipe 6"	3/4" rods
Pipe 8", 10" and 12"	7/8" rods
Pipe 14", 16" and 18"	1" rods
Pipe 20" up to 30"	1-1/2" rods

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

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

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

Pipe up to, and including 1-1/4"	5 feet
Pipe 1-1/2" and 2"	*5 feet
Pipe 2-1/2" and 3"	*5 feet
Pipe 3-1/2" and 4"	*5 feet
Pipe 5" and 6"	*5 feet
Pipe 8" and larger	*5 feet
* Maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.	

J. Unless shown otherwise on the Drawings, all horizontal runs of “Poly” thermoplastic type piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following maximum spacing:

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

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

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

L. There shall be a hanger within two feet (2') for any ferrous or copper piping and eighteen inches (18") for any “poly” thermoplastic type pipe 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.

M. 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.

N. 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.

O. Expansion bolts shall be Ackerman-Johnson.

P. 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.

Q. No perforated straps shall be used to support any mechanical equipment item or piping of any kind.

R. Potable and non-potable domestic cold water, domestic hot water (includes recirculated lines), horizontal and vertical storm drain downspouts and soil piping receiving cold condensate piping hangers shall be sized to go around the insulation with shields being provided to protect the insulation. Shields shall be Anvil Fig. 167.

S. 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 91 00.

T. 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 22 05 00 for additional requirements of penetrations through fire-rated assemblies.

2.7 GAUGES AND GAUGE COCKS OR NEEDLE VALVES

A. Provide the following pressure gauge cock or needle valve connections:

1. At the suction and discharge of each pump.
2. At the domestic water riser, downstream of main isolation value.
3. Downstream of the building main backflow preventor.
4. At the inlet and outlet of pressure reducing stations.
5. At circuit setter balance stations and any other points indicated or detailed on diagrams on the Drawings.
6. At the inlet and outlet of circulation pumps.

B. Where gauge connections are installed in insulated lines, install gauge cocks or needle valves on a nipple of sufficient length that the gauge cock or needle valve handle will be free of the pipe insulation. Position each gauge cock in relation to surrounding piping and equipment so that the gauge may be easily read and so that a gauge having a 4" diameter dial can be screwed into and out of the piping nipple where the gauge cock or needle valve is installed. All gauge cocks shall be of the tee-handle type. Needle valves shall be a Weksler AV32, AV34, or BBV4.

C. Install gauge cocks or needle valves at pumps at the pump suction and discharge flange connections at the pre-drilled and tapped gauge connections as provided by pump manufacturer.

D. Furnish and install a pressure gauge suitably calibrated at each of the following locations:

1. At the suction and discharge of each pump.
2. At the domestic water riser, downstream of main isolation value.
3. Downstream of the building main backflow preventor.
4. At the inlet and outlet of pressure reducing stations.
5. At circuit setter balance stations and any other points indicated or detailed on diagrams on the Drawings.
6. At the inlet and outlet of circulation pumps.

E. Gauges shall be of the bourdon tube type, glycerin filled, and shall be selected to operate at about the midpoint of their full range, i.e., for a 50 PSI operation, select a gauge of 0 to 100 psi. Each gauge shall be provided with a brass lever handle union cock or brass handle needle valve. Cases shall be Stainless Steel, not less than four inches (4") in diameter.

F. Pressure gauges shall be equal to Weksler Model 401L-4-PD with type ASD case, phosphor bronze with phosphor bronze brushed rotary movement and link; 4" dial, nickel plated ring, free standing stainless steel case; equipped with micrometer adjustment pointer. Provide each gauge with scale range suitable for the duty.

G. Provide pulsation dampeners, adjustable snubbers, or piston type pressure snubbers in line with all pump gauges.

H. Cocks and gauges shall be manufactured by:

1. Crosby.
2. Weksler.
3. Marsh.
4. Trerice.
5. Miljoco.
6. Weiss.

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 Threadolets; 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.

S. Valves required for control or isolation of any part of the various systems shall be provided and shall be located in approved or accessible positions or made accessible through removable panels, etc., and where several valves are related as to function, they shall be grouped in a battery. Request approval from Owner's Representative for proper location of all access panels required for valves, etc.

T. All shut-off and isolation valves shall generally be installed with valve stems pointed vertically upwards. In no case shall valve stems be pointed downwards or less than in a horizontal position.

U. Where new lines are indicated to connect into existing lines, careful coordination shall be exercised to determine exact elevations and locations of existing lines, to establish grades of interconnecting new lines, to establish procedures to interconnect lines, and to establish other details.

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 22 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. Pressure piping systems shall be tested with either water or air to a pressure of 150 psig or to 1-1/2 times the operating pressure, whichever is the greatest, for six (6) hours.

E. Domestic hot and cold water piping shall be tested at 1.5 times the operating pressure or 150 PSIG, whichever is greater, for six (6) hours. Any leaks developed shall be made tight and the test repeated. Test pressure shall not be applied to specialties, but joint shall be tested for leaks at operating pressure when complete.

F. Waste and vent piping shall be tested at completion of the rough work and before fixtures and traps are connected. Openings, except tops of bends, are to be plugged and the system completely filled with water. System shall stand without leak or loss of water for a period of not less than four (4) hours.

G. 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.

H. Partial systems shall be tested prior to connecting into existing lines.

I. 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.

J. Additional testing shall be as specified in the individual Sections of these Specifications.

K. 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 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, and its sleeve, with neoprene or non-hardening sealant.

B. No pipe or duct shall be allowed to contact its surrounding sleeve or the wall, floor, or ceiling. Effective isolation shall be provided as described in Section 23 05 48 to the end that no vibration or direct noise transmission shall be transmitted. Vibration

transmission limits shall be as established in Section 23 05 48. Use special materials as may be required to comply.

C. Firestop pipe and duct floor and wall penetrations as specified in Section 22 05 00.

3.8 PAINTING

A. All equipment specified in Division 22 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 22 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 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 Specifications Section 01 30 00 for “Submittals”.

1.2 RELATED DOCUMENTATION

A. Section 01 04 00: Coordination.

B. Section 01 70 00: Contract Closeout.

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 - (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 auxiliaries; 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. Contractor and all system installers for each Section of these Specifications shall realize that the present building houses a completely functioning facility that must continue in full operation 12 hours per day during the school year. Outages of any kind cannot occur during the school year, except only when and as the Owner's Representative or Owner may direct otherwise. 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.

C. 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. Owner's Representative will verify scheduled times of work in the various areas involved, each system installer shall cooperate in establishing these times and locations and the system installers shall process their work so as to insure proper execution and completion.

D. 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. This is particularly applicable where new connections are to be made to existing lines, services, or items of equipment in the present building or where existing equipment items or services in that building are to be replaced or modified in any way.

E. Generally, modifications to, replacing of, or making new connections into existing service lines shall be accomplished only during the times directed by the Owner. New lines shall be installed and tested before connections are made into existing lines, meters, or services.

F. All other modifications to existing piping systems and appurtenances, including necessary interconnections between old and new portions of the various systems, shall be accomplished at times scheduled so as not to interfere with the normal use of the building and the existing systems to which connection is to be made.

G. 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. Explosives shall also not be used for any excavation inside an existing building.

H. 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.

I. 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.

J. 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. For all projects constructed in the City of Dallas, TX, this requires all duct openings to be covered with plastic or sheet metal.

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, horsepowers 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 mininum 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. Cooling Towers.

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 30 00 and 23 05 00.

B. Indicate on submittal the motors proposed for each system of equipment to be installed. This shall be in tabular form in one location for each type of equipment submitted. The lack of this information will be grounds for rejection of equipment submittals.

C. Product Data shall be furnished which shall include:

1. Motor Manufacturer.
2. Motor Type; Open Drip Proof, Totally Enclosed (Fan Cooled or Air Over).
3. Model of Manufacturer.
4. Motor Horsepower.

5. Motor RPM.
6. NEMA Motor Efficiency at 25%, 50%, 75%, and 100% of Full Load Rating for motors served by variable frequency drives; 100% only for constant speed motors 1 HP and larger.
7. Power Factor at 25%, 50%, 75%, and 100% of Full Load Rating for motors served by variable frequency drives; 100% only for constant speed motors 1 HP and larger.
8. Service Factor.

D. Certification: Provide manufacturer's literature indicating NEMA premium motor efficiency as tested in accordance with IEEE Standard 112, Test Method B. Provide documentation to verify motors served by variable frequency drives meet NEMA MG1, Part 30 for 6-step drives and Part 31 for PWM drives.

E. Provide closeout documents as required in Division 1.

1.4 QUALITY ASSURANCE

A. Comply with all regulatory requirements in the following order of precedence:

1. Codes, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction over installation, inspection, and testing, including local codes.
2. Provisions specified in this Section of Specifications.
3. Applicable provisions of standards of National Electric Code (NEC).

B. Manufacturer shall have been manufacturing the motors as described herein for a minimum of ten (10) years.

PART 2 - PRODUCTS

2.1 ELECTRICAL MOTORS, GENERAL

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

B. Motors shall conform to the standards of manufacture and performance of the National Electrical Manufacturer's Association (NEMA) as shown in their latest publication.

C. Motors shall be furnished with an open-frame, unless otherwise noted, or required by the NEC for the service conditions encountered. Motors exposed to weather shall be the totally enclosed type suitable for 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, 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 15

COMMON VARIABLE FREQUENCY MOTOR CONTROLLER

REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Comply with Division 1 - General Requirements and related 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. Furnish and install variable frequency motor drives (controllers) to provide motor speed control for air handling, pumping and cooling tower systems as indicated on the drawings or as scheduled for equipment with all apparatus, specialties, controls, etc., to make the systems complete.

B. Drives shall all typically be the Pulse-Width-Modulated (PWM) AC type drives. Three phase input power shall be converted to a sine-coded, variable frequency output, used for optimized speed control of induction motors.

1.3 QUALITY ASSURANCE

A. All equipment and materials shall be new and of the best quality.

B. The manufacturer of the variable frequency motor controller shall have a minimum of fifteen (15) years experience in the design, construction, and application of adjustable frequency controls for heating, ventilating and air conditioning applications.

C. All controllers, with factory mounted options, shall be UL (508C), ETL or CSA certified.

D. All drive manufacturers shall require local supplier representation within 50 miles of the job site, and a suitable service organization capable of repairing equipment within a 24 hour period of notification.

E. All drive manufacturers shall generally have a full line of locally stocked drives with similar features and in sizes consistent with those specified for emergency 24 hour replacement.

F. All VFD's shall have a minimum mean time between failure ratings of no less than 150,000 hours.

G. All drives to be installed in a return air plenum shall be rated for installation in plenum conditions in accordance with U.L. Standard 1995 or UL 508C (Plenums). The UL listing shall allow for mounting in plenums or other air handling compartments. The NEMA rating of the enclosure shall be whatever is necessary to comply with this requirement.

1.4 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 23 05 00.

B. Clearly identify all options furnished including detailed wiring diagrams indicating required field connections and wiring to be provided under Division 26 and for Temperature Control System interface.

C. Submittal shall include a list of each specification section paragraph number and notation on each specific feature, function or method of operation in which compliance is intended. Lack of compliance with this requirement will be cause for rejection of submittals.

1.5 PRODUCT HANDLING

A. Storage, handling, and protection of materials shall be in accordance with Section 23 05 00. All drives shall be completely wrapped at the factory with a semi-dust tight enclosure, similar to a heat shrink plastic, to prevent dust and debris from getting into the drive enclosure. Drives shall continue to be protected during construction in a similar fashion and be stored in a dry clean location.

B. The drive shall be wrapped with a low efficiency polyester media filter when power is supplied to the drive and when operated during the construction period. Filter shall be cleaned or replaced regularly to prevent overheating of the drive and electronics.

C. All materials or equipment damaged during transit, handling, or installation shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. The variable frequency controllers furnished shall convert 480 or 208 volt (Refer to and verify from Plans and submittals), +10 to -5%, three-phase, 60 Hertz, + 3% utility power phase to phase imbalance to adjustable voltage and frequency, + 1%, three phase

A-C power for stepless motor control from 10% to 110% of base speed under variable torque load.

B. All general options and modifications shall mount within the standard adjustable frequency motor controller enclosure unless otherwise specified or in an integrally mounted expansion module.

C. Variable frequency drive systems shall not cause any radio, television, computer, or other communication system interference within the building in which it is installed. All drives shall meet the requirements of Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, Part 15, Subpart J, Class A devices. All drives shall include EMI/RFI filters.

D. The service voltage distortion shall be limited to 5% peak to peak. All drives shall comply with interference and distortion requirements contained herein. If, after units are installed and distortion or interference is traced back to the VFD Units, equipment manufacturer shall install isolation transformers or input line reactors at no cost to the Owner to eliminate the objectionable interference. All PWM drives shall have a minimum 5% line impedance, via, a 5% input 3 phase A.C. line reactor, 5% DC bus reactor, or a 3% input 3 phase A.C. line reactor combined with a 3% DC bus reactor.

E. All drive systems shall be capable of installation in long term operation in a mechanical room environment with a temperature range of 32 degrees F. to 104 Deg.F., a humidity level of 0% up to 95% non-condensing relative humidity, and be rated for the altitude applicable to the job site.

F. Enclosures shall have a minimum NEMA 1 rated metal enclosure, unless indicated otherwise elsewhere herein.

G. For outdoor applications provide a NEMA 3R outdoor rated enclosure suitable for direct exposure to the sun. Provide mounting feet for enclosure where the enclosure is free-standing and where indicated on the Drawings. Provide a sun shield cover and suitable rain protected vent openings for ventilation of the electronics. Drives installed in outdoor enclosures shall be derated for elevated ambient conditions of up to a minimum of 110 Deg.F. Provide a heater in the enclosure to prevent condensation.

H. VFD's shall be capable of withstanding the following conditions without failure or mechanical damage:

1. Being disconnected under full load.
2. Single phasing or phase failure on both Input and Output.
3. Loose wiring on load or line side main connections.
4. Shorting between terminals on the same terminal board.
5. Being disconnected and/or make disconnect on a coast down of equipment.

6. Be able to be energized, pick up a motor load, with a spinning fan wheel, as an example.

I. Variable frequency drives shall be the pulse width modulated (PWM) type as manufactured by **ABB, Danfoss, or Yaskawa**. All drives shall be of the same manufacturer unless the drive is furnished integral with a factory made piece of equipment.

J. All motors connected to drives shall have individual dedicated drives, Two (2) or more motors shall not be controlled by one (1) drive.

2.2 VARIABLE FREQUENCY DRIVE FEATURES

A. Drives shall include as a minimum the following:

1. Converter, inverter, regulator with replaceable plug in circuit boards.
2. Hand-off-auto selector switch or buttons.
3. Manual speed (frequency) selection.
4. Independently tuned acceleration and deceleration ramps (0-600 seconds).
5. 6-66 Hz controlled speed range.
6. Annunciator for remote indication of fault conditions. Store up to the last 10 faults that have occurred in the drive control panel.
7. All protective circuits and features as recommended by the manufacturer.
8. Frequency meter mounted in the door or on the enclosure or displayed on control panel display.
9. Electronic 4-20ma input signal receiver, with transceiver as required to interface with the temperature control system, adjustable for direct or reverse acting. Provide internal drive limits to prevent drive from exceeding 60 Hertz or dropping below minimum drive speed when the input signal exceeds 20ma or drops below 4ma, respectively.
10. Output contactor (for positive motor disconnect).
11. Plug-in tester card and meter unless all trouble shooting can be accomplished via control panel display and keypad.
12. Recommended replacement modules per operations and maintenance manuals.
13. Non-resettable elapsed time meter to indicate run time of connected load/motor (not power on to drive).
14. Input line fuses, Class J.
15. Automatic shut-off for overload conditions.
16. Output thermal overloads (one in each phase).
17. 115 VAC Control Power transformer with fused primary where required for the external control circuit. Coordinate requirement with Section 23 09 00.
18. Field adjustable input signal offset bias control device.
19. Auxiliary contacts for connection to an Energy Management System. Provide up to 2 analog outputs, 3 digital inputs and 3 output relays. Refer to Section 23 09 00, Controls and Instrumentation.

20. Standardized communications interface card suitable for connection to the specified Energy Management System (EMS), an embedded Building Automation System protocol for network communications. Refer to Specification Section 23 09 00 for requirements.
21. Electronic Ground Fault Protection shall be provided for all operating conditions to include initial power applied up to full speed and full load conditions.

B. Provide manual constant speed bypass switch with magnetic across the line starter, to include overload relays, and disconnects to allow the motor to open across the line in the event of VFD shutdown and to allow for a maintenance or service person to safely repair/service the drive while the load is operated by the starter. Provide drive output isolation contactors and bypass contactors to accomplish this function. Provide time delay in switch-over circuitry to allow running motor to coast to stop when switched from drive to starter and vice versa. Additionally provide an integral input power supply disconnect on all drives. Bypass features shall include a control safety circuit terminal strip, 115 VAC control transformer, a Drive/Bypass selector switch, Hand-Off-Auto Switch, and indicating LED lights for BYPASS ON, Control Power ON and Drive RUNNING. Either 3 contactor bypasses are acceptable or 2 contactor bypasses with service switch and fast acting fuses (NEC approved disconnect switch to service drive) will be allowed.

C. Variable frequency drives shall be of the pulse width modulation type provided the minimum number of pulses per output cycle is at least 5000 at 30 hertz and below to minimize motor heat and noise

D. Provide auto restart package on each drive to restart the motor when power resumes after a power interruption. A minimum of five (5) attempts at restart shall occur before the drive goes into a fault condition.

E. Provide a minimum of three (3) critical speed coast troughs for all fan drives.

F. Provide bus capacitors, or equivalent feature, for minimum 500 millisecond power loss ride-through capabilities at a minimum of 50% load.

G. Provide components necessary for maintaining a high input power factor, with a minimum displacement angle of 0.95, over the entire range of operating speeds and loads.

H. Minimum drive efficiency shall be 95% at 50% speed and 97.5% at 100% speed conditions without exception.

I. Drives shall be rated to withstand 110% of full load amps of connected motor size for up to one (1) minute (60 seconds) and 150% of rated full load amps instantaneously.

J. VFD's and bypasses shall each have a minimum short circuit rating of 65K amps RMS where circuit breaker disconnects are employed and 100K amps RMS when drives employ fused disconnects, all without additional input fusing.

K. The starting torque shall be 100% available from 0.5 Hertz up to 60 Hertz output operating frequency.

L. Provide for DC injection braking to prevent fan "wind milling" at a start or stop command, adjustable, with current limited, on all drives serving fans.

M. All programming memory shall be saved when the VFD power source is disconnected. This shall require that all memory for the purpose be non-volatile memory (NV RAM).

N. Provide an automatic energy saving, reduced voltage operation, when the drive has been de-energized, no command to "run", for a pre-determined time frame, adjustable. This shall be the equivalent to a sleep mode function.

2.3 ELECTRONIC COMPONENTS QUALITY ASSURANCE

A. All printed circuit boards shall be tested under a temperature cycling (0 Deg.C. to +65 Deg.C.) load test and then functionally tested via fault finder bench equipment prior to unit installation.

B. All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults and drive shall trip electronically without device failure.

C. Each VFD shall be put through a 30-minute cycling motor load test before inspection and shipping.

D. Certification that all of the testing above has been performed shall be provided by the drive manufacturer.

E. Conduct in circuit testing of all printed circuit boards to insure the proper mounting and the correct values for all electronic components.

F. Final printed circuit board assemblies shall be functionally tested, via computerized test equipment. All tests and acceptance criteria shall be pre-programmed. All test results shall be stored as detailed quality assurance data.

G. All fully assembled controls components shall be functionally tested, with fully loaded induction motors. The combined test data shall then be analyzed, to insure adherence to identified quality assurance specifications.

H. Inspect and perform a production test, under load, for each completed VFD assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The motors and drives approved shall be shipped to the job site as scheduled and installed under the supervision of a factory trained manufacturer's superintendent. The manufacturer shall furnish all control and wiring diagrams for inclusion in the temperature control system shop drawings. The electrical wire, wiring and termination work shall be done under Division 26 for power wiring and Section 23 09 00 for temperature control wiring, coordinating all work with and under the supervision or instruction of the drive equipment manufacturer's representative.

B. A variable frequency controller shall be provided as indicated on the schedule for each individual pump or cooling tower fan as scheduled.

3.2 SERVICE

A. The manufacturer shall provide the following services performed by a factory authorized and fully trained representative only.

1. Factory coordinated start-up service.
2. Training of Owner's personnel in basic trouble-shooting.
3. Training shall be on site and shall be a minimum of four (4) hour duration and shall be performed in addition to start-up of system on a different day after completion of test and balance work.
4. Visit the facility two (2) times during the warranty period, once six (6) months after and once twelve (12) months after the warranty period to perform check-out and maintenance of drives, make any required adjustments and replace any components found to be defective. Report to the Owner in writing outlining work performed.

B. Furnish spare parts list.

C. Provide a three (3) year parts and labor warranty for all drives beginning at Substantial Completion. Warranty shall also include travel and lodging expenses for warranty repair personnel as required. All units shall be installed and checked out to be operating as recommended by the manufacturers authorized and factory trained start-up agent before warranty begins. This includes completion of a factory authorized representative start-up report. Submit completed start-up reports with close-out documents.

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. Each pipe connected to a floor mounted pump and to an item of equipment mounted on external vibration isolators shall have a sufficient number of spring hangers to permit compensation for movement of the piping and equipment, but in no case shall there be less than five (5) per pipe. These spring hangers shall also serve to dampen vibration transmission to the building. Provide other spring hangers for pipes, compensators, etc., as required to comply with the vibration transmission limits listed hereinbefore. In central plant mechanical rooms all piping within these rooms shall receive spring isolators. Isolators shall be similar to Amber-Booth BSW-1, BSS-1, BS-1 or KSX-1.

D. Water cooled chillers shall be mounted on ribbed neoprene pads equal to Amber Booth Ampad Type NR or NRC, Style B isolators.

E. For all curb mounted fans 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 materials used shall be equivalent to Amber-Booth (The VMC Group), Korfund Dynamics (The VMC Group), Vibro-Acoustics or Mason Industries.

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. Primary Chilled Water Supply (Green background)
2. Primary Chilled Water Return (Green background)
3. Chilled Water Supply (Green background)
4. Chilled Water Return (Green background)
5. Condenser Water Supply (Green background)
6. Condenser Water Return (Green background)
7. Chemical Supply (Yellow background)
8. Chemical Return (Yellow background)
9. Make-Up Water (Green background)
10. Expansion (Green background)
11. 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.

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. Variable Frequency Drives.
2. Chillers.
3. 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

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. Where markers are installed exterior to building, they shall be UV resistant or shall be stenciled.

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

MECHANICAL SYSTEMS TESTING, ADJUSTING, AND BALANCING (TAB)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section shall be related to the General Provisions of the contract, including General and supplementary conditions.

B. Refer to Section 23 05 00 for general provisions.

1.2 SCOPE OF WORK

A. The work included in this Section consists of the furnishing of all labor, instruments, tools and services required in connection with the Testing, Adjusting and Balancing (TAB) of the Heating, Ventilating and Air Conditioning (HVAC) systems as described in the mechanical specifications and shown on the mechanical Drawings, or reasonably implied therefrom, to include the overall commissioning of systems and subsystems such as verification of operation of each control device and all equipment sequences of operation.

B. TAB of the HVAC systems will be performed by an impartial independent Technical Firm who is a member of the Associated Air Balance Council (AABC) and whose operations are limited only to the field of professional TAB work. The firm selected shall not be engaged in any contracting, manufacturing or engineering services. TAB services shall be paid from allowance, refer to section 01 02 00 Allowances. Owner/Engineer shall select the TAB firm at an early stage of the project and notify the Contractor the TAB Firm that shall be employed.

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, pressurization, ventilation rates, and noise levels in the conditioned spaces of the building.

E. The following basic components of the HVAC systems shall be tested, adjusted and balanced:

1. Air distribution systems.
2. Pumping systems (chilled water, hot water, condenser water, etc.).
3. Cooling systems.
4. Heating systems.

5. HVAC control systems verification to include end devices, control sequences of operation and energy management system control and monitoring point verification.

F. Document Review

1. The TAB Firm shall be responsible for reviewing the HVAC Drawings and specifications relating to the TAB services for proper arrangement and adequate provisions of devices for testing, adjusting and balancing.
2. TAB Firm shall review HVAC manufacturer's submittal data relative to suitable provisions to allow system to be balanced
3. TAB Firm shall review submitted HVAC automatic temperature control sequences for conformity to the specifications.

G. Two (2) hard bound copies and three (3) .PDF file copies sent electronically of final report shall be submitted to the owner, or representative thereof, indicating a summary of actual operating data and any abnormal operating conditions. The report will contain all required information as described within this specification. The files shall also include copies of HVAC drawings annotated to reflect tags used for air and water components balanced.

1.3 SERVICES OF CONTRACTOR

A. Contractor shall start up and test all materials and equipment which normally require testing. All piping, ductwork, etc., shall be tested to meet code requirements and the specification requirements, whichever is the more stringent. All equipment shall operate a sufficient length of time at the Contractor's expense to prove to the Engineer, and Owner that the equipment is free from mechanical defects, runs smoothly and quietly and performs satisfactorily to meet the requirements set forth in the Mechanical Drawings and Specifications.

B. In order that all HVAC systems can be properly tested, adjusted and balanced, the Contractor shall operate the HVAC systems at their expense for the length of time necessary to properly verify their completion and readiness for TAB, and shall further operate and pay all costs of operation during the TAB period if not otherwise specifically addressed to be paid by the Owner. Operating expenses to be paid for by the Contractor (not TAB firm) will include, where applicable, but not necessarily be limited to, the following:

1. Utility costs; electrical, water, 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.
5. Water treatment.

C. The drawings and specifications have indicated valves 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, valves, or the addition of valves as required, to correctly balance the HVAC systems as required by the TAB firm at no additional cost.

F. Provide sufficient time in Project Contract completion schedule to permit the completion of TAB services prior to Owner occupancy of the project.

G. Contractor shall furnish, without charge to the TAB Firm, the following (Digital and Hard Copies):

1. One (1) complete set of project specifications to include all mechanical sections.
2. One (1) complete set of Contract Drawings.
3. All pertinent change orders and all Addenda.
4. Two (2) complete sets of mechanical plans with latest revisions.
5. Any "As-installed" and shop drawings.
6. Approved HVAC system control diagrams.
7. Approved manufacturer's submittals for all HVAC equipment to be included in the TAB scope of work.

H. Have all HVAC systems complete and in operational readiness prior to notifying the TAB Firm that the project is ready for TAB services. So certify in writing to the , Engineer, and Owner that such a condition exists. Complete operational readiness prior to commencement of TAB Services shall include the following:

1. Construction status of building shall permit the closing of doors and windows, ceilings installed, etc., to permit the obtaining of projected actual operating conditions. Preliminary air testing may be conducted without ceiling tiles and completion of the facility. However, final air testing requires that ceilings be completely installed so that air pressurization relationships can be properly verified.

2. Air Distribution Systems:
    a. Verify that all fans (Supply, Exhaust and Relief) are operational including proper fan rotation, operates free from vibrations, belts are properly aligned, and belt tension is proper.
    b. 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.
    c. Make a record of actual motor amperage and voltage, for each phase, and verify that they do not exceed nameplate ratings.
    d. Verify specified vibration isolation accessories are correctly installed and adjusted.
    e. 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. Water Circulating Systems:

1. Check and verify pump alignment and rotation.
2. All water circulating systems shall be filled until full of water and purged to be free of air; expansion tanks set for proper water level; systems set to proper operating pressure; air vents installed at all high points of systems and operating free of air.
3. Open all valves to full open position. Set automatic control valves to full flow through system coils or components and close off bypasses at 3-way valves. Flush and clean systems as specified in other sections of the mechanical specifications (with full flow through all coils). Circulate clean water through system for a sufficient time to verify flow through all system components. Remove and clean all strainers. Repeat operation until circulating water systems are clean.
4. 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.
5. Make a record of actual motor amperage and voltage, per phase, for each pump and verify that they do not exceed nameplate ratings.
6. Verify specified vibration isolation accessories are correctly installed and adjusted.

J. Refrigeration Machines:

1. Verity that the specified start-up and check-out of the refrigeration machines was accomplished by approved representatives of the machine manufacturer, and that all necessary adjustments have been made in conformance with recommendations thereof.
2. Verify that electrical circuits, control and power, have been properly and permanently installed and connected, with circuit protective devices correctly sized and calibrated.
3. Verify that specified vibration isolation accessories are correctly installed and correctly adjusted.
4. Record the voltage and amperage at each motor, per phase, and verify that name plate values are not exceeded.

K. Cooling Towers:

1. Verify that the specified start-up and check-out of each cooling tower cell was accomplished by the approved representatives of the equipment manufacturer, and that any necessary adjustments have been made in conformance with recommendations thereof.
2. Verify that cooling tower fans are operating at the intended speed, that fan drives are properly adjusted, and that fan motors do not draw more than their name plate current, for each phase.
3. Verify that balancing valves have been adjusted to provide intended flow into each hot water basin.
4. Verify that electrical circuits, control and power, have been properly installed and connected, with all circuit protective devices correctly sized and calibrated.
5. Verify installation and intended operation of basin heaters, and controls, including low water level safety controls to prevent operation of heaters when not submerged in water.
6. Verify installation and intended operation of electrical heating tape provided for freeze protection of outdoor piping.
7. Check towers for proper operating water levels, correct settings of float switches or valves, and for nozzle spray patterns.
8. Verify that specified vibration isolation accessories are correctly installed and adjusted.
9. Verify the operation of any safety devices to include vibration cut-out switches for each tower fan.

L. Boilers:

1. Verify that specified start-up and check-out of each boiler was accomplished by approved representatives of the equipment manufacturer, and that necessary adjustments have been made in conformance with recommendations thereof.
2. Verify that electrical circuits, control and power, have been properly and permanently installed and connected, with circuit protective devices correctly sized and calibrated.
3. Verify that specified vibration isolation accessories are correctly installed and adjusted.
4. Record the voltage and amperage at each heating element and each motor, per phase, and verify that name plate values are not exceeded
5. Verify that all piping connections have been made in accordance with the manufacturer's recommendations, and specification and drawing requirements.
6. Verify that flue gas vent piping has been correctly installed in accordance with the boiler manufacturer's recommendations and these specifications. Verify that the proper draft has been achieved for each boiler burner system.

M. 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 design operating conditions with the exception of room thermostats which shall be calibrated at the completion of TAB services in full cooperation between TAB Firm and controls system installer.
3. Automatic temperature control and/or energy management system installer shall thoroughly check all controls, sensors operators, sequences of operation, etc. before notifying the TAB agency that the automatic temperature controls and energy management system are operational. Automatic temperature control and/or energy management system installer shall provide technical support staff (technicians and necessary hardware and software) to the TAB agency to allow for a complete check out of these systems; controls personnel to be on site with TAB firm as needed to assist the TAB firm in completing the TAB work.
4. The controls system installer shall also provide trending reports with the specific points and trend intervals, as requested by the TAB firm or engineer, when abnormal conditions are experienced.
5. The scope of the TAB work, as defined herein, is indicated in order that the contractor will be apprized of their responsibility regarding the coordination and assistance required to complete the project requirements for final TAB. The TAB Firm will be responsible to the Engineer, and Owner for the satisfactory execution of the TAB services.

1.4 SERVICES OF THE TAB FIRM

A. TAB Firm Qualifications:

1. TAB Firm shall be one which is organized to provide <u>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.</u> 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 , 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.

C. TAB Firm Services:

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

    a. Air Distribution Devices:

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

    b. Fans (Exhaust, Relief, Supply):

        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 to1000 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. Pumps:

1) At the time the contractor removes the start-up strainers, verify (by witnessing) that they are clean and are of the proper type. Verify the specified final strainers are clean and installed.
2) Verify correct pump rotation.
3) Verify correct sizing of each motor overload protection device.
4) Verify pump motors are not overloaded; amperage readings do not exceed motor nameplate rating for all phases.
5) Preset all manual isolation and balance valves at pumps and heat transfer devices to 100% open position.
6) Set all automatic control valves to 100% flow position. Verify valve design water flow rates match approved equipment submittal flow rates (must be balanced within +10% of design/submittal flow rate).
7) Determine total GPM by measuring actual pumping head of pump and relate to manufacturer's curves.
8) Measure actual pressure drop at each heat transfer device and flow metering device, if applicable.
9) Proportionally balance all heat transfer devices to within + 10% of design GPM by adjusting balancing valves. Overall total flow rate shall also be balanced to within +10% of total design.
10) If GPM is above design and the mechanical specifications indicate the pump impellers are to be trimmed to provide design GPM, data will be furnished to the Contractor so that they can trim the impeller or impellers, as required. If not, discharge balancing valve at each pump will be adjusted as required to obtain design GPM as related to the manufacturer's curves (with variable frequency drives set at 60 Hertz, where applicable).

11) Verify all temperature control devices are set and calibrated at design set point.
12) Verify all interlocks and flow switches are installed and operating properly to include minimum differential set points for differential pressure type flow switches.
13) Test and record all entering and leaving air and water temperatures and pressures at all heat transfer devices, as applicable. Refer to individual heat transfer device and cooling and heating coil data requirements.

d. Refrigeration Machines (Chillers): Take and record the following readings on each refrigeration machine (readings shall be taken as nearly simultaneously as possible). Readings on refrigeration machines shall be taken from gauges or indicating devices supplied with the machines. Readings shall not be taken on components that would void machine warranty. Manufacturer's authorized representative shall be present to assist in taking readings.

1) Evaporator:

a) Entering and leaving water pressures.
b) Water pressure drop.
c) Entering and leaving water temperatures.
d) Water temperature drop.
e) GPM through evaporator (may be obtained from pump GPM).

2) Condenser:

a) Entering and leaving water pressures.
a) Water pressure drop.
b) Entering and leaving water temperatures.
c) Water temperature drop.
d) GPM through condenser (may be obtained from pump GPM).

3) Compressor:

a) Make/model/serial number.
b) Voltage (T1-T2, T2-T3, T3-T1).
c) Amperes (T1, T2, T3).
d) Chilled water control setting.
e) Condenser water control setting.
f) Low temperature cut-out setting.

4) General:

a) Scheduled capacity.
b) Refrigerant type.
c) Starter manufacturer, size, and type.
d) Overload heater sizes.

e) Low temperature safety cut-out setting.
f) Demand limit set-point.

5) All the above tests shall be conducted at full load, and at each of the part-load conditions listed elsewhere in other Sections of these Specifications.

e. Cooling Towers: Conduct capacity performance tests generally in accordance with the Cooling Technology Institute (C.T.I.) recommendations. A full Certified CTI test is not required. Take and record the following readings on each cooling tower (readings shall be taken as nearly simultaneously as possible).

1) Tower Manufacturer/model/serial number.
2) Number of fan motors.
3) Motor manufacturer/frame size/horsepower.
4) Motor Name Plate RPM(s).
5) Name plate Volts/Phase/Hertz.
6) Motor sheave diameter or gear pitch diameter.
7) Fan sheave diameter or gear pitch diameter.
8) Belts: Number/manufacturer/size.
9) Ambient wet bulb temperature.
10) Fan RPM(s).
11) Voltage (T1-T2, T2-T3, T3-T1).
12) Amperes (T1, T2, T3).
13) Entering water pressures, PSIG.
14) Entering and leaving water temperatures, Deg.F.
15) Water temperature drop, Deg.F..
16) GPM through each tower cell and to each warm water basin.

f. Boilers: Take and record the following readings on each boiler (readings shall be taken as nearly simultaneously as possible). Boilers shall be tested with the manufacturer's representative present. Readings shall not be taken on components such that manufacturer's warranty would be voided.

1) Manufacturer/model/serial number.
2) Energy source - type fuel(s).
3) Capacity ratings, input and output.
4) Hot water system working pressure.
5) List electrical loads, with name plate, versus actual electrical characteristics for each motor (Volts and Current, per Phase).
6) Check water level controls (feeders and low water cut-offs).
7) Check operation of operating and limit controls (hot water cut-out temperature).

8) Check safety valves for conformance to boiler manufacturer's recommendations, and for settings.
9) Verify operation and correct setting of each differential pressure flow proving switch.

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 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 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 /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. Test probes used in domestic water system testing shall be sterilized before being used in these systems.
4. Air Distribution Devices (Supply, Exhaust, Return, and Relief Air type where Balance Dampers are Used):
    a. Manufacturer, model and size; include neck sizes for diffusers.
    b. Location (Room name and number, ceiling, wall, etc.).
    c. Design and actual CFM (cooling and heating).
    d. Air distribution devices, where a velocity indicating instrument is used to determine CFM; provide the required and actual velocity in FPM (when an air flow hood is used to determine CFM, only CFM is required to be recorded.)
5. Fans (Exhaust, Relief, Supply):
    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. Pumps:
    a. Manufacturer, model, size and serial number.
    b. Design and estimated impeller size from manufacturer's pump curves (obtained through shut-off head test).

c. Actual pump suction and discharge pressures.
d. Design and actual pumping head.
e. Design and actual GPM.
f. Motor nameplate data.
g. Motor starter data and motor overload protection (heater) sizes and rating.
h. Actual motor amperage and voltage (all phases).

7. Chillers:

a. Manufacturer, model, size and serial number.
b. Rated tonnage.
c. Design and actual chilled water pressure drop (entering and leaving pressures).
d. Design and actual chilled water flow rate, GPM.
e. Design and actual condenser water pressure drop (entering and leaving pressures).
f. Design and actual condenser water flow rate, GPM.
g. Design and actual entering and leaving chilled water temperature at 100% load.
h. Design and actual entering and leaving condenser water temperature at 100% load.

8. Cooling Towers:

a. Manufacturer, Model, size and serial number.
b. Rated Capacity, GPM, tons of cooling and motor nameplate data.
c. Entering Water Temperature per cell, Deg.F.
d. Leaving Water Temperature per cell, Deg.F.
e. Water flow rate, GPM to each cell.
f. Entering water pressure to each cell in feet or PSI.
g. Fan motor running amps and rpm, per cell.
h. Fan motor rated amps and rpm, per cell.
i. Basin Heater voltage and amps per heater compared to nameplate.

9. Boilers:

a. Manufacturer, Model, size and serial number.
b. Fuel Type (natural gas, No. 2 fuel oil, etc.)
c. Rated Capacity:
d. Input-MBH.
e. Output-MBH.
f. Design and actual water flow rate, GPM
g. Design and actual entering and leaving water pressures, to include total water pressure drop, ft. of water, or PSI.

h. Design and actual entering and leaving water temperature at high fire under full load.

D. Instructions to Operating Personnel: TAB Firm shall instruct the operating personnel regarding the following:

1. Systems Operation.
2. Unusual Operating Conditions
3. System Troubleshooting Procedures.

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

C. Provide piping identification systems as specified in Section 23 05 53, Mechanical Systems Identification for HVAC ductwork, 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, Childers, Certainteed, Johns Manville, 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. Chilled Water Supply and Return Piping Insulation:

1. Insulation shall be approximately 4 lb. or heavier in density, molded sectional glass fiber pipe covering with factory applied, white FRG, fire resistant, vapor barrier jacket.
2. Insulate valves and fittings with pre-molded glass fiber fitting pipe insulators with ASJ manufactured by Knauf, Owens-Corning, Johns Manville, or Manson, equal in thickness to the adjoining pipe covering. Where pre-molded fitting insulators are not available, for welded pipe fittings insulate with field fabricated mitered segments of straight pipe insulation without ASJ equal in density and thickness to the adjoining pipe covering. Where pre-molded fitting insulators are not available for screwed or soldered/brazed pipe fittings insulate with field fabricated insulation which shall consist of loose low density glass fiber insulation wrapped and compressed tightly, equal in thickness and density to adjoining straight pipe insulation. Vapor seal with one 1/8" thick wet coat of Foster 30-33, Childers CP-33, or approved equivalent vapor barrier coating, placed over 10 x 10 strands per square inch glass fabric mesh which shall have an emulsion imbedded in it when applied. Apply a second of coating of 1/8" thick Foster No. 30-33, Childers CP-33, or approved equivalent adhesive applied over the mesh and first coating of vapor barrier. This coating application shall result in a minimum total dry film thickness of 37 mils. Vapor barriers - coatings shall have a maximum permeance rating of 0.07 at 43 mils dry film thickness per ASTM E-96, procedure B. Apply a PVC jacketing as specified elsewhere herein over all insulated valves and fittings.
3. Valves, flow control valves, strainers and control valves may be insulated with contoured, custom cut, and fully glued one inch (1") thick Armaflex sheet or pipe insulation.

4. Finish entire exposed straight pipe insulation installations with PVC sheet jacketing where exposed from the finished floor up to 12'-0" above the finished floor including all portions of horizontal piping that occurs at and extends above 12'-0". Under Alternate No. 4, all insulated piping, regardless of height is to be provided with colored PVC jacketing as noted in Section 23 05 48. Jacketing shall be applied to all straight piping sections, as well as to all elbows, tees, valves, flanges, fittings and other piping accessories. Use "smoke-safe" PVC fitting covers, similar to Speedline 1, Knauf “Proto” or Johns Manville “Zeston 2000.” Suitably seal all jacketing seams with tape, or other approved means, along the entire length and butt joints of jacketing seams. Unless specifically noted otherwise, all PVC jacketing will be white in color.
5. Loose "Diaper" inserts at fittings shall not be allowed.
6. Insulation thickness shall be as follows (per International Energy Conservation Code, 2015):

PIPING SYSTEMS	INSULATION THICKNESS - INCHES P I P E S I Z E S					
	* RUNOUTS 3/4" & SMALLER	LESS THAN 1"	1" TO 1-1/2"	2" TO 3"	4" TO < 8"	8" and OVER
Heating Water (200 Deg. F. or less)	1.50	1.50	1.50	2.00	2.00	2.00
Chilled Water (40-60 Deg. F.)	1.50	1.50	1.50	1.50	1.50	1.50
* Runout piping for individual terminal or fan coil units not exceeding 4'-0" in length between the isolation valves and coils and not exceeding 3/4" in diameter.						

B. Interior Domestic Cold Water Lines: Refer to Division 22.

C. Waste, Drain and Miscellaneous Lines:

1. The drain from each piece of Air Handling Equipment condensate drain pan and all refrigerant suction piping shall be insulated with foamed plastic, Armacell Armaflex or Aeroflex Aerocell slipped on while the piping is being fabricated, and with all joints, butt type, sealed using an adhesive recommended by the manufacturer of the plastic. The insulation shall be continuous from the drain opening in the Air Handling equipment condensate pan to the point of discharge with an open sight air gap over a drain. All formed plastic insulation shall meet ASTM E-84 requirements. Provide 1/ 2" thick insulation on drains.

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. Chilled water systems, chillers and respective distribution pumps, shall be turned off, chilled water in piping shall have equalized with the average ambient temperature and all condensation shall be completely dried off of the pipe.

B. For operational systems, perform work after operational hours and only during periods of scheduled equipment shutdown. During this period chilled water flow to the piping segments to be insulated shall be stopped and the water and piping shall have equalized in temperature with the average ambient temperature of the space in which the piping is installed. If time does not permit this to occur then apply heat to the piping in a controlled, suitable manner, to warm the water and pipe sufficient to prevent any condensation from occurring during the insulation process. For any segments to be left uninsulated until the next system shutdown, mastic seal the ends and penetrations through of the installed insulation and allow sealant to dry prior to re-energizing the chilled water system. Continue to insulate the piping system in small enough portions after-hours, or as required, to insure no insulation is applied over a wet surface.

C. In the covering of surfaces subject to low temperatures (below 60 Deg. F.), take extreme precautions to secure a complete vapor seal and avoid air pockets of any kind within the insulation. All insulation shall be tightly fitted to the piping system and all systems shall have an equal thickness and density of insulation around all piping, valves, strainers, accessories, etc. Where fiberglass insulation is cut to contour insulation around valves or strainers add additional insulation to obtain the overall insulation thickness specified. Where vapor barrier jackets are lapped at seams and joints, paste such flaps carefully to assure no break in the vapor seal. Seal around butt joints with strips of vapor barrier jacket. Coat all taped ASJ butt and longitudinal seams with vapor barrier coating to prevent moisture ingress. Use self-sealing laps on all insulation for pipes carrying a medium below 60 Deg. F. Stapling will not be permitted where vapor barrier jackets are specified. Vapor barriers for these systems shall have a perm rating not to exceed 0.05.

D. On glass fiber pipe covering with factory applied vapor barrier jacket, lap the jacket on the longitudinal seams and seal with vapor barrier lap adhesive equivalent to Foster 85-

20 or Childers CP-82. Tightly butt the ends and cover butt joints with a 4" wide band of vapor barrier jacket secured with the same adhesive. On piping systems with contents below ambient temperature, coat all taped ASJ butt and longitudinal seams with vapor barrier coating to prevent moisture ingress. At all run-out piping to chilled water equipment mastic seal, with specified vapor barrier coating to prevent moisture ingress from one section of piping to another, the ends of the branch piping insulation, where it meets the main piping insulation, to prevent the migration of moisture should it ever become trapped in the insulation system. Generally, mastic seal the ends of butt joints in chilled water piping systems every 50 feet for the entire system with the specified vapor barrier coating.

E. Where jacketing systems are specified, use standard weight, PVC sheet rolls. Exercise care to locate seams in an inconspicuous place and apply all jacketing neatly, including that on valves and fittings. Unsightly work will be considered a justifiable basis for rejection. Adhere the jacketing in all cases with a lagging adhesive, Foster 30-36 AF (Anti-Fungal) or Childers CP-137 AF, or by other approved methods. Adhesives shall have mold and mildew inhibitors. Lagging adhesives shall meet ASTM D 5590 with a “0" growth rating.

F. 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.

G. 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

H. No insulation shall be applied to the bodies of unions and flanges on building heating water supply and return lines only. Terminate the insulation short of the unions or flanges at this equipment, and bevel off at a forty five degree angle to permit "breaking" the union or removal of the flange bolts without damaging the insulation. Bevel the insulation off also at caps on scale pockets, and blow-off connections on strainers, and at valve bonnets on these same systems. All valves, unions, flanges, strainer blow-off and drain caps for chilled water systems shall be fully insulated.

I. Unsightly work shall be cause for rejection, including poor application of adhesives and coatings beyond the insulation which coats valves or other piping specialties.

J. 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.

K. 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.

L. 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.

M. Material Changes: Wherever there is a change in materials on lines that are vapor sealed, apply a suitable vapor barrier that is compatible with both materials, tapes, etc., as required to maintain the vapor barrier.

N. 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.

O. In all "exposed" areas, up to 12'-0" above the finished floor (base bide), insulation shall receive a PVC jacketing system. Neatly install all insulation systems not receiving jacketing such that they are suitable for finish painting.

P. All insulation materials and jacketing shall exhibit the following characteristics:

1. Water absorption, 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 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"

B. Provide inserts of calcium silicate on hot piping and cellular glass or 7#/Cu. Ft. fiber glass pipe insulation on cold piping at hangers except pipes 1-1/2" or smaller in size. Inserts between the pipe and pipe hangers shall consist of rigid pipe insulation of a thickness equal to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall not be less than the following lengths:

Pipe Size	Insert Length
3/4" to 3"	12"
4" to 6"	12" - 18"
8" to 10"	24"
12" & Larger	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: exhaust fans, relief fans, air handler supply fans, chillers, pumps, cooling towers, 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 building or plant operator is also 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 – 2007 is mandatory. **Commissioning shall be paid for and provided by the District**. The commissioning agent shall not be associated with or employed by a mechanical contractor, or equipment supplier.

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 pre-functional 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 pre-functional checklists being completed before functional testing.
6. The Subcontractors, under their own direction, execute and document the pre-functional 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:
10. Ensure that Subcontractors execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
11. 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 pre-functional 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 pre-functional 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, set points 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 set point (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 Set point: Point that controls equipment and can have its set point 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 pre-functional 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 in (A) 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 set point 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 <u>not</u> 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 pre-functional 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 owner's 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 pre-functional tests and checklist completion by reviewing pre-functional 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 the Specifications. 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 15 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. Pre-functional checklists, functional tests and monitoring reports will not be part of the final report, but will be stored in the Commissioning Record 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. Pre-functional 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 pre-functional checkout. No sampling strategies are used. The pre-

functional 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 pre-functional 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. Pre-functional 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 pre-functional 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.

Sensor	Required Tolerance (+/-)		Sensor	Required Tolerance (+/-)
RTU 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 Pre-functional 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 pre-functional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off pre-functional 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 pre-functional 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 pre-functional tests and checklists.
5. Only individuals that have direct knowledge and witnessed that a line item task on the pre-functional 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 pre-functional 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 set point 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 pre-functional 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 pre-functional 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 pre-functional 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 AND 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, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, 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- 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.

Hours	System
12	Pumps, Chillers, Cooling Tower
6	Exhaust Fans, Relief Fans, Air Handler Supply 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 12 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 set points 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

CONTROLS AND INSTRUMENTATION

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; cocks and wells for various temperature and pressure control, 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, valves, dampers and actuators, switches 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 and off site by a Central Work Station located at the Facilities Central Maintenance office in the OPS Center via Owner's WAN, or Ethernet LAN, where such exists and is allowed thereby. The entire system of control and automation at this building shall thus become an integral part of the existing facilities Energy Management System (EMS).

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 Central EMS 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 local factory trained 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.
4. Bids by wholesalers, distributors, mechanical contractors and non-franchised contractors shall not be acceptable.
5. All work described in the Plans and Specifications shall be installed, wired, and commissioned by factory certified technicians qualified for this work and in the regular employment of the control system manufacturer’s local office.
6. A local office is defined as a corporate branch office or an independently owned office with a current contractural agreement with the system manufacturer that allows the office to purchase, install, and service the manufacturer’s products.
7. The local office shall be full service facility within 50 miles of the project site. The local office shall be staffed with engineers and technicians trained on the installation, commissioning, and service of energy management and control systems based on the BACNET technology.

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. All control system components shall operate satisfactory without damage at 110% above and 85% below rated voltage and at ± 3 hertz variation in line frequency. Provide static, transient, and short circuit protection on all inputs and outputs. Communication lines shall be protected against incorrect wiring, static transients and induced magnetic interference. All bus connected devices shall be A.C. coupled, or equivalent, so that any single device failure will not disrupt or halt bus communications. Provide line voltage input protection to all network level controllers to protect these devices from over-voltage and lightning strike conditions.

E. 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 and maintenance of the system for a minimum of eight (8) 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".

F. 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.

G. 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).

H. All network level controllers shall be native “ASHRAE BACNET” and shall communicate with all other BACNET Protocol communication systems at the building network level or be provided with a gateway which shall facilitate the building network level controller communicating with one of this system.

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 Architect 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 05 00, 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 set points, 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. One (1) sets of Blue or Black line prints of "As-Built" drawings, half size (11" X 17"), inserted in a three ring binder.
2. One (1) copies of the final approved Shop Drawings in suitably sized three ring binders. This shall include copies of product data sheets and other operations and maintenance documentation.
3. A complete replacement spare parts list.
4. A back-up copy of the EMS settings and sequences of operation on a compact disc (CD). The CD shall include all of the files necessary to restore the EMS and controls systems to normal operation in the event of a system failure.
5. Two (2) labeled C.D.'s with all the information indicated above for items 1, 2 and 3 in PDF format.

1.6 EMS SOFTWARE TOOLS AND LICENSES

A. Submit a copy of all software installed on the servers and workstations related to this project.

B. Submit all licensing information for all software installed on the servers and workstations.

C. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.

D. Submit all licensing information for all of the software used to execute the project.

E. All software revisions shall be as installed at the time of system acceptance.

1.7 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.

1.8 CODE COMPLIANCE

A. All electrical components shall be UL listed or labeled.

B. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.

C. All wiring shall conform to the National Electrical Code.

D. Provide BAS components and ancillary equipment which are UL-listed and labeled.

E. Provide enclosures and controls which comply with NEMA's Publication No. 250.

F. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.

G. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.9 PRE-INSTALLATION CONFERENCE

A. The Contractor shall convene a conference to review project submittals and proposed installation at least two weeks prior to commencing work of this section.

B. The attendance of all parties effecting work of this section is required.

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. Sensors shall operate in a stable manner in a 5-95% relative humidity, non-condensing environment.

B. Ambient temperature limits shall be minimum of 0-125 Deg.F. with a +/- 0.5% accuracy at a nominal resistance equal to 70 Deg.F.

C. Temperature sensors and cabling used for temperatures below 60 Deg.F. shall be hermetically sealed to prevent condensation damage to conductors or elements. Sensors for immersion locations shall not be affected by vibrations encountered in normal piping systems.

D. Piping thermowells shall be furnished for each pipe or tank mounted temperature sensor. All wells shall extend to a minimum of the middle of the piping. Tank sensor wells shall be a minimum of 18" in length. Wells shall be single piece machined brass or stainless steel. Diameter of wells shall allow for the easy fit of sensors and shall

have a minimum 1/2" internal threads and 3/4" external threads. Insert heat conductive paste in wells prior to placement of sensor. Wells shall be equal to MAMAC A-500 and thermal compound shall be equal to MAMAC A-505.

E. 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.

F. Furnish sensors with maximum 6 to 9 inch insulated pigtail leads or trim sensor pigtail leads to meet this criteria once installed.

G. All sensor actions shall be the same for the entire building.

H. Mount all room wall sensors at 48" inches above finished floor to comply with A.D.A., unless indicated or approved otherwise by the Architect or Owner's Representative.

I. Wall space temperature sensors for normally occupied spaces shall include the following accessories, features and functions:

1. Normal Increase/Decrease Temperature Setpoint adjustments; limits set through software.
2. Impact Resistant Lexan type cover material.

J. Wall space temperature sensors in high abuse areas (Central Plant, etc.) shall include the following accessories, features and functions:

1. Stainless steel cover plates with temperature sensor on back of cover plate.

K. Sensors shall be as manufactured by Reliable Controls; or Automation Components, Inc. (ACI).

2.2 AUTOMATIC CONTROL VALVES

A. Valves 1/2" up to 2-1/2" in size shall have hardened and polished stainless steel stems, brass plugs (globe type) and have spring loaded cone packing rated for a maximum fluid temperature of 280 Deg. F. Globe valves shall have screwed cast brass bodies with a body rating of 150 PSIG at 250 Deg.F.

B. In lieu of globe valves, only in sizes from 1/2" to 2", electronic characterized ball control valves may be used. Characterized ball valves shall have a forged brass body with stainless steel stem, stainless steel ball, fiberglass reinforced Teflon seals (PTFE), have a “Tefzel” characterized disc, two (2) EPDM packing O-rings and be suitable for pressures up to 400 PSI and temperatures from 0-212 Deg.F.

C. All control valves 3” and larger shall have flanged iron bodies with a body rating of 150 PSIG at 250 Deg.F. and be the globe type only.

D. Control valves shall be sized for full flow with a maximum pressure drop of 4.0 PSI for fan coil units, VAV terminal units, duct mounted water coils, and air handling units handling less than 6500 CFM and 5.0 PSI for air handling units with a capacity of 6500 CFM and over. Control valves with flow rates of 2.0 GPM, or less, shall be sized for a maximum pressure drop of 2.0 PSI.

E. Two position valves shall be line size. Butterfly valves may be used for two position control.

F. Two and three way valves, modulating type only, shall not be dual butterfly arrangement in sizes 6" and below. Valves 6" and below shall have single contoured plugs, globe style, made of brass or stainless steel construction for metal to metal seating. Valves 2 inches and smaller shall have screwed cast brass bodies with a body rating of 150 PSIG at 250 Deg.F. Valves 2-1/2" and smaller may also be characterized ball type valves.

G. Butterfly type valves, used for control, over 6" only, shall have tight sealing gasketing in contact with the wafer suitable for end of line pressure shut off, bubble tight, and shall have single piece bodies; i.e., two (2) separate butterfly valves are not acceptable as a three-way valve. Three-way butterfly valves shall consist of a single cast iron flanged tee.

H. All valves shall have tight closing seats and be of the equal percentage type for two-way valves and be the linear type for three-way valves.

I. Valves shall be as manufactured by

1. Johnson Controls, Inc.
2. Honeywell, Inc.
3. Siemens.
4. Belimo.
5. Keystone (Butterfly type only).
6. VSI Series 2000 (Butterfly type only).
7. TAC/Schneider.

2.3 ELECTRIC VALVE ACTUATORS

A. All control valves 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. Heating water valves serving coils on air handling equipment directly connected to an outside air intake shall have spring return. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.

G. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. Floating point type control is acceptable on fan coil units, unit heaters and variable air volume terminals. All actuators shall provide for a 2 to 10 VDC position feedback signal although not used at this time. However, software feedback will be used at this time.

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. Modulating actuators shall be compatible with the PWM output of the direct digital controllers.

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 valves and dampers shall have independent control and adjustment from one another to emulate a pilot positioner.

O. Acceptable Manufacturer's:

1. Belimo.
2. Honeywell, Inc.
3. Johnson Controls, Inc.
4. Siemens.
5. Honeywell, Inc.
6. VSI (Butterfly control valves only).

2.4 CURRENT SENSING STATUS RELAYS

A. Provide 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, setpoint adjustable to +/-1% range from 0-95% non-condensing relative humidity

E. Sensors shall be as manufactured by Veris Industries, Inc.

F. Pilot relays on output for current sensor shall be RH2 BUAC 24V 2PDT (10 amp) or SH2B05 (7.5 amp) as manufactured by Idec.

2.5 WATER FLOW SENSORS AND TRANSMITTERS

A. Provide a Data Industrial or Onicon bi-directional flow sensor with a six-bladed flow wheel with a non-magnetic sensing mechanism.

B. Use a low impedance 8VDC signal to transmit at a frequency proportional to the flow rate. Signal shall travel up to 2,000' between the sensor and the display unit without the need for amplification. Sensors shall be supplied with 20' of Belden type 9320 (two conductor shield) cable.

C. Provide Data Industrial Model 226SS sensors or Onicon Model FB-1210 dual turbine sensors. Sensors shall mount in a 2" NPT pipe saddle or Threadolet using positioning

nuts on three threaded retaining rods. Insertion depth shall be a minimum of 1-1/2" inches in the pipe with a minimum of 10 upstream and 5 downstream straight pipe diameters of uninterrupted flow. An accuracy of +/- 1% of actual flow rate shall be obtained between flow velocities of 1 to 30 feet/second.

D. Sensor design parameters shall be as follows:

1. Accuracy:	+/-1% of full scale.
2. Linearity:	+/-1%
3. Repeatability:	+/-0.3%
4. Rangeability:	+/-30:1
5. Flowrate:	1-30 feet/second
6. Maximum Pressure:	200 psi maximum
7. Maximum Temperature:	220 Deg.F.
8. Wetted Materials:	
a. Impeller:	Glass reinforced nylon
b. Bearing:	Pennlon (UHMWPE) Ultrahigh molecular weight polyethylene
c. Shaft:	Tungsten Carbide
d. Housing:	Ryton-Glass reinforced polyphenylene sulfide (PPS).
e. O-Rings:	Ethylene propylene (EPDM)
f. Sleeve:	316 Stainless Steel and Hex adapter.

E. Provide a Data Industrial Analog Flow Transmitter, without a visual display of flow rate, to interface with the automation system. The analog output transmitter shall be a frequency-to-analog converter designed to operate in conjunction with non-magnetic insertion flow sensors.

F. The transmitter shall allow the user to select any one of four analog output signals including a 4-20 ma current output or three voltage outputs, (0-1V, 0-5V, or 0-10V). Output signal shall be directly proportional to the flow rate.

G. Each end of the analog range shall be set independently so that the analog range can bracket a specific flow range to increase the resolution of the output.

H. Transmitter design parameters shall be as follows:

1. Operation Temperature Range:	From 0 to 55 Deg.C.
2. Storage temperature Range:	From -40 to 70 Deg.C.
3. Power requirements:	120 VAC, 60 Hz.
4. Linearity:	Better than 1%
5. Output response time:	6 seconds; 10% to 90% step response
6. Designed Output Ripple:	Less than 0.25% of full scale
7. Outputs:	4-20 ma (22V compliance); 0-5 Volt; or 0-10 Volt

2.6 WATER PRESSURE SENSORS AND TRANSMITTERS

A. Sensors shall be variable capacitance type made from a one-piece stainless steel body and an insulated electrode plate.

B. Materials exposed to the wetted media shall be solid 17-4 PH stainless steel.

C. Sensor shall be free of welds, seams, or O-Rings.

D. Provide an electrical output of 4 to 20 ma for easy interface directly into the specified Direct Digital Control System. Sensor and transmitter shall be designed to meet ISA-S50.1 (1975) standard "Compatibility of Analog Signals for Electronic Industrial Process Instruments", Type and Class 2U (Universal).

E. Sensors shall be temperature compensated for low ambient thermal error.

F. Sensor accuracy shall be 0.11% of full scale at constant temperature.

G. Design parameter shall be as follows:

1. Non-linearity	Less than +/-0.1% full scale
2. Hysteresis:	Less than 0.05% full scale
3. Non-repeatability:	Less than 0.02% full scale
4. Thermal Effects:	30 Deg.F. to 150 Deg.F. range
5. Zero Shift, % full scale:	Less than +/-0.015%
6. Span Shift, % full scale:	Less than +/-0.01%
7. Temperature:	0 Deg.F. to 175 Deg.F. operating; 65 Deg.F to 250 Deg.F. storage

H. Sensors shall be a Setra Model C-280E Series designed for electrical connection to a two-wire circuit by simple screw termination. An equal model by Dwyer is acceptable.

2.7 AIR FLOW DIFFERENTIAL PRESSURE SWITCHES

A. Air flow differential pressure switches shall be provided to verify operating status of air moving equipment, where specified elsewhere herein, to sense flow in air ducts, to detect clogged air filters, and to sense space pressurization unless specified in other sections of these specifications.

B. Switches shall be capable of 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. Siemens.
4. Robertshaw.
5. Dwyer.

2.8 WATER FLOW DIFFERENTIAL PRESSURE SWITCHES

A. Water flow differential pressure switches shall be provided to verify flow status for equipment, such as chillers, evaporators, water cooled condensers, and other similar equipment.

B. Switches shall be heavy duty type capable of operating in ambient conditions from 32 Deg.F. to 104 Deg.F. for indoor applications. Where switches are used outdoors, suitably rated devices shall be used. Maximum differential pressure rating shall be a minimum of 50% above the normal system operating pressure differential. Switches shall be rated for 300 PSI and 300 Deg.F. service.

C. Provide one (1) set of main contacts with one (1) set of auxiliary contacts in a dust protected enclosure. Enclosure shall be moisture protected where used outdoors.

D. Case and cover shall be made of cold rolled steel; case shall be 0.062 inches thick minimum; with the cover painted and 0.028 inches thick minimum; or anodized cast aluminum. Material exposed to flow stream shall be brass, bronze or stainless steel material.

E. Switches shall be rated for the voltage of the circuit to which connected, and shall be minimum 120 volt rated for up to 6.0 amperes. Provide magnetic switching with a sealed tube of stainless steel isolating the switch compartment from the liquid and pressure within the piping system.

F. Switch action shall be suitable for the intended purpose, and shall be manually reset.

G. Differential pressure range shall be suitable for the application which shall typically be 2 to 26 PSI, or 2-30 PSI with a 1.2 or 2.0, respectively, fixed switch differential. Setpoint shall be field adjustable.

H. Provide all mounting brackets and accessories for a complete installation up to the shut-off devices furnished under Section 23 21 13.

I. Acceptable manufacturers:

1. Johnson Controls, Inc.
2. Honeywell, Inc.
3. Siemens.
4. Robertshaw
5. McDonnell & Miller
6. Dwyer.

2.9 DIFFERENTIAL WATER PRESSURE SENSORS (TRANSDUCERS)

A. Differential Water Pressure Sensors (Transducers) shall be provided under this division and installed under Section 23 31 13 by Mechanical Contractor, where indicated and as required to effect the sequences of operation as specified elsewhere herein.

B. Sensors shall be all stainless steel construction and be a 100% solid state transducer with dual diffused piezoresistive sensing elements with stainless steel media isolation.

C. All media exposed to the water shall be compatible with the water and chemical treatment added thereto.

D. Sensors shall generally be applied to sensing pump differential pressure and for other applications as specified.

E. Sensors shall not be sensitive to surge, water hammer, vibration or thermal shock from equipment and pipe mounting.

F. Sensors and related components shall be mounted in a easily accessible NEMA 1 enclosure.

G. Provide output signal compatible with control system installed and have a direct or reverse acting signal output option.

H. Provide an electronic averaging or snubbing option as required for the application to provide for stable operation or signal.

I. Sensor shall have a pressure range suitable for the application and have an accuracy of $\pm$ 1%, linearity, repeatability and hysteresis of $\pm$ 0.1%, be rated for temperatures of 0-180 Deg.F and have a differential pressure capability of 200% of the rated range.

J. Strictly coordinate all pressure tap locations between piping installer; Testing, Adjusting and Balancing (TAB); and this section.

K. Sensors shall be as manufactured by:

1. MAMAC PR-282 or equals by
2. Johnson Controls, Inc.
3. Honeywell, Inc.
4. Siemens.
5. Veris (P.W. Series).
6. Dwyer.

2.10 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 control equipment and control devices. They shall be totally enclosed and pre-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 typically not acceptable.

C. Thermometers, pilot light switches, and gauges shall be flush mounted on panel surface, where applicable.

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 connections shall be provided at top and bottom of each 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, as applicable. Devices wired through and inside panels, such as relays, 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 current sensing relays 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 wiring of the panel.

M. All panels shall be factory assembled and wired and include a key cylinder lock. All locks shall use the same master key.

2.11 ENERGY MANAGEMENT SYSTEM

A. The central EMS HARDWARE is located in the District OPS Center Building and shall be reused.

B. Network Automation Engine:

1. Provide a Network Automation Engine (NAE) which shall be a fully user-programmable supervisory controller. Automation Engine shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Automation engines.
2. The NAE shall reside on the automation network. Each NAE shall support one or more sub-networks of a minimum of 100 controllers each.
3. Each NAE shall have the ability to deliver a web based user interface. All computers connected physically or virtually to the automation network shall have access to the web based User Interface (U.I.). Systems without such capability at this level shall provide a user interface via the combination of operator workstations and web servers as determined by the owner for comparable operation.
4. Processor-controllers shall be multi-tasking, multi-user, and real-time digital control/processors. Standard operating systems shall be employed. Controller size and capacity shall be sufficient to fully meet the requirements of this Section of the Specifications.
5. Each controller shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Each NAE controller shall have an integrated Hardware-Based, real time clock.
7. The NAE shall provide at least one USB port and one URS-232 serial data communication port for the operation of operator I/O devices, such as industry standard computers, modems, and portable operator's terminals. Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
8. Controllers shall continuously perform self-diagnostics, communication diagnostics, and diagnostics of all panel components. The automation engine shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failures to establish communication.
9. In the event of the loss of normal power, the NAE shall continue to operate for a user adjustable period of up to 10 minutes, after which, there shall be an orderly shutdown of all the programs to prevent the loss of database or operating system software. Flash memory shall be incorporated for all critical controller configuration data.
    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions.
    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

10. All NAE controllers shall be listed by Underwriters Laboratories (U.L.)."

C. 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 network controller shall have an on-board 30 day battery back-up 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.

D. 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.

E. 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 for all control points.
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 all air handling units, fan coil units over 2000 CFM in capacity, pumps, chillers, controlled exhaust fans over 2000 CFM in capacity, boilers and cooling towers. Alternately, provide this capability integral with the Direct Digital Controllers. Terminal units such as Variable Air Volume boxes, small exhaust fans, small fan coil units, and rooftop A/C units are not required to have function switches. Switches shall be concealed within the local control panel or digital controller enclosure to be lockable. The network manager software shall identify points that are locally overridden and report by display to the building CPU to include generating a printout at the local or remote location printer.
7. Provide a hard wire connection between the Building LAN serving all new Controllers to the Central Facilities Energy 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.
8. Energy Management System programs shall include, but not all are necessarily utilized, but shall not be limited to:

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

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

F. 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.
3. Provide sensitivity adjustment for all DDC output control points.
4. The library of routines available in firmware must be capable of generating additional programs as may be required for specific client tailored requirements. The Owner shall be capable of revising programs without the aide of the installer.
5. Adjustments of all new control variables shall be conveniently available at the computer terminal through the use of the 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 each 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:

1) Basic Arithmetic
2) Binary Logic
3) Relational Logic
4) Fixed Formulas for Psychometric Calculations

b. Utility Routines for:

1) Process entry and exit
2) Keyboard functions
3) Variable adjustments and output
4) Alarm Indication
5) Restart

c. Control Routines for:

1) Signal compensation
2) Loop control
3) Energy conservation
4) Timed programming

2. Final field programs shall be stored in battery backed up RAM or in permanent memory.

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 manufacturer 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:

1. New DDC system controllers 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.
2. DDC modules shall have automatic restart capabilities with sequencing after a power failure without program interruption. All EMS controlled equipment with motor loads of one horsepower, or equivalent, and larger shall be started after power resumes in equal load groups in intervals of every 20 seconds, adjustable, to minimize electrical demand.

K. Associated Hardware:

1. All actuators for valves and dampers shall be supplied under this section of the specifications.
2. Where modulating 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 pump that did not start, etc.) and all deviation alarms (temperature, off, normal, etc.) will report to the 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 CPU location. A scan can then identify all alarm conditions and their identifier.

N. Cabinet:

1. The DDC modules 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 shall be provided with a key lock. All cabinets on each installation shall utilize one master key.
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. System Architecture: The network architecture shall consist of two levels. The top level controller shall contain a high speed LAN communication bus capable of sharing data over MISD's TCP/IP Ethernet Wide Area Network. Top level controllers will also contain a communication bus to lower level controllers, referred to throughout the specification as the field bus. The second level shall be a RS485 bus to support a family of dedicated local controllers for control of HVAC equipment and miscellaneous points of monitoring and control.

1. Field Bus
    a. The Level 2 bus, or field bus, supports local control units of modular size for operation of the building's HVAC and lighting systems. This RS485 bus shall operate at a minimum speed of 19200 baud, with a minimum length of 4000 feet or 32 nodes before requiring a network repeater. A minimum of 16 HVAC or access controllers shall be configurable on the field bus. Manufacturers with baud rates of less than 19200 shall be limited to 64 Level 2 controllers to insure adequate global data and alarm response times
    b. The field bus shall permit peer to peer communications among all Level 2 controllers and allow simultaneous communications with laptop computer service tools that are connected to a Level 2 controller. Failure of the Level 1 controller will not impair the operation of its associated field bus.
2. Network Transparency
    a. All points contained on Level 1 and Level 2 controllers shall be considered global points. Any program in any controller on the network shall be able to reference any point in any controller regardless of its location on the network.
3. Workstation Communications
    a. Existing workstations located within the Administration Annex shall be able to communicate to the communication controller via a high speed WAN communication bus capable of sharing data over MISD's existing TCP/IP Ethernet Wide Area Network.
4. Dial-up Communications
    a. It shall be possible to access the network remotely through a standard dial-up modem. This modem shall permit direct access to the high speed LAN via a Level 1 network controller. It shall be possible to configure multiple modems in Level 1 network controllers to enable multi-user communications when more than 1 telephone line is available.

Q. General software features of the CPU and field controllers, 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
5. Night Setback/Setup
6. Electric Demand Limiting
7. Override Feature
8. Run Time Totalization with data in non-volatile module memory.
9. Provisions shall be made for on-line programming and override.

R. On/Off Points of System Control shall be provided for the following:

1. Pumps:
    a. Primary Chilled Water Pumps: PCHP-1 and 2 (existing to be re-used).
    b. Secondary Chilled Water Distribution Pumps: CHP-1 and 2 (existing to be re-used).
    c. Primary Heating Water Pumps; PHWP-1 and 2 (existing to be re-used)
    d. Heating Water Distribution Pumps: HWP-1 and 2 (exiting to be re-used).
    e. Condenser Water Pumps: CWP-1 and 2 (existing to be re-used).
2. Cooling Towers: CT-1 and 2 (Fans served by variable frequency drives).
3. Exhaust Fans:
    a. Central Plant Exhaust Fans: EF-1.
4. Chillers CH-1 and 2.
5. Each air handler supply fan (refer to plans for quantity, control install work to be priced per unit for VFD replacement).
6. Each relief air fan (refer to plans for quantity, control install work to be priced per unit for VFD replacement).

S. Run Status (On/Off) of all units indicated above shall also be provided and shall be capable of being accessed for on-line programming. Status shall be by means of the local motor controller through the use of adjustable current sensing relays, or air flow differential pressure switch using a current sensing relay on pump motors status on fluid handling equipment. For motors operated with variable frequency drives use the status from the drive. Coordinate the means of status with all equipment furnished.

T. Failure Alarm Status for the following EMS controlled items shall be provided through the EMS:

1. Combined Safety Alarm, one (1) for each chiller, cooling tower (vibration switches) and each EMS controlled fan.
2. Low/High Temperature Alarms for each temperature sensor installed, four (4) Deg.F. above or below set point, adjustable.
3. Vibration switch trip-off for each cooling tower fan.
4. Each Variable Frequency Drive-Fault Condition (Refer to Plans for quantity and unit pricing and alternate scope).

U. Provide cumulative run time logging and indication for equipment noted in Paragraph "R", above.

V. Provide analog indication for the following:

1. Provide water temperature indication for the following (existing to be re-used):
   a. Primary chilled water supply temperature, one (1) for each chiller, Deg.F.
   b. Primary chilled water return temperature, one (1) for each chiller, Deg.F.
   c. Secondary chilled water supply temperature, Deg. F.
   d. Secondary chilled water return temperature, Deg. F.
   e. Common heating water return temperature, Deg.F.
   f. Condenser water supply temperature leaving cooling tower cold water basin, Deg.F. (One sensor).
   g. Condenser water return temperature leaving chiller condenser, one (1) for each chiller, Deg.F.
2. Re-use existing indication of outside air temperature in Deg.F for this building.
3. Re-use existing indication of outside are relative humidity in % R.H. for this building.
4. Provide feedback of variable frequency drive operating frequency, or speed, for drives serving the following equipment (refer to proposal form, the majority of the VFD work is to be priced as an alternate with install provided on a unit pricing basis):
   a. Pumps CHP-1 and CHP-2 (alternated).
   b. Pumps HWP-1 and HWP-2 (alternated).
   c. Cooling Tower Fans: CT-1 and 2.
   d. Relief Air Fans (refer to plans for quantity).
   e. Air Handler Supply Fans (refer to plans for quantity).
5. For each unit designated to have a VFD as shown in the Paragraph above that is controlled via system pressure, provide indication for system water pressure differential for distribution water pumps. Refer to sequence of operation for the locations where water distribution differential pressure sensors are required as well as the quantities. Refer to Sequence of Operation for non-pressure controlled

VFDs. Re-use existing sequence of operation for all existing equipment with new VFDs.

6. Space Temperature, Degrees F.:
   a. Mechanical Central Plant.
      1) Chiller Room.
7. Flow (GPM) and direction of flow in chilled water system bypass line.
8. Flow (GPM) for the make-up water meter to the cooling tower.
9. Provide BacNET MS/TP interface between new chiller and EMS.
10. All new VFDs shall have BacNET MS/TP interface card, but only existing points for start/stop, status shall be used for this scope of work. BacNET MS/TP interface to be connected in a future project.
11. Valve and Damper Position Feedback: On the graphical systems schematics CRT display provide indication of the valve and damper positions in % open; 25% open, 50% open, 75% open, etc. Program trend logs for each damper and valve installed.

W. 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 (6) 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 Central Computer Workstation (CPU), 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:
      1) Point addition, deletion, and modification
      2) Sampling intervals and ranges
      3) Historical samples to be stored per individual point
      4) Dynamic data values

5) 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 Times
   f. Trend Selected Points
   g. Observe Any System Point, Hardware, or Software
   h. 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 Central Computer Workstation 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 shall be via hardware connection compatible with electric category Type 3002, as described in Bell System Technical Publications for Data Transmission using 9600 Baud Rate.
7. New field panels/controllers shall be able to communicate with the existing front end system same as currently exists.
8. CRT Format:
   a. The CPU 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 or off normal conditions which are active.
      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.
9. 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, setpoints 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.

2.12 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 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."

2.13 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.

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 pull wire each run in conduits carrying 5 or more conductors. Conduits with 9 or more conductors shall have two pull wires installed. Terminate pull wires at control panels in an acceptable manner and tag wires as “future”.

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 above accessible lay-in ceilings only 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, furnish and install, 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. Install with pull wire for installation of sensors and related wiring at a later stage of construction. For existing construction, either fish flexible conduit down accessible walls, use surface mounted wire mold components on masonry walls (color to be approved by Architect) in finished areas, or use surface mounted EMT in unfinished areas.

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.

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 16, 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, 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 Automatic Temperature Control (ATC)/Energy Management System shall be a complete, separate, independent 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 minimum #16 THHN.
8. Digital Input (D.I.), Analog Input 4-20 mA (A.I.) and Analog Output (A.O.) wiring shall be min., #20 TSP (twisted shielded stranded pair with drain wire).
9. Analog Input or voltage types (A.I.) wiring shall be min., #20 TSP (twisted shielded stranded pair with drain wire).

2.14 GENERAL

A. System shall be installed complete with DDC panels, remote panels, thermostats, sensors, control valves, control dampers, all actuators, switches, relays, alarms, etc., and control piping 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 valve bodies, piping thermowells, and taps for flow switches and pressure sensing devices which shall be furnished under Section 23 21 13.

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 controllers, thermostats, relays, control valves, 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 wells, and automatic valves.

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 - CHILLERS CH-1 AND CH-2

A. The liquid chiller system shall be energized by the Energy Management System and software interlocked to run when any air handling unit or group, as designated by the Engineer, of fan coil units served with chilled water is energized, requires cooling and the economizer cycle cannot meet load demand. Provide manual disconnect for each control circuit.

B. Provide a primary chilled water return temperature sensor set at 54 degrees F., adjustable, to energize the lead primary chilled water pump and the respective chiller served after proof of flow is verified. Start the second (lag) primary pump and chiller in the same manner after a rise of common secondary pump discharge temperature of 2 Deg.F., or more, adjustable, above chiller setpoint, initially set at 44 Deg.F., for 30 minutes or longer, adjustable.

C. Turn off second, lag chiller and respective primary pumps, with auxiliaries, after a 30 minute time delay (each chiller to run a minimum 30 minutes), adjustable, if the flow rate in the bypass, supply to return, exceeds 110%, adjustable, flow rate of one chiller, the lesser value of the operating chillers, the secondary supply temperature is less than 2 degrees above chiller setpoint, i.e., less than 46 Deg.F., adjustable, and the temperature difference of the secondary supply and primary return is less than 5 Deg.F., adjustable.

D. Alternate starting of chillers and respective primary pumps and auxiliaries to provide even distribution of operating hours for the two chiller systems through software. Chillers No. 1 and No. 2 shall generally be the primary operating chillers, alternate after each start. Provide a BacNET interface to new chiller and monitor the load on each chiller. Typically, when the chiller load drops below 20% on Chiller No. 1 or 2.

E. Initially, one primary pump and chiller and auxiliaries will start and as load increases beyond the capacity of that chiller then the second and then the third chiller system will be energized. As load decreases, the reverse shall occur.

F. Chiller capacity shall be controlled by individual chilled water discharge thermostats for each chiller, set at 44 degrees F. (adjustable).

G. Chiller safety and operating controls shall be master over auxiliary controls.

H. Chillers shall be turned on only after respective primary pumps have started and proof of flow is made in both the evaporator and condenser. Flow switches are differential pressure type furnished under other Sections of these Specifications. Chillers shall be turned off 15 minutes, adjustable, prior to the respective primary pumps being de-energized unless the chiller manufacturer allows this time to be decreased.

I. Primary chilled water pumps shall be started, and hard-wire interlocked with condenser water pumps under this Section of the Specifications. Chillers shall be started after a one-minute time delay (adjustable) after the chilled and condenser water pumps are started and proof of flow is verified. Lock out the chillers, chilled water and condenser water pumps and cooling tower below 38 deg. F. outside air temperature, adjustable.

J. Provide differential pressure flow switches, under this Section of the Specifications, if not specified to be furnished with the chillers, in the chilled water and condenser water lines to prevent chiller operation unless flow is proven. Flow switches shall be located between isolation valves and chillers. Utilize McDonnell & Miller differential pressure type switches.

K. Provide other interlocking relays to de-energize pumps as required by safety controls of chiller manufacturer, under this section of the specifications.

L. Hand-Off-Auto (H.O.A.) Switches, for control of primary chilled water pumps, shall be provided at the motor controllers under other Sections of these Specifications. Control and interlock wiring through motor controllers shall be performed under this Section of the Specifications. Wiring shall be such that pumps shall be capable of turning "On" in the hand position without energizing chillers or other interlocks that should operate only when turned on in the automatic position. However, all safety devices shall be wired to operate in both the "Hand" and "Auto" positions.

M. Any time a primary pump is energized the designated chilled water distribution pump shall be started and be controlled as indicated elsewhere herein.

3.2 SEQUENCE OF OPERATION - COOLING TOWERS: CT-1 AND 2

A. The cooling tower fans shall be staged on and start any time condenser water pumps CWP-1 or CWP-2 are operating. The cooling tower fans shall be controlled by variable frequency drives to maintain the maximum condenser water supply temperature set point of 85 Deg. F. (adjustable). Under normal operation, when Chiller No. 1 or 2 are energized, start two towers and the associated fans (provide equal run-time between tower CT-1 and 2 and alternate every 48 hours which tower is the lead tower) at minimum speed at the same time as the condenser water supply temperature rises above 75 Deg.F., adjustable. With both fans at a minimum speed and on a further rise in condenser water temperature, both fans shall uniformly increase in fan speed as required to prevent the condenser water supply temperature from exceeding 85 Deg.F., adjustable. Prior to energizing the associated chiller, the associated isolation valve in the condenser water return line at the respective tower shall be modulated open. The isolation valve shall remain closed for inactive towers.

B. On a drop in water temperature below 85 Deg.F., adjustable, the fans shall be decreased in speed in the reverse sequence of that specified above. On a drop in water

temperature to 75 Deg. (adjustable), all fans shall be de-energized. On a further drop in water temperature, the bypass valve shall modulate open to divert flow from the cooling towers to the cold water basin to maintain a minimum 70 Deg.F. condenser water supply temperature, adjustable.

C. Provide for condenser water relief by resetting the condenser water supply temperature downward from 85 Deg.F. to 75 Deg.F. based on a reduction in the outdoor air temperature from 100 Deg.F. down to 70 Deg.F., adjustable. In no case shall the condenser water supply temperature drop to below 65 Deg.F., unless otherwise allowed by the chiller manufacturer.

D. The tower fans shall be locked out when the outside air temperature is below 40 Deg.F., adjustable.

E. The tower basin heaters and controls shall be furnished by the tower manufacturer and shall be independently hardwired and controlled, per basin, under this Section of Specifications. On a drop in basin water temperature below 35 Deg.F., the heaters shall be energized; and, on a rise above this temperature, 2 Deg.F. differential, adjustable, the heaters shall be de-energized. Individual low water cut-out switches shall prevent heaters from operating when elements are not completely submersed. Low water cutout switches and thermostats are furnished by the tower manufacturer. Install and wire under this Section of Specifications.

F. Monitor the cold water make-up quantity through the chemical treatment make-up water meter, to report an alarm to the Central DDC System, when make-up water quantity exceeds the cooling tower manufacturer's recommendations by 10%, adjustable. Coordinate compatibility of meter and pulse signal. Dual meters are not acceptable.

G. Each tower fan motor shall be furnished with a vibration cut-out switch by the tower manufacturer, which shall be wired under this Section of the Specifications to de-energize the respective fan when vibration becomes excessive. This shall be manually reset.

3.3 SEQUENCE OF OPERATION - CHILLED WATER DISTRIBUTION SYSTEM - PUMPS CHP-1 AND CHP-2

A. Chilled Water Distribution Pump CHP-1 and CHP-2 shall distribute chilled water to the building for cooling effect. These pumps shall be alternated by the EMS every 48 hours, adjustable, for even wear of equipment and accessories.

B. Provide manual disconnect for the control circuit. Additionally provide for Hand-Off-Automatic (H.O.A.) switch control through the individual motor controller, controllers furnished under other Sections of these Specifications, for each pump. Only the pump

served shall operate through the "Hand" position, to include full functioning of all safety devices. In the "Auto" mode, both safety and interlock wiring shall function as specified. This wiring shall be performed under this Section of the Specifications.

C. Chilled Water Distribution Pump CHP-1 and CHP-2 shall be connected to separate variable frequency drives such that one or the other may be operated from the respective variable frequency drive, or manual bypass starter, but both shall not be capable of being operated from the same motor controller simultaneously. When the EMS switches from one pump to the other, it shall also switch the motor controllers.

D. Chilled Water Distribution Pumps CHP-1 and CHP-2, shall operate anytime an air handling unit, or group of units is operating and requiring cooling, during building cool-down, night set-up and during the freeze protection mode. One distribution pump will be energized instantaneously when any primary chilled water pump is energized. Only one (1) pump shall operate at any given time. The second pump is a redundant pump.

E. Re-use existing differential pressure sensors with transmitters at the chilled water coil of existing equipment. The design differential of greatest demand shall be maintained through the variable frequency drive modulating the speed of the active distribution pump. The design differential shall be the combined pressure drop of the control valve and the cooling coil, and shall be field determined by the Testing, Balancing and Adjusting (TAB) Agency. Utilize a 30 PSIG range differential sensor. Provide test tee with gauge cock for TAB firm testing.

F. During chilled water distribution system freeze protection, all inactive air handling unit, chilled water valves shall be open to the coil and one (1) chilled water distribution pump shall be activated and maintain the design differential water pressure set point. This sequence shall be activated by software any time the outside air temperature is below 35 Deg.F., the building is secured (generally unoccupied); air handling is generally all off, and not operating in a night set-back or morning warm-up mode.

3.4 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. Chiller exhaust system in machine room shall normally be thermostatically controlled. Provide an override timer, 0-2 hours, without hold capabilities, to energize exhaust system for occupied conditions; label switch "Occupied Ventilation". Additionally, energize this ventilation system in response to a refrigerant alarm, via the Refrigerant Alarm and Monitoring System furnished with the chillers under other Sections of these Specifications. Also provide a manual purge button, mushroom-like type, at each exit of the machine room with cover or other suitable protective device to prevent accidental activation. Label switches "Emergency Refrigerant Leak Purge Exhaust". Provide a manual reset button to allow fan to return to normal operation. Reset button shall not allow ventilation system to shut down should a high level refrigerant alarm continue to exist. The fan could only be turned off at its starter.

C. Provide a remote wall mounted refrigerant alarm and equipment shut-down control panel at all main interior building entrances to the machinery room that contains the following items:

1. A blue light that is energized by "Alarm Level 1".
2. A yellow light that is energized by "Alarm Level 2".
3. A red light that is energized by "Alarm Level 3".
4. A momentary push-button used to reset the alarm at the monitor. This shall only reset a past alarm condition, and shall not disable the monitor. The alarm shall reactive within 10 seconds if the alarm condition still exists in the machinery room.
5. A separate shut-down switch for every chiller or refrigeration system compressor shall be provided, but shall require the use of a keyed switch to prevent unauthorized tampering. Compressor or refrigeration system shut-down shall not bypass safeties, and will provide for the orderly shut-down of all auxiliaries.
6. Provide interlock with all gas fired equipment in the central plant such that upon detection of refrigerant by the refrigerant monitoring system, the gas supply to the boilers shall be shut-down and the boilers de-energized as well as any associated gas fired unit heaters.

3.5 SEQUENCE OF OPERATION - NIGHT SET-BACK AND SET-UP MODES

A. Night set-back and set-up modes shall be provided to keep equipment from operating except as needed to heat or cool the space to protect the building systems from freezing and potential water damage in cold weather or from excessive heat or humidity build-up in warm weather.

B. Designate one of the space temperature sensors shown on the plans, preferably 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 for VAV units. For single zone systems, utilize the space temperature sensor shown. Use this same sensor for night set-up control which shall have a set point of 84 Deg.F., adjustable.

C. Below set-back setpoint, respective air handlers shall receive a control signal, fans shall be energized, and related heating equipment shall be started if not already energized, until all units are no longer in the night set-back mode, temperature rises above 60 Deg.F.

D. Above the night set-up set point, respective air handlers shall receive a control signal, fans shall be energized and related cooling equipment shall be started if not already operating, until the units are no longer in the night set-up mode, temperature drops below 80 Deg.F.

E. During the night set-back mode, lockout cooling system, ventilation cycles, morning warm-up and cool-down modes, night set-up mode, close all outside and relief air dampers, as applicable, and de-energize all EMS controlled toilet exhaust fans located in the areas served by the units being controlled.

F. During the night set-up mode, lockout the same systems, except allow the cooling system to be energized and lock-out the heating system.

3.6 SEQUENCE OF OPERATION - MORNING COOL-DOWN MODE

A. A morning cool-down mode shall be provided to cool the building, or area served by a system, to within 1 Deg.F. of the normal occupied cooling set point, adjustable, through the building Energy Management System optimized start feature.

B. Cool-down shall function the same as night set-up, except the set point shall be as noted above.

C. Lockout the cool-down mode after the cycle is completed until the following scheduled cycle, generally not to occur more than once per day.

D. During the cool-down mode, lockout the heating system, night set-back, morning warm-up, night set-up, close all outside and relief air dampers, as applicable, and de-energize all EMS controlled toilet exhaust fans in the areas served by the units being controlled.

3.7 SEQUENCE OF OPERATION - MORNING WARM-UP MODE

A. A warm-up mode shall be provided to warm the building, or area served by a system, to within 1 Deg.F. of the normal occupied heating setpoint, adjustable, through the building Energy Management System optimized start feature.

B. Warm-up shall function the same as night setback, except the setpoint 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 the cooling system, ventilation cycles, night set-back, morning cool-down, night set-up, close all outside and relief air dampers, as applicable, and de-energize all EMS controlled toilet exhaust fans located in the areas served by the units being controlled.

3.8 ELECTRICAL INTERLOCKS

A. Certain electrical interlocks shall be as listed herein and in other sections of these specifications.

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

3.9 TEST, ADJUST, AND BALANCE SUPPLEMENTARY PROVISIONS

A. Furnish and install capabilities at each control device a test tee for testing of the control system on water distribution systems, to include input and output of all related control devices.

B. Furnish and install Pete's Plug or test tees with gauge cocks at water piping system temperature sensors/wells for verification, testing and calibration of each device without causing disassembly or removal of component systems.

C. Identify all required thermowells and supplementary test wells or plugs. Verify acceptable locations with TAB Firm. Then mark locations to be installed under Section 23 21 13.

D. Under this section of the specifications, provide a temperature test port adjacent to all EMS sensor locations. Additionally, furnish any other permanent test tees or wells for sensor calibration and for verification of all system monitoring data.

E. Under this section of the specifications, provide all thermowells for pipe mounted temperature sensors, pressure taps, test tees with cocks, sensors, wiring/cabling, etc., to be co006Enected to the Energy Management System to include all points necessary for the sequence of operations specified hereinafter.

3.10 DDC CONTROL

A. Provide complete DDC Control for all equipment as indicated elsewhere herein.

B. Not more than one local unitary direct digital controller shall be utilized per AHU/piece of equipment.

C. Separate monitoring only control points not associated with specific pieces of equipment and which are global in nature are desired to be grouped together in a separate controller, or controllers, other than dedicated equipment controllers.

D. Each DDC controller used for Central Plant equipment control and those used as the main building network controller shall have their own real time clocks.

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. Valves or cocks shall be installed to control the flow of water to each of the various systems, to segregate individual items of equipment and parts of fluid circulating or supply systems, and to permit draining of systems or portions thereof, to blow-off strainers, etc., as directed on the Drawings and specified.

D. The work shall include the furnishing and installing of all supporting structures and members for pipes, ducts, and equipment.

E. Support devices and members shall include vibration and noise isolating devices and assemblies. Penetrations of walls to structure shall be sealed off to limit noise transmission through sleeves.

1.3 QUALITY ASSURANCE

A. All equipment and materials shall be new and of the best quality.

B. All equipment and materials shall be installed by experienced mechanics certified and trained for the work performed.

1.4 SUBMITTALS

A. Product Data: Submit complete manufacturer's descriptive literature and installation instructions in accordance with Section 01 30 00 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 Sections 01 30 00 and 23 05 00.
2. Submit 1/4" = 1'-0" Scale HVAC and Plumbing Piping Shop Drawings.
3. Overlay piping Shop Drawings over other Shop Drawings of other trades to include electrical and sheet metal Shop Drawings.
4. Plan views of congested areas and sections thereof shall be drawn at a scale of 3/8" = 1'-0".

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

1.5 PRODUCT HANDLING

A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall and will be rejected.

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

C. Take special precautions to protect control valve internals from construction dirt and debris. If valves are stored on site cover valve openings until just prior to installation but in no case shall valves be unprotected for more than 48 hours.

D. Openings in piping system, coil headers, boilers, pumps, valves and other heat exchangers shall be covered during the construction period to protect the interior accumulation of dirt and debris in these systems until immediately prior to connection to these components to similarly protected systems.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. In general, the following listed materials shall be used in fabricating the piping systems. Where special classes of piping are involved and are not listed, the Contractor shall request instructions as to the class of material involved and the method of fabricating it before ordering the materials. Steel pipe 2-1/2" and larger shall generally have plain

ends to be assembled by welding and pipe 2" and smaller shall generally have screwed ends, except where special requirements dictate otherwise.

1. Chilled and Heating Water Lines:
    a. Schedule 40 black steel pipe conforming to ASTM A-53, Type “F” for sizes 2" and smaller, and Grade “B”, Type “ERW, for all sizes 2-1/2" and larger. Piping 12" and larger in Central Plant Chiller and Boiler Rooms shall be Schedule 40 in wall thickness. Piping 12" and larger outside the Chiller and Boiler Plant may be standard weight piping.
    b. For pipe sizes two inches (2") and smaller the Contractor may use Type "L" copper, with soldered joints, in lieu of threaded black steel pipe, using dielectric unions as specified elsewhere herein.
2. Condenser Water Lines:
    a. Schedule 40 black steel pipe conforming to ASTM A-53, Type “F” for sizes 2" and smaller, and Grade “B”, Type “ERW, for all sizes 2-1/2" and larger.
    b. Atmospheric Relief Lines: Schedule 40 black steel pipe, or Type "L" copper.
3. Miscellaneous drains from Air Handling Units, Pump Bases, strainer blow-offs, backflow preventors and expansion tanks: Type "M" or DWV (1-1/4" and larger) hard drawn copper.
4. Miscellaneous Lines: Pilot, bleed, control, sampling, and equalizing lines, and similar auxiliary lines shall be fabricated of the material used in the system to which they are connected in each case. Drains from appurtenances installed in copper lines shall be of Type "L" hard drawn copper tubing. Drains from air vent valves installed in steel piping systems shall be Schedule 40 black steel pipe. Other drains shall similarly match the piping system materials.
5. Chemical treatment piping and valves shall be Schedule 80 PVC or Type "L" hard drawn copper, up to final connections to the main system which shall be schedule 40 black steel or Type "L" hard drawn copper.

B. Steel pipe shall be made and tested in accordance with the latest edition of the "Standard Specifications for Welded Steel Pipe" of the National Tube Company, or Youngstown Sheet and Tube Company. Piping 2" and smaller shall be manufactured by LeClede, Sawhill, or Wheatland. Piping 2-1/2" and larger shall be manufactured by Tex-Tube, Paragon, U.S. Steel, Wheatland or Armco. Unless otherwise specified, all pipe shall be Schedule 40 of ASA Standard B36.10.

C. In general, fittings used for the various piping systems shall be as listed below. Special fittings shall be used where required by job conditions and when approved for particular use.

1. Welding Fittings: All fittings in welded lines shall be factory fabricated welding fittings of the same material and the same schedule or weight as the piping system in which installed.

a. All elbows, reducers, tees, caps and special fittings shall be standard factory fabricated butt welding fittings, conforming to ANSI B16.9, with the following exceptions: Branch takeoffs from lines 2-1/2" in size and larger and where the size of the takeoff does not exceed two-thirds of the nominal diameter of the mains to which connected may be made with shaped nipples or with Bonney or Grinnell Weldolets or 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 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. Miscellaneous Fittings: Provide all reducers, increasers, adapters, bushings, etc., as required to properly inter-connect the various items, to change sizes, etc. Steel fittings shall be used in steel lines, and copper and red brass fittings shall be used in copper lines.

G. <u>All piping materials and fittings shall be manufactured in the United States</u>.

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, Watts, Zurn or Mueller Streamline.

2.5 VALVES

A. All valves of any one type shall be of the same make throughout and insofar as practicable all valves in a given category shall be of the same make.

B. All valves shall be so located as to be readily accessible for operation and maintenance.

C. Furnish and install all valves indicated on the Drawings, specified herein, and required to control the flow of water to and from various parts of the systems and to isolate various pieces of machinery and equipment and to isolate various parts of the systems.

D. Each valve for installation in a line to be insulated shall have sufficient clearance between the valve body and the operating handle or device to accommodate the insulation.

E. All valves shall be designed for re-packing under pressure when fully opened and shall be equipped with packing suitable for the service.

F. Valves shall generally be installed with stems up; but, in no case, less than horizontal and whenever possible shall be grouped together in a uniform manner.

G. Except where special valves are specified elsewhere herein or as required by special conditions or class of work, valves shall be equivalent to the following Crane Co. valve numbers listed herein.

H. All globes valves 2" and smaller shall be Class 150 rated to 200 degrees F. or Class 300 rated up to 300 Deg.F. All valves 2-1/2" and larger shall be Class 125WP and 200WOG rated for 200 degrees F., be of the flanged design, be made of ASTM A 126, Class B, with bronze trim, and have an outside screw and yoke design.

1. Valves shall have rising stem, screwed or union bonnet and manufactured in accordance with MSS-SP-80.
2. Body and bonnet shall be manufactured of ASTM B-62 alloy or ASTM B-61 alloy.
3. All valves shall have ductile or malleable iron handwheels.
4. Stems shall be made of dezincification resistant silicon bronze ASTM B-371 or be low zinc alloy B-99.
5. All valves shall be suppled with non-asbestos packing, amarid fibers or approved equal.
6. Where higher operating pressures approach 300 PSI, Class 300 Union bonnet valves of similar construction shall be used.
7. Class 150 valves shall be one of the following:
    a. Nibco - T-235-Y.
    b. Crane - 7TF.
    c. Jenkins - 106BJ.
    d. Hammond IB413-T.
    e. Milwaukee 590T.
8. Class 125 valves shall be one of the following:
    a. Nibco - F-718-B.
    b. Crane - 351.
    c. Jenkins - 2342J.

d. Hammond IR116.
e. Milwaukee 2981A.

I. Where cocks are required, they shall generally be brass, screwed pattern up to 2" and cast iron flanged pattern 2-1/2" and larger plug cocks suitable for the system pressure. Also provide and install all special cocks required such as pet cocks, gauge cocks, etc.

J. Provide plug valves where indicated, at "all water balance stations" and at all pump discharges.

1. In no case shall butterfly or ball valves be substituted for plug valves where plug valves are indicated on the Drawings.
2. Valves shall be flanged-type, 2-1/2" and larger, and threaded 2" and smaller.
3. Plug valves 4" and smaller shall be equal to DeZurik (or SMG) Series 400 eccentric plug valves with cast iron bodies.
4. Plug valves over 4" in size shall be equal to DeZurik (or SMG) Series 100 eccentric plug valves with cast iron bodies.
5. Valves 4" or smaller shall have cast iron bodies with bronze plugs on sizes 2" and smaller and electroless nickel plated cast iron plugs on 2-1/2" to 4" valves.
6. Valves over 4" shall have cast iron bodies with stainless steel plugs and bearings.
7. All plugs shall have resilient faces rated for water temperatures up to 250 Deg.F. and stem seals meeting the same temperature rating. For general chilled and heating water applications, elastomeric coating shall be EPDM.
8. Furnish lever operator for all valves except at water coils of terminal units where snap-on plastic caps shall be furnished.
9. All valves shall have adjustable memory stops with plastic drip caps.
10. Plug valves shall be furnished with drilled and tapped 1/8" openings for pressure gauge connections at both upstream and downstream sides.
11. Plug valves shall be bubble tight with 150 pound differential pressure across the seat.
12. An indicator shall be included to show valve position.
13. All flanged plug valves shall have bolted bonnets.
14. All valve seats shall be welded in nickel for plug valves over 4" in size.
15. Plug valves shall be as manufactured by:

a. DeZurik (or SMG).
b. W-K-M.
c. Rockwell-Nordstrom.
d. Milliken.

K. Check valves in pump discharge lines shall be flanged non-slam type silent check valves. Valves shall have a cast-iron body and be bronze fitted with stainless steel springs. Valves shall be rated for 125 PSIG WOG and be one of the following products:

1. Nibco - F-910-B Series.

2. Combination Pump Valve (CPV) Manufacturing, Inc.- 20D Series.
3. APCO - 600 Series.

L. Swing Check Valves 2" and smaller shall be the Y-pattern swing-type manufactured in accordance with MSS-SP 80, and be Class 125 rated to 200 Deg.F. or below, have bronze ASTM B-62 bodies with bronze discs. Swing check valves 2" and smaller shall be one of the following:

1. Nibco - T/S-413-B.
2. Crane - 37 or 1340.
3. Jenkins - 4037J or 997AJ.
4. Hammond - IR1124.
5. Milwaukee - 2974A.

M. Swing Check valves 2-1/2" and larger shall be the swing-type manufactured in accordance with MSS-SP71, be Class 125 rated for 200 Deg.F. or below, be flanged, have ASTM A126, Class B, cast iron bodies with bronze trim, and have non-asbestos gaskets. Swing Check valves 2-1/2" and larger shall be one of the following:

1. Nibco - F-918-B.
2. Crane - 373.
3. Jenkins - 588J.
4. Hammond - IB904.
5. Milwaukee - 509.

N. Contractor shall furnish butterfly valves as indicated on the Drawings. Generally, all isolation valves in chilled, heating and condenser water lines 2-1/2" and larger shall be the butterfly type.

1. They shall have ductile iron bodies with aluminum bronze discs, 416 stainless steel shafts and shall be generally as specified for plug valves above as to materials, trim, tightness of closing, etc.
2. Liner shall generally be resilient EPDM with brass bushings and collar. Liner and seats shall be rated for 225 Deg. F at 150 PSIG.
3. Valves 2-1/2" and larger shall have lug bodies and resilient seating or have a resilient faced plug.
4. Valves shall be rated for end of line service, without the need for a downstream flange, and be bubble tight to a minimum of 150 PSI with bi-directional flows.
5. Where butterfly valves are used for balancing, only where shown, use infinite position lever lock handles with memory stops similar or equal to Nibco LD/WD 2000/3000. Valves shall be able to have the handles padlocked in the open, closed or balanced positions. Handles shall be polymer coated iron with lever lock and throttling plates made with zinc plated steel. No aluminum die cast lever handles allowed.
6. Valves 6" and over shall be provided with heavy duty cast iron hand wheel gear operator with indicator. Where these valves are also used for balancing provide with a memory stop. Provide with babbit sprocket (and chains) only where

specified elsewhere herein. Operators shall be suitable for all weather conditions and shall be the self-locking worm gear type.

7. Provide two inch (2") extension necks for insulated lines.
8. Butterfly valves shall be as manufactured by
    a. Nibco LD Series in 2" - 12" sizes and LD1000-5 Series for 14" - 24" sizes.
    b. Dezurik (or SMG) BRS-C1-EPDM-EPDM-BZ-S4.
    c. Demco NE-C Series in 2" - 12" sizes and NF-C Series for 14" - 24" sizes.
    d. Keystone AR2 Series.
    e. Grinnell Series 8000.
    f. Apollo LD 141 Series.
    g. Milwaukee ML233E in 2"-12" sizes only; larger valves not allowed.

O. Contractor shall provide ball valves in chilled, heating, condenser and domestic cold and hot water lines 2" and smaller, Contractor shall furnish ball valves without exception as follows:

1. Ball valves shall be on the following products (All bronze bodies only):
    a. Nibco T-585-70-66 or S-585-70-66.
    b. Apollo 77C-140 Series or 77C-240 Series.
    c. Hammond 8303-A or 8311-A.
    d. Milwaukee BA400 or BA4505 (Not allowed on chilled water systems).
2. Ball valves may also be used in lieu of plug valves for balancing purposes for lines 2" and smaller and only when provided with memory stops.
3. Ball valves shall be full port design with stainless steel ball and stem.
4. All ball valve body pieces and stems shall be manufactured from a dezincification resistant material with less than 15% zinc.
5. All ball valves shall have a threaded packing gland. Each ball valve will not require the handle and handle nut to be installed in order to keep the valve packing in place.
6. Provide memory stops where used for balancing or as shown and where detailed.
7. Provide extended lever handles for all valves installed in insulated lines.
8. Ball valves installed on chilled water piping shall be provided with an extended "T" handle with insulation insert and collar that creates a vapor seal to prevent condensation while allowing adjustment of memory stops and valve packing maintenance without disturbing the insulation. Insulated "T" handles shall be equal to Nib-Seal as manufactured by NIBCO. No extended metal handles are allowed.

P. Provide chain operators on all gate and butterfly valves installed 10'-0" or higher above the finished floor with chains to extend to not lower than 7'-6" or higher than 8'-0".

2.6 PUMP SUCTION DIFFUSERS

A. Furnish and install as shown on plans, an angle pattern flow straightening fitting equipped with a combination diffuser-strainer-orifice cylinder, with flow straightening vanes, start-up strainer and adjustable support foot. The combination diffuser-strainer-orifice cylinder shall be designed to withstand a pressure differential equal to the system pump shutoff head (refer to pump schedule) and shall have a free area equal to five times the cross sectional area of the pump suction opening for the actual pumps to be used. The length of the flow straightening vanes shall be no less than 2-1/2 times the diameter of the system pump suction connection.

B. Pump Suction Diffusers shall be manufactured of Cast Iron and be Flanged Models Rated for a Maximum Working Pressure of 175 PSIG.

C. The flow straightening fitting shall be made of cast iron construction with Flanged system and Flanged pump connections. The fitting shall have a stainless steel combination diffuser-strainer-orifice cylinder with 3/16" diameter perforations to protect the system pump. The full length stainless steel flow straightening vanes shall provide non-turbulent flow to the suction side of the system pump.

D. Furnish a start-up strainer which consists of a 16 mesh bronze screen.

E. The support foot (supplied by Piping System Installer) shall eliminate pipe strain at the flow fitting/pump connection. All internal components shall be replaceable without removal of fitting.

F. Each suction diffuser/flow straightening fitting shall be ITT Bell and Gossett fully flanged models or approved equals only.

2.7 PIPE HANGERS

A. Pipe hangers, except for fire protection types, shall be as manufactured by Anvil International, Inc. and be of a type suitable for each use. Approved equals by Mason Industries, Inc., B-Line, Erico Caddy, and PHD Manufacturing, Inc. will be considered.

B. For cast-iron pipes up to three inches (3") in size, use Anvil Fig. 104 malleable iron, adjustable, split ring, swivel hanger, or Anvil Fig. 590 steel clevis hanger. For cast iron plumbing piping four inches (4") and larger, use only Anvil Fig. 590 steel clevis hanger.

C. Heating and air conditioning piping (chilled, heating and condenser water piping) 3/4" in size up to and including twelve inches (12"), shall be Anvil Fig. 260, adjustable clevis hangers. Hangers shall be sized to be on the outside of the insulation.

D. Where several pipes are routed parallel to each other and at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where rollers are called for elsewhere by these specifications.

E. For bare copper pipes (uninsulated only) up to and including three inches (3") in size, use Anvil Fig. CT-109 malleable iron, copper plated, split ring, hangers or Anvil Fig. CT-65 copper plated clevis hangers. For uninsulated copper pipes larger than three inches (3"), use Anvil Fig. CT-65 copper-plated clevis hanger.

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

Pipe up to, and including 2"	3/8" rods
Pipe 2-1/2", 3", and 3-1/2"	1/2" rods
Pipe 4" and 5"	5/8" rods
Pipe 6"	3/4" rods
Pipe 8", 10" and 12"	7/8" rods
Pipe 14", 16" and 18"	1" rods
Pipe 20" up to 30"	1-1/2" rods

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

Pipe up to, and including 1-1/4"	8 feet
Pipe 1-1/2" and 2"	10 feet
Pipe 2-1/2" and 3"	12 feet
Pipe 3-1/2" and 4"	14 feet
Pipe 5" and 6"	* 8 feet
Pipe 8" and larger	* 8 feet

* Maximum 8 foot spacing for pipe supports for pipes 5" and larger due to structural considerations.

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

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

I. There shall be a hanger within two feet (2') of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps.

Vertical pipes within a space shall have not less than two (2) supports. Where the vertical run of pipe in a space exceeds 14 feet then three (3) supports shall be required.

J. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting; nor shall it be supported from equipment connections.

K. Inserts shall be used where piping or equipment is to be hung from concrete construction. Inserts shall be Anvil Fig. 281, wedge type, concrete inserts. All inserts shall be pre-treated to prevent rusting. After the forms are removed, clip off all nails flush with the exposed surface of the inserts.

L. Expansion bolts shall be Ackerman-Johnson.

M. Beam clamps suitable for the use with the type of steel construction involved shall be an Anvil product or an approved equal as indicated elsewhere herein.

N. No perforated straps shall be used to support any mechanical equipment item or piping of any kind.

O. Chilled water, heating water, domestic cold water, domestic hot water (includes recirculated lines), condensate drains, horizontal and vertical storm drain downspouts and soil piping receiving cold condensate piping hangers shall be sized to go around the insulation with shields being provided to protect the insulation. Shields shall be Anvil Fig. 167.

P. All steel hangers, base plates, supports, nuts, bolts, and all thread rod located outdoors, in crawl spaces, and exposed to the weather, shall be made of galvanized steel or equally suitable corrosion resistant steel alloy or aluminum. Where steel components are allowed and used under these conditions they shall be painted with an equivalent protective coating similar to a two-part epoxy. Refer to Section 09 90 00.

Q. 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.

2.8 SLEEVES AND ESCUTCHEONS

A. Generally where pipes pass through interior building walls or floors above the first floor (out of the ground), 22 gauge galvanized sheet metal sleeves shall be used.

Sleeves shall extend a minimum one inch (1") above a floor or beyond the wall, as applicable.

B. All pipes penetrating grade beams, exterior walls, concrete structural members, or concrete slabs of mechanical equipment rooms on the first floor shall generally use standard weight galvanized steel pipe as the sleeving material.

C. For concrete or masonry walls, sleeves shall be inserted into the masonry, decking or form work prior to the pouring or placement of concrete or masonry units to create a leave out.

D. The sizes of all sleeves shall be such as to permit the subsequent insertion of the intended pipe of the proper size with adequate clearance for movement due to expansion and contraction. In the case of insulated lines, the diameter of the sleeves shall be at least 1/2" greater than the outside walls of the pipe with specified thickness of insulation. This will require that the inside diameter of galvanized steel pipe sleeves be at least 1/2" greater than the outside diameter of the service pipe with insulation. Galvanized steel pipe sleeves set in floors shall project two inches (2") above the floor.

E. After the pipes are installed, fill the annular space between the pipe, and insulation as required, and its sleeve with an approved mastic or caulk. Use loose fibrous insulation packing as required to accomplish this. In all cases the annular spaces around the pipes within the sleeved openings shall be filled with loose fibrous insulation and then sealed with an approved caulking or expanded foam insulation.

F. Escutcheons, except as specifically noted or specified, shall be installed on all pipes passing exposed through floors, walls, or ceilings. Escutcheons shall be equal to the Crane No. 10, chrome plated sectional floor and ceiling plates, and shall fit snugly and neatly around pipe or pipe insulation or insulated lines. Solid chrome plates with set screws shall be used if sectional plates do not fit properly or stay in place. Where multiple pipes penetrate floors or walls in close proximity in concealed areas, shop made sheet metal escutcheons may be used.

G. Pipes sleeved through grade beams open to basements, crawl spaces or void spaces below grade shall additionally receive "Link Seal" or equal closures made of interlocking synthetic rubber links. Seals shall provide for absolute water tightness. Seal shall be constructed to insulate electrically pipe from wall. Install as recommended by manufacturer. Provide Century-Line sleeves with water stop and anchor collar for pipes penetrating grade beams designated to be anchored.

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.

2.9 STRAINERS

A. Strainers shall be of the "Y" pattern type bodies, unless shown or specified otherwise. Body ends shall be screwed or flanged to match the type of joints in the piping in which the strainers are installed. Strainers shall have a 125 lb. ANSI pressure rating.

B. Each strainer, screen, or mesh shall be of Type 304 Stainless steel, brass, or monel construction. Screen or mesh sizes shall be as scheduled below:

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

C. Where vertical space does not permit the installation of the "Y" strainer, install an equivalent basket strainer.

D. Where strainers are used in domestic water supply systems they shall be coated (all wetted parts) with an FDA approved epoxy coating.

E. Strainers for screwed piping shall be Sarco Type IT (cast iron body) with optional bronze plug for steel piping or Sarco Type BT (cast bronze body) for copper piping; for flanged piping shall be Sarco Type CI-125 or F-125 and CI-250 or F-250 (cast iron bodies) as suitable for the pressures and temperatures encountered. Equivalent as manufactured by the following will be considered:

1. Grinnell.
2. Crane.
3. Lesley.
4. McAlear.
5. Keckley.
6. Mueller.
7. Nibco.

2.10 GAUGES AND GAUGE COCKS OR NEEDLE VALVES

A. Provide the following pressure gauge cock or needle valve connections:

1. At the suction and discharge of each water pump.
2. At the inlet and outlet of each heat exchanger, evaporator, and condenser.
3. At the inlet and outlet of pressure reducing stations.
4. At water balance stations and any other points indicated or detailed on diagrams on the Drawings.

B. Where gauge connections are installed in insulated lines, install gauge cocks or needle valves on a nipple of sufficient length that the gauge cock or needle valve handle will be free of the pipe insulation. Position each gauge cock in relation to surrounding piping and equipment so that the gauge may be easily read and so that a gauge having a 4-1/2" diameter dial can be screwed into and out of the piping nipple where the gauge cock or needle valve is installed. All gauge cocks shall be of the tee-handle type. Needle valves shall be a Weksler AV32, AV34, or BBV4.

C. Install gauge cocks or needle valves at pumps at the pump suction and discharge flange connections at the pre-drilled and tapped gauge connections as provided by pump manufacturer.

D. Furnish and install a pressure gauge suitably calibrated at each of the following locations:

1. The suction and discharge of each water pump.
2. The water line entering and leaving each heat exchanger, evaporator, and condenser.
3. At the inlet and outlet of each pressure reducing station.
4. At other points indicated on the Drawings.

E. Gauges shall be of the bourdon tube type, and shall be selected to operate at about the midpoint of their full range, i.e., for a 50 PSI operation, select a gauge of 0 to 100 psi. Accuracy shall be +/- 1%. Each gauge shall be provided with a brass lever handle union cock or brass handle needle valve. Cases shall be Phenol or Steel, not less than four and one-half inches (4-1/2") in diameter.

F. Pressure gauges shall be equal to Weksler "Regal" series Industrial gauges with an aluminum safety case with bottom or lower connection, phosphor bronze bourdon tube with brass socket and all 300 Series stainless steel movement, 4-1/2" white enameled aluminum dial with black graduations and numbers on a 270 degree arc, 1/4" male NPT thread size; and be equipped with a geared micrometer adjustment pointer (balanced). Provide each gauge with scale range suitable for the duty. Gauges shall be Weksler Model BA14 or equal.

G. Provide pulsation dampeners, adjustable snubbers, or piston type pressure snubbers in line with all pump gauges.

H. Cocks and gauges shall be manufactured by:

1. Weksler.
2. Trerice.
3. Weiss.
4. Miljoco.
5. Marsh.
6. Crosby.

2.11 THERMOMETERS AND THERMOMETER WELLS

A. Furnish and install brass or stainless steel closed separable thermometer wells for all thermometer and controller bulbs which are designed for liquid measurements. Whenever a thermometer or controller bulb is inserted in a pipe for either remote or local temperature indication or control, locate the thermometer well so that it will be completely surrounded by flowing fluid. Such thermometer locations as are shown on the Drawings are diagrammatic only. Install thermometer wells for maximum effectiveness and in the case of locally indicating instruments, for easy readability.

B. Supply each brass test well for use with the stem thermometers, a threaded brass plug and keeper chain. Install these test wells in the following locations such that they can be filled with oil to facilitate temperature measurements:

1. At the inlet and outlet of each heat exchanger, evaporator and condenser.
2. At the discharge of each modulating 3-way control valve.
3. At other locations as specified herein or shown on the Drawings.

C. Where thermometer wells are called for, furnish and install brass wells with the tip of the well extending into the water stream. The well shall have a plug attached to it with a short length of chain. The wells shall be installed in the vertical or at 45 degree angle up.

D. Thermometers shall be of the industrial type with red spirit filled liquid (no mercury allowed), bronze enameled aluminum cases, glass fronts, 9" scales, separable sockets; straight or angle pattern so selected that they can be read from the floor. Straight type equal to Weksler Type 105 and angle type equal to Weksler Type 115, Type 125, or Type 135, depending upon the angle and aspect. Furnish thermometers with 2-1/2" stem extensions where they are installed in insulated lines. Select scale ranges for maximum readability at the design temperature of the medium being measured.

E. Thermometers shall be installed in the following locations:

1. At the discharge of each pump or Blending Station valve.
2. At the inlet and outlet of each heat exchanger, evaporator and condenser.
3. At other locations as specified herein or shown on the Drawings.

F. In lieu of the industrial stem type thermometers 5" dial silicon filled bi-metal thermometers with vari-angle feature or “solar only” self powered digital thermometers (no batteries allowed) with sealed sensor technology, minimum 1/ 2" tall LCD digit size display, 1% accuracy, and variable angle stem assembly shall be allowed.

G. Thermometers and thermometer wells shall be as manufactured by:

1. Weksler.
2. Trerice.
3. Marsh.
4. Taylor.
5. Miljoco.
6. Weiss.

2.12 TEMPERATURE AND PRESSURE TEST PORTS

A. Temperature and Pressure Test Ports, or Pete’s plugs, shall be dual valve type with valve pocket between valves, retaining cap with gasket and cap "saver" connector.

B. These ports may be used at water coil connections in lieu of gauge cocks or needle valves and thermometer test wells.

C. Pete’s plugs shall have the pipe nipple extended to beyond the insulation thickness to make the plug fully accessible and a minimum of one inch (1") above the pipe insulation.

D. Ports shall be as manufactured by:

1. Pete.
2. Autoflow.
3. Flowset.

2.13 AUTOMATIC FLOW CONTROL VALVES

A. Valves shall be rated for up to 200 psi and 200 Deg.F.

B. Body shall be of wrought copper, brass or ductile iron construction with AISI Type 300 series passivated stainless steel parts, electroless nickel plated brass, and 17-7 PH spring.

C. Provide label on body to indicate flow rate, model number, PSID range and flow rate. Information shall be on minimum 3" x 3" aluminum tag.

D. Flow shall automatically be controlled within + 5% of rated flow.

E. Provide Y-Type strainers with blowdown valve upstream of all flow control valves made of bronze or cast iron with a bronze or cast iron cap rated for temperature and pressure same as valve. Screen shall be stainless steel with 0.055 inch diameter holes. Refer to Para.2.9, Strainers.

F. Provide brass P/T ports with extensions for insulated piping for each flow control valve.

G. Automatic flow control valves shall be as manufactured by:

1. Griswold Controls.
2. "Autoflow" by Flow Design, Inc.

H. It is the intent of this article to specify single devices which will be field piped per Schematics shown on the Drawings. Pre-piped assemblies of multiple piping accessories are not allowed, unless otherwise indicated elsewhere herein.

2.14 RELIEF VALVES

A. All closed water systems shall be protected with a relief valve. Valves shall be spring operated, all brass, and shall meet A.S.M.E. requirements for discharge capacities. Discharge lines shall be piped to the nearest floor drain.

B. Relief valves shall be as manufactured by Watts, Klipfel, McAlear, or McDonnell and Miller.

C. Provide atmospheric relief piping routed to the outdoors as required by local code for all steam and natural gas systems.

2.15 AIR VENTS

A. Provide and install air vents, air eliminators, where shown and at any high points or traps in water circulating lines where air might collect.

B. Each such air vent shall be installed with a valve at its inlet and shall discharge through an integral check valve. The waste lines from the discharge from air vents shall be collected and piped to the nearest floor drain in each case.

C. All automatic air vents shall have cast or ductile iron bodies with corrosion resistant bolts, Buna-N or EPDM seating materials to meet system pressure and temperature requirements, and all stainless steel internal control components.

D. Provide manual air vent cocks, or needle valve, for all water coils where not integral or supplied with coil by manufacturer.

E. Automatic air vents shall be rated for a maximum working pressure of 150 psig and 250 Deg.F.

F. Automatic air vents shall be as manufactured by:

1. Hoffman Model No. 792.
2. Armstrong Model No. AV.
3. Bell & Gossett Model No. 107A.
4. Or equivalent by Amtrol.

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 Threadolets; 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.

S. Valves required for control or isolation of any part of the various systems shall be provided and shall be located in approved or accessible positions or made accessible through removable panels, etc., and where several valves are related as to function, they shall be grouped in a battery. Request approval from Owner's Representative for proper location of all access panels required for valves, etc.

T. All automatic control valves shall be installed such that the valve stem is pointed upwards, vertical, and in no case shall it be mounted at less than a 45 degree angle from the vertical position unless specifically approved by the Engineer prior to installation. There will be no exception for chilled water type systems.

U. All shut-off and isolation valves shall generally be installed with valve stems pointed vertically upwards. In no case shall valve stems be pointed downwards or less than in a horizontal position. Chilled water system valve stems shall not point less than 45 degrees below vertical in any case.

V. Where new lines are indicated to connect into existing lines, careful coordination shall be exercised to determine exact elevations and locations of existing lines, to establish grades of interconnecting new lines, to establish procedures to interconnect lines, and to establish other details.

W. Pre-assembled water coil piping assemblies are not allowed unless specifically indicated otherwise elsewhere herein. The intent of these Specifications is to have individual piping valves and specialties field assembled per the Schematic Diagrams illustrated on the Drawings and to meet all other installation requirements indicated elsewhere herein.

3.2 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 EXCAVATION AND BACKFILLING

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

3.4 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.

3.5 PIPE INSULATION INSERTS AND SHIELDS

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

B. Refer to Section 23 07 00, Insulation.

3.6 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.

3.7 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. Domestic hot and cold water piping shall be tested at 1.5 times the operating pressure or 150 PSIG, whichever is greater, for six (6) hours. Any leaks developed shall be made tight and the test repeated. Test pressure shall not be applied to specialties, but joint shall be tested for leaks at operating pressure when complete.

F. Waste and vent piping shall be tested at completion of the rough work and before fixtures and traps are connected. Openings, except tops of bends, are to be plugged and the system completely filled with water. System shall stand without leak or loss of water for a period of not less than four (4) hours.

G. 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.

H. Partial systems shall be tested prior to connecting into existing lines.

I. 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.

J. Additional testing shall be as specified in the individual Sections of these Specifications.

K. 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.

3.8 SEALING PENETRATIONS

A. Seal all pipe and duct penetrations through walls run to structure, ceilings, floors and roofs. Fill the annular space between the insulation on the pipe, or the pipe only where uninsulated, or duct and its sleeve, with neoprene or non-hardening sealant.

B. No pipe or duct shall be allowed to contact its surrounding sleeve or the wall, floor, or ceiling. Effective isolation shall be provided as described in Section 23 05 48 to the end that no vibration or direct noise transmission shall be transmitted. Vibration transmission limits shall be as established in Section 23 05 48. Use special materials as may be required to comply.

C. Firestop pipe and duct floor and wall penetrations as specified in Section 23 05 00.

3.9 CONTROLS AND INSTRUMENTATION

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

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

B. Temperature control valves shall be furnished as specified in Section 23 09 00, and installed as a part of this Section of the Specifications.

C. Where pressure gauge cocks and pressure/temperature test ports are shown on the Drawings and allow for TAB firm verification additional devices are not required. It is not the intent to provide redundant test ports. However, where sensors are installed in thermowells or other mounting devices separate test ports are required such that sensors do not have to be removed to calibrate or test.

3.10 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 and 23 05 53.

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 21 33

HVAC WATER PIPING SOLIDS SEPARATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Comply with Division 1 - General Requirements and referenced documents.

B. Comply with all other Division 23 Sections as applicable. Refer to other Divisions for coordination of work with other portions of work.

1.2 SYSTEM DESCRIPTION

A. Install condenser water piping systems complete including connecting piping, flow and pressure regulating valves, solids separators, drains, related specialties, insulation, hangers and supports, and appurtenances as shown on the Drawings, as specified herein, and as specified in other Sections of these Specifications.

B. Provide water solids separators and closed liquid recovery systems to remove solids from the open water piping systems on a continual basis after the system is flushed, cleaned, and chemically treated for corrosion protection.

1.3 QUALITY ASSURANCE

A. All equipment and materials shall be new and of the best quality.

B. All equipment and materials shall be installed in a suitable manner by technicians experienced in the work described.

C. All piping flushing, cleaning, and chemical treatment work shall be performed by the piping system installer as specifically directed and supervised by trained and qualified representatives of the firm providing the chemicals and as specified elsewhere in other Sections of these Specifications before the solids separation system is opened to the respective piping system.

1.4 SUBMITTALS

A. Product Data: Submit complete manufacturer's descriptive literature for each item specified herein, cut sheets for each size and type of solids separator and closed liquid recovery system, and instructions for installation, operation, and maintenance of these components.

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.

PART 2 - PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Refer to Section 23 21 13, Hydronic Piping.

B. All piping shall be Schedule 40 black steel, or may be Type "L" hard drawn copper with wrought fittings using 95-5 or 15% solder. Use dielectric unions where connected to dissimilar materials.

C. All piping and isolation valves of every kind required for the application of the solids separation system shall be furnished and installed by the piping system installer. Refer to Specification Section 23 21 13.

2.2 SIDE STREAM LIQUID SOLIDS SEPARATORS

A. Provide centrifugal-action vortex liquid solids separators for each closed water system as indicated on the Drawings.

B. After a single pass through of the liquid handled, each separator, given solids with a specific gravity of 2.6 and water at 1.0, shall remove 98% of solids 74 microns and larger. Additionally, particles finer in size, heavier by specific gravity, and some lighter by specific gravity will also be removed, resulting in an appreciable aggregate removal of particles by up to 75% of solids down to 5 microns in size. In each circulating system, 98% removal of solids shall be predictable to as fine as 40 microns (given solids with a specific gravity of 2.6), with correspondingly higher aggregate performance percentages of up to 90% of solids to as fine as 5 microns. Provide test data information to verify this level of performance.

C. Separators shall have tangential inlets and mutually tangential internal accelerating slots to promote the proper velocity necessary for the removal of separable solids. The internal accelerating slots shall be spiral-cut for optimum flow transfer, laminar action, and particle influence into the separation barrel. This process shall occur without wear to the accelerating slots.

D. Separated particle matter shall spiral downward along the perimeter of the inner separation barrel, in a manner which does not promote wear of the separation barrel, and into the solids collection chamber, located below the vortex deflector plate.

E. To insure maximum particle removal characteristics, the separator shall incorporate a vortex-induced pressure relief line (Vortube), drawing specific pressure and fluid from the separator's solids collection chamber via the outlet flow's vortex, venturi effect, sending solids into the collection chamber without requiring a continuous underflow or excessive system fluid loss.

F. System fluid shall exit the separator by following the center vortex in the separation barrel and spiral upward to the separator outlet.

G. Evacuation of separated solids shall be accomplished automatically, employing a dedicated solid-state controller mounted in a NEMA 4 housing, suitable for 120 volt, single phase power. Programming options shall include a purge frequency range of every 60 seconds to every 23 hours, 59 minutes. Purge duration shall range from 10 seconds to 59 minutes, 59 seconds. Controller shall have a non-volatile memory and meet all CSA requirements. Controller shall automatically operate in one of the following methods:

1. Motorized Ball Valve: An electrically actuated valve shall be programmed at appropriate intervals and duration in order to efficiently and regularly purge solids from the separator's collection chamber. Valve both shall be bronze. Valve ball shall be stainless steel with teflon seat.
2. Pneumatic Ball Valve: A fail-safe valve shall be programmed at appropriate intervals and duration in order to efficiently and regularly purge solids from the separator's collection chamber. A spring return control shall provide that the full-ported ball valve closes in the event that compressed air or electricity is interrupted. Valve body shall be bronze. Valve ball shall be stainless steel with teflon seat.
3. Solids Recovery Vessel: Separated solids shall be continuously purged under controlled flow into a vessel equipped with one (or three, depending on the model specified) 25 micron fiberfelt solids collection bag. Solids collection capacity shall be 360 cubic inches. If a larger vessel is specified, the collection capacity shall be 1080 cubic inches. Excess liquid shall pass through the bag and return to system flow, via, the separator's integral Vortube, eliminating any need for piping return flow to the system's pump suction line.
4. Provide optional Indicator Package which shall also include manual isolation valves for use when servicing the collection bag; sightglass for verification of flow through the vessel; annunciator for indicating when the collection bag needs cleaning/replacement; flow control orifice to minimize fluid volume/velocity through the vessel and collector bag; clamps, tubing, and specialty piping for completing the system assembly.

H. Each separator and respective accessories shall be packaged as a complete system, with all components supplied from a single source. In addition to the equipment already specified, the system shall also include pressure gauges with petcock valves for both the inlet and outlet of the separator and an isolation valve at the purge outlet for servicing of the automatic valve, as necessary, without interrupting system flow. A connection spool shall also be included for installation on the separator's outlet to properly facilitate the separator's internal access feature.

I. Inlet and outlet connections shall be threaded, flanged, or grooved in the sizes scheduled or as shown on the Drawings. Purge outlets shall be threaded with screw-on flange connections. Each separator shall operate within a flow range as scheduled or as shown on the Drawings. Pressure loss of each component shall range between 3-12 psi, remaining constant, varying only when the flow rate changes. Maximum pressure drop at design flow shall not exceed that scheduled.

J. Separators shall feature the following access capabilities for either inspection or the removal of unusual solids/debris:

1. An upper-chamber full-size grooved coupling (flange for HTX-3500 and larger), allowing complete access to the inlet chamber, acceleration slots, and internal separation barrel.
2. A hand hole port at the collection chamber (Model HTX-0285 and larger only).
3. A 1/2 inch inspection/drain, located at the lowest point of the upper chamber.

K. Each separator shall be constructed of A-36, A53B, or equivalent, quality carbon steel, with a minimum thickness of 0.25 inches. Maximum operating pressure shall be 150 psi, unless specified otherwise. Separators shall have a protective coating of acrylic urethane or epoxy, sprayed on at the factory

L. Separators shall be constructed in accordance with the standards of the American Society of Mechanical Engineers (ASME), Section VIII, Division 1 for pressure vessels. Certification shall be confirmed with a registered "U-stamp" on the body of the separator.

M. Separators shall be as manufactured by LAKOS Filtration Systems, a division of Claude Laval Corporation, Puroflex Corporation, or Griswold.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping system Installer shall lay condenser water piping on an even slope throughout to insure freedom from air locks and traps. Grade each system downward to low points. At each such low point provide a service drain, discharging above a floor drain, where reasonably practical, to permit the complete drainage of the system. Where it is

impractical to route such drain to a floor drain, hub drain, or janitor sink, then provide a valve with hose connection with brass cap and label as "Drain". Such drains, where not routed to a floor or similar drain, shall only be allowed where approved by the Owner's Representative, or where indicated on the Drawings.

B. Automatic air vents shall be provided at all high points in the piping system and where air might collect in piping systems on a recurring basis. Each automatic vent shall have a valve at its inlet, a valved bypass and discharge line to the nearest floor drain or janitor sink. At all other locations in the piping system where air might collect and need purging on system fill, and where deemed necessary by the Test and Balance Firm, provide a manual valve or pet cock, with removable cap, for manual venting.

C. Piping system Installer shall provide drains from each pump base, air separator, backflow preventors, compression tanks, and other system components with drain connections to the nearest floor drain in each case. Provide any other drain lines indicated on the Drawings in conjunction with the water circulating system or specified elsewhere herein.

D. Piping system Installer shall install valves where required to segregate individual items of equipment or sections of the piping systems as required for project phasing, partial system pressure testing, for temporary bypasses and where indicated on the Drawings.

3.2 SIDE STREAM LIQUID SOLIDS SEPARATORS

A. Install all Liquid Solids Separators in full accordance with the manufacturer’s Installation Instructions.

B. Mount solids separators and closed loop solids recovery vessels on walls or on housekeeping pads as shown on the Drawings. Suitably, rigidly, fasten in each case.

C. After systems are fully piped, pressure test system similar to piping system. Once any discovered leaks are suitably repaired, insulate piping, valves, separators, and solids recovery vessels same as required for the piping system. Refer to Specification Section 23 07 00.

D. Keep separation system isolated from system flow until the system has been fully flushed, cleaned, and chemically treated as specified.

E. Once the aforementioned has been completed, then open the separation system to system flow. Bleed off air as required. Adjust and balance flow through the separator and closed liquid solids recovery vessel to meet design flow rates.

F. Verify proper power supply to and wiring of Automatic Purge System. Adjust purge cycle frequency and duration of purge at controller. Verify that activation of audible alarm occurs when excess differential pressure, above set point, exists at the closed liquid solids recovery vessel (indicates when filter bag needs to be cleaned or replaced). Verify correct operation of this system.

END OF SECTION

SECTION 23 25 13

HVAC WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Comply with Division 1 - General Requirements and referenced documents.

B. Comply with all other Division 23 Sections as applicable. Refer to other Divisions for coordination of work with other portions of work.

1.2 SYSTEM DESCRIPTION

A. Install closed chilled and heating water piping systems complete including water distribution lines, compression tanks, pumps, strainers, air control fittings, flow and pressure regulating valves, relief valves, specialties, insulation, hangers and supports, and appurtenances as shown on the Drawings, as specified herein, and as specified in other Sections of these Specifications.

B. Provide water treatment equipment, chemicals and treatment testing services to treat the closed water piping systems to be cleaned, flushed, and chemically inhibited from corrosion.

1.3 QUALITY ASSURANCE

A. All equipment and materials shall be new and of the best quality.

B. All equipment and materials shall be installed in a suitable manner by technicians experienced in the work described.

C. All piping cleaning, flushing, and chemical treatment work shall be performed by the piping system installer as specifically directed and supervised by trained and qualified representatives of the firm providing the chemicals and as specified elsewhere herein.

D. Chemical treatment companies providing chemicals, supervision, cleaning, and flushing instructions and chemical testing and adjustment services shall have a minimum of ten (10) years experience in the local area, located within a 25 mile radius of the project site, in the performance of these services for projects of this size and type. Acceptable firm shall be Worth Hydrochem, contact Chad Naizer at 682-518-6200.

1.4 SUBMITTALS

A. Product Data: Submit complete manufacturer's descriptive literature for each item specified herein, instructions for water piping flushing and cleaning, and chemical treatment procedures.

B. Include Material Safety Data Sheets on all chemicals to be used.

C. Shop Drawings: Submit in accordance with Section 23 05 00.

1.5 PRODUCT HANDLING

A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall be rejected.

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

PART 2 - PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Refer to Section 23 21 13, Hydronic Piping.

B. All chemical treatment, make-up water and expansion piping shall be Type "L" hard drawn copper with wrought fittings using 95-5 solder. Use dielectric unions where connected to dissimilar materials.

C. All piping and isolation valves of every kind required for application of the chemical treatment system shall be furnished and installed by the piping system installer. Refer to Specification Section 23 21 13.

2.2 VERTICAL PRESSURIZED BLADDER TANKS (EXISTING TO BE RE-USED)

A. Vertical pressurized bladder type compression tanks for chilled and heating water piping systems shall be furnished and installed in the sizes and where indicated on the Drawings.

B. Tanks shall be made of carbon steel with ASME Boiler and Pressure Vessel Code Section VIII, Division 1 stamp, rated for a minimum 240 Deg.F. design temperature and 125 PSIG design pressure.

C. Bladder shall be made of a heavy duty butyl rubber or full volume flexible elastomer, and shall be replaceable. Bladder material shall be suitable for use in glycol systems.

D. Each tank shall be primed and painted.

E. Provide each tank with floor support ring base, lifting rings, 3/4" drain tapping, air charger valve assembly, and 1", 40 gallon or smaller tanks, or 1-1/2", over 40 gallon tank capacity system connection.

F. Acceptable Manufacturers shall be:

1. Bell and Gossett Type Series "B" Pressurized Vertical Tank,
2. TACO,
3. AMTROL,
4. Or the John Wood Company.

2.3 IN-LINE AIR SEPARATORS

A. In-line type centrifugal air separators shall be furnished for each of the chilled and heating water systems where indicated on the Drawings.

B. Separators shall be line size as a minimum and have 150 pound ANSI Standard flanged connections on the inlet and outlet connections on sizes 2-1/2" and larger, NPT on sizes 2" and smaller. Separators shall be sized as follows:

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

C. Separators shall have internal stainless steel air collector tubes to direct air to the top of the separator which shall include a NPT vent, air release connection; minimum size of 1-1/4".

D. Provide a NPT blow down connection at the base of each separator to facilitate blow down of debris from within the separator; minimum size of one inch (1").

E. Tanks shall be primed and painted carbon steel same as compression or pressurized bladder tanks.

F. Air separators shall be designed, constructed, and stamped for a minimum 125 PSIG design pressure at 350 Deg.F., design temperature, in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

G. Maximum pressure drop of each separator shall not exceed 2.0 feet of water and the air elimination rate shall be a minimum of 50% on one pass. Submit data to verify compliance with all requirements specified herein.

H. Acceptable Manufacturers shall be:

1. Bell & Gossett Rolairtrol Model RL (No Strainer),
2. TACO,
3. The John Wood Company, or
4. American Wheatley.

2.4 PRESSURE REDUCING VALVES (EXISTING TO BE RE-USED)

A. Pressure reducing valves shall be furnished at the make-up water connection to each of the chilled and heating water systems where indicated on the Drawings.

B. Valves shall have an adjustable range of 10 to 25 PSIG. TAB Agency to determine final setting.

C. Valve size shall be a minimum of 3/4" in size.

D. Valves shall have a brass body, low inlet pressure check valve, and integral strainer, which must be removable without system shut down.

E. Acceptable Manufacturers:

1. Bell and Gossett,
2. TACO.
3. American Wheatley.

2.5 PRESSURE RELIEF VALVES

A. Furnish and install individual pressure relief valves at the make-up water connections for each of the chilled and heating water systems where indicated on the Drawings. Combination valves are not acceptable.

B. Valves shall have brass bodies with brass internal parts designed for a maximum operating pressure of 125 PSIG, at a maximum operating temperature of 225 Deg.F.

C. Valves shall be equipped with an EPDM diaphragm to assure positive operation of the valve and to protect non-wetted parts from system fluid.

D. Valves shall be minimum one-half inch (1/2") in size, and have a relief pressure setting of 30 PSIG.

2.6 CHEMICAL SHOT (BYPASS-FILTER) FEEDERS (EXISTING TO BE RE-USED)

A. Provide and install one shot type chemical feeders for each of the chilled and heating water systems where indicated on the Drawings.

B. Feeders shall be complete with wide mouth (minimum 3-1/2 inch) secured cap, inlet and outlet taps, and drain tapping, as detailed on the Drawings. Provide a dome shaped top and bottom on all feeders.

C. Shot feeders shall have a minimum five (5) gallon capacity, and be made of cast iron or carbon steel with a 200 PSIG rating at 200 Deg.F. Body shall be painted with an enamel finish.

D. Feeders shall include accommodations for the insertion of filter bags. Provide one (1) initial set of filter bags for each feeder and five (5) additional replacement filter bags per feeder. Filters shall be rated for 25 microns.

E. Feeders and filter bags shall be furnished by the chemical treatment services firm and installed by the piping system installer

F. Acceptable Manufacturers shall be:

1. Garratt-Callahan,
2. Nalco,
3. J. L. Wingert Co.,
4. or Neptune.

2.7 AIR VENTS

A. Refer to Section 23 21 13, Hydronic Piping.

B. All air vent purging systems shall be furnished and installed by the piping system installer.

2.8 WATER TREATMENT CHEMICALS

A. Once the water system is filled, circulated, flushed, and cleaned, provide sufficient chemicals for treatment up to the period of Substantial Completion.

B. All closed chilled water systems in the Central Plant shall be chemically cleaned with an alkaline, phosphate formulation, containing dispersants, iron sequestrants, and surface- active materials that remove excess oil, lift solids from metal surfaces and suspend solid particles, and then be thoroughly flushed. After flushing is complete, closed system shall be treated with a liquid nitrite-borate and/or silicate corrosion inhibitor based formulation, with 600-800 Parts Per Million (PPM) nitrite levels in the chilled

water systems. For systems with high make-up water flow rates use a molybdate/silicate blend of chemicals and maintain a molybdenum residual range of 48-60 PPM. In lieu of these chemicals the use of Chemsearch 777 shall be allowed.

C. All flushing and cleaning and feeder filter bag replacement work shall be performed by the piping system installer at the direction of the chemical treatment firm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping system Installer shall lay chilled water piping on an even slope throughout to insure freedom from air locks and traps. Grade each system downward to low points. At each such low point provide a service drain, discharging above a floor drain, where reasonably practical, to permit the complete drainage of the system. Where it is impractical to route such drain to a floor drain, hub drain, or janitor sink, then provide a valve with hose connection with brass cap and label as "Drain". Such drains, where not routed to a floor or similar drain, shall only be allowed where approved by the Owner's Representative, or where indicated on the Drawings.

B. Automatic air vents shall be provided at all high points in the piping system and where air might collect in closed water systems on a recurring basis. Each automatic vent shall have a valve at its inlet, a valved bypass and discharge line to the nearest floor drain or janitor sink. At all other locations in the piping system where air might collect and need purging on system fill, and where deemed necessary by the Test and Balance Firm, provide a manual valve or pet cock, with removable cap, for manual venting.

C. Piping system Installer shall provide drains from each pump base, air separator, backflow preventors, compression tanks, and other system components with drain connections to the nearest floor drain in each case. Provide any other drain lines indicated on the Drawings in conjunction with the water circulating system or specified elsewhere herein.

D. Piping system Installer shall install valves where required to segregate individual items of equipment or sections of the piping systems as required for project phasing, partial system pressure testing, for temporary bypasses and where indicated on the Drawings.

3.2 FLUSHING, CLEANING, AND CHEMICAL TREATMENT

A. The chilled water systems, existing and new, in the Central Plant ONLY shall be flushed and pre-cleaned after successful completion of pressure tests and all leaks discovered are repaired.

B. Contractor shall isolate the central plant at the plant isolation valves and shall provide temporary bypass tee fittings with temporary plastic piping, where needed, if bypass leg of primary/secondary pumping system cannot be utilized for bypass.

C. System flushing shall encompass filling the entire system with water, purging all air from the system at high points of the piping and at equipment; and, then, circulating water throughout the central plant piping system with all isolation and control valves open to full flow through their respective coils and equipment. Operate multiple system pumps, primary and secondary, as required, to insure water flow throughout the plant. Once water has been circulated for a minimum of 24 hours, the piping system installer shall, starting at the most remote location of the system, quickly open and close coil and equipment drain and strainer blow-down valves, to flush all silt, dirt, sediment, scale, grease, solder, debris, weld slag, and foreign material out of the main and run-out piping, coils, and equipment. Once all such system valves are blown-down, the central plant system water shall be completely drained at each item of equipment and low point drains.

D. Once the system is flushed, refill with fresh water, and purge of air; same as the procedure utilized before initial flushing, as described above. Then, add the specified solution of alkaline, or approved equal, pipe cleaner as provided by the Chemical Treatment Supplier, to be submitted for review for equivalency (to include detailed written cleaning and flushing instructions). This solution shall be circulated in each system for a minimum of 72 hours. During this 72 hour period flush the system by opening and closing each blow down and low point drain valves in the entire system to be cleaned for at least three (3) minutes once every eight (8) hours but not less than eight (8) times total. Following cleaning the system, crack open the blow-down valve at the circulating pump strainer to gradually bleed off the cleaning solution at a rate of approximately 1 gallon per minute which should not exceed the make-up rate while providing make-up water to the system and keeping the system air free. Continue to bleed off the cleaning solution until the discharged water alkalinity, at a remote point in the system, is approximately equal to that of the make-up water. Iron content should be less than 0.1 parts per million (ppm) and total dissolved solids should be within 10% of the make-up water. Testing for these levels shall be performed by the Chemical Treatment Service firm. Additional flushing may be required by the piping system installer should these levels not be accomplished. All strainer screens at pumps and water coils, existing and new, shall be removed and cleaned at completion of this flushing and cleaning process.

E. After system cleaning and flushing is complete, the Chemical Treatment Company shall provide and apply an initial system treatment of corrosion inhibiting chemicals as specified herein, for all closed chilled and heating water systems, existing and new,

consistent with system operating temperature and piping materials installed based on local water analysis.

F. During the construction period after initial system treatment, up until "Substantial Completion", the Chemical Treatment Company shall provide a continuing water treatment service to include a monthly system analysis and addition of chemicals, as required, to maintain adequate protective treatment concentrations. Log all analysis and chemical additions, during this period.

G. The Chemical Treatment Company shall provide a two (2) hour training session on operation and maintenance to Owner’s maintenance personnel beyond normal system start-up.

H. All chilled water system chemicals shall be compatible with the existing system treatment as the new system is an extension of an existing Central Plant System and will be directly connected to the same. Field verify compatibility.

I. Piping System Installer shall physically remove and clean all system pump and water coil strainer screens from their bodies at the completion of system flushing and cleaning. Reinstall screens in strainer bodies. Opening and closing of blow-off, drain and blow down connections is not a satisfactory substitute for this requirement. All are required.

J. Once all flushing and cleaning of the plant is done, the system shall be re-opened to the main building water piping system.

3.3 AIR SEPARATORS

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

END OF SECTION

SECTION 23 25 16

WATER TREATMENT FOR OPEN HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Comply with Division 1 - General Requirements and referenced documents.

B. Comply with all other Division 23 Sections as applicable. Refer to other Divisions for coordination of work with other trades as required.

1.2 SYSTEM DESCRIPTION

A. Provide and install open condenser water systems complete including water distribution lines, pumps, strainers, piping specialties, flow and pressure regulating valves, all related equipment, hangers and supports, and appurtenances as shown on the Drawings, as specified herein, and as specified in other Sections of these Specifications.

B. Include a thorough system flushing and cleaning to include the installation of a fully automatic condenser water treatment system with related technical services as specified herein.

C. Coordinate the installation of all chemical treatment controllers, piping, valves, meters, and electrical power supply and control wiring. Re-use existing where deemed acceptable by chemical treatment provider.

1.3 QUALITY ASSURANCE

A. All equipment and materials shall be new and of the best quality.

B. All equipment and materials shall be installed in a suitable and workmanlike manner by technicians experienced in the work described.

C. All piping cleaning, flushing, and chemical treatment work shall be performed by the piping system installer as specifically directed and supervised by trained and qualified representatives of the firm providing the chemicals and as specified elsewhere herein.

D. Chemical treatment companies providing chemicals, supervision, cleaning, and flushing instructions and chemical testing and adjustment services shall have a minimum of ten(10) years experience in the local area, located within a 25 mile radius of the project site, in the performance of these services for projects of this size and type. Acceptable firm shall be Worth Hydrochem, contact Chad Naizer at 682-518-6200.
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1.4 SUBMITTALS

A. Product Data: Submit complete manufacturer's descriptive literature for each item specified herein, installation instructions for water pipe flushing and cleaning, chemical treatment procedure and recommended treatment levels for each type of chemical treatment product.

B. Include Material Safety Data Sheets (MSDS) on all chemicals to be used.

C. Shop Drawings: Submit in accordance with Section 23 05 00.

1.5 PRODUCT HANDLING

A. Cover and protect material in transit and at site. Material not properly protected and stored and which is damaged or defaced during construction shall be rejected and shall be replaced at no cost to the Owner.

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

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Refer to Section 23 21 13, Hydronic Piping.

B. All chemical treatment, make-up water, blow-down and similar piping shall be Type "L" hard drawn copper with wrought fittings using 95-5 solder unless indicates otherwise.

C. All piping and isolation valves, blow down valves, make-up water meters, chemical injection tees and other chemical treatment system piping, drains and accessories specified herein shall be installed by the piping system installer under Specification Section 23 21 13.

2.2 CHEMICAL WATER TREATMENT - CONDENSER WATER SYSTEMS

A. Furnish and install a complete automatic condenser water treatment system complete with controls, pumps, piping, chemicals, specialties, hangers and supports, and appurtenances.

B. Water treatment system and program shall be as specified herein with chemicals, service and equipment supplied by a single water treatment company to be fully compatible with the piping system in which installed and accessory components as specified elsewhere herein.

C. Water treatment chemical and service supplier shall be a recognized specialist who shall have been active in the field of commercial and industrial water treatment for at least ten (10) years, whose major business is in the field of water treatment, and shall have regional water analysis laboratories, development facilities and local service department, plus full-time service personnel located within a 25 mile radius of the job site.

D. Furnish supply of the recommended formula for control of scale and corrosion in the open recirculating system to include the furnishing of two separate formulas for prevention of microbiological growths in the same system. The supply of the recommended formulas for scale, microbiological and corrosion protection for the open condenser water system shall commence once the water system is filled, circulated, flushed and cleaned, up to the period of Substantial Completion.

E. All Chemical Formulations shall not contain any ingredients which are harmful to system materials of construction, and shall meet existing environmental standards at the time of bid submission. The chemical formulations for scale and corrosion control shall be furnished in liquid form for direct feed from shipping container to the cooling system. Biocide products recommended shall be properly registered with the Environmental Protection Agency and EPA registration number shall be clearly shown on all product literature and drum labels.

F. Water treatment chemical and service supplier shall re-use existing chemical treatment drums currently existing in the central plant for the condenser water system. Water treatment chemical and service supplier shall furnish basic water test equipment., ,

G. Water treatment chemical and service supplier shall provide a Water Treatment Management and Service Program through substantial completion of the project. After this time, the current chemical maintenance contract currently in place for the facility shall be in effect. These services shall include:

1. Initial and on-going on-site water analysis and recommendations.
2. Installation and system start-up assistance and recommendations to include written instructions to contractor on proper flushing and cleaning procedures.
3. Training of Contractor and Owner designated operating personnel.
4. Monthly field service and consultation.
5. All work shall be performed by a qualified full-time local representative.
6. Preparation of customer report charts and log sheets at no additional charge.
7. Laboratory and technical assistance.
8. Furnish appropriate plumbing and wiring schematics for the overall treatment system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping System Installer shall lay condenser water lines on an even slope throughout to insure freedom from air locks and traps. Grade each system downward to low points. At each such low point provide a service drain with valve, discharging to above a floor drain, where reasonable practical, to permit the complete drainage of the system.

B. Where it is impractical to route such drain to a floor drain, hub drain, or janitor sink, then provide a valve with hose connection with brass cap and label as "Drain". Such drains, where not routed to a floor or similar drain, shall only be allowed where approved by the Owner's Representative, or where indicated on the Drawings. Where a drain is remote from the low point drain valve, then provide a valve and cap or plug.

C. Piping System Installer shall provide automatic air vents at all high points and all other places where air is trapped and might collect. Each automatic vent shall have a valve at its inlet, a valved bypass and discharge line to the nearest floor drain or janitor sink. At all other locations in the piping system where air might collect and need purging on system fill, and where deemed necessary by the Test and Balance Firm, provide a manual valve or pet cock, with removable cap, for manual venting.

D. Piping System Installer shall provide drains from each pump base, backflow preventers or other system components having a drain connection to the nearest floor drain in each case. Provide any other drain lines indicated on the Drawings in conjunction with the water circulating system or specified elsewhere herein.

E. Piping System Installer shall install valves where required to segregate individual items of equipment or sections of the piping systems, as required for project phasing, partial system pressure testing, for temporary bypasses and where indicated on the Drawings.

F. Piping System Installer shall provide valving and bypass piping.

3.2 CLEANING

A. The condenser water systems, existing and new, shall be pre-cleaned after successful completion of pressure tests, all leaks discovered are repaired, with the specified solution as provided by the Chemical Treatment Supplier, to be submitted for review for equivalency, to include written cleaning and flushing instructions. Prior to adding cleaner, flush the entire piping system and components by filling the system, circulating the water in the system for a minimum of 24 hours, and then completely draining the system using all low point drains. Refill the system, remove all air and then add the cleaning solution and circulate for a minimum of 48 hours. Completely flush system after circulation until free of all scale, grease, and other foreign material and the

discharged water alkalinity, at a remote point in the system, is approximately equal to that of the make-up water. Iron content should be less than 0.1 parts per million (ppm) and total dissolved solids should be within 10% of the make-up water. Testing for these levels shall be performed by the Chemical Treatment Service firm. Additional flushing may be required by the piping system installer should these levels not be accomplished. All condenser water piping strainer screens at pumps and all others in the system shall be removed and cleaned at completion of this flushing and cleaning process.

B. System cleaning and flushing shall encompass circulating water with cleaner throughout the entire piping system with all isolation and control valves open to full flow through their respective heat exchangers and equipment. Once the cleaning solution has been circulated for a minimum of 48 hours, the piping system installer shall, starting at the most remote location of the system, quickly open and close heat exchanger and equipment drain valves, to flush silt, dirt, sediment, debris, weld slag, and solder out of the run-out piping and equipment. Once all such system valves are blown-down, the system water shall be gradually bled off at the respective circulating pump strainer blow-off valves with equal make-up water while maintaining a full air free system.

C. After system cleaning and flushing is complete, provide and apply an initial system treatment of corrosion inhibiting chemicals and two (2) types of biocides as specified, for all open systems, existing and new, consistent with system materials based on local water analysis. Set up automatic chemical injection system to maintain specified treatment levels consistent with the intent of these specifications as well as per the recommendations of the Water Treatment Service providers written instructions.

D. During the construction period after initial system treatment, up until "Substantial Completion", provide a continuing water treatment service to include a monthly system analysis and addition of chemicals, as required, to maintain adequate protective treatment concentrations. Log all analysis and chemical addition on a monthly basis, during this period.

E. Provide a four (4) hour training session on operation, maintenance and safety procedures to Owner's maintenance personnel beyond normal system start-up to include instruction of the use and adjustment of the digital chemical treatment feed controller.

F. All condenser water system chemicals shall be compatible with the existing system treatment as the new system is an extension of an existing Central Plant System and will be directly connected to the same. Field verify compatibility.

G. Physically remove and clean all new pump and other strainer screens installed in the system from their bodies at the completion of system flushing and cleaning. Reinstall screens in strainer bodies. Opening and closing of blow-off, drain and blow down connections is not satisfactory.

END OF SECTION

SECTION 23 64 16

CENTRIFUGAL WATER CHILLERS

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 trades as required.

1.2 SCOPE

A. Furnish each hermetic or open drive microprocessor controlled centrifugal water chilling unit together with all required controls, factory unit mounted starter, pump-out unit, accessories, insulation, supports, and appurtenances as indicated herein.

B. Each chiller shall be purchased and installed by the Contractor who shall install chiller and all field installed accessories and make connection to all components, as necessary to make a complete and operational system.

C. Provide one (1) year maintenance service for the one-year warranty period and factory authorized representative start-up service. Under Alternate No. 2, Provide an additional four 4 year warranty on the compressor after the one (1) year guarantee has expired. The first year of Warranty shall include all parts and labor.

1.3 QUALITY ASSURANCE

A. All equipment and materials shall be new and of the highest quality.

B. Equipment shall be rated in accordance with the latest edition of Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standard 550.

C. Equipment and installation shall be in compliance with the latest edition of the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE Standard 15.

D. Cooler and Condenser shall include ASME "U" stamps and name plates certifying compliance with the ASME Code for Unfired Pressure Vessels, Section VIII, Division 1 when the total water side of all tubes and water boxes per vessel, contains 120 gallons, or more.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's descriptive literature and installation instructions indicating capacities at the conditions scheduled and all accessories furnished.

B. Include in submittal all dimensional data, operating weight, connection points, wiring diagrams, and other pertinent performance data. Submit performance data indicating energy input versus cooling load output from 15% to 100% of full load with constant entering condenser water temperature.

C. Shop Drawings: Submit in accordance with Section 23 05 00 and 01 30 00.

1.5 PRODUCT HANDLING

A. Cover and protect material in transit and at site. Store and handle in full accordance with the manufacturer's instructions. Material not properly protected and stored and which is damaged or defaced during delivery or storage shall be rejected and replaced at no cost.

B. Units shall be shipped with all refrigerant piping and control wiring factory installed.

C. Units shall be shipped with metal name plate firmly attached to the unit indicating the manufacturer, model number, compressor type, and refrigerant used, including quantity of refrigerant charge.

D. Storage and protection of materials shall be in accordance with Division 1.

PART 2 - PRODUCTS

2.1 WATER CHILLERS

A. Water chilling units shall be completely factory assembled and manufactured to have the characteristics specified herein. Each unit shall have the capacity scheduled and shall be rated to handle the listed water quantities without excessive pressure drops and without exceeding the manufacturer's rating on water velocities through the tubes.

B. Ratings shall be with a 0.0001 fouling factor on the water side of the cooler and 0.00025 fouling factor on the water side of condenser tubes. The KW power draw shall not exceed the scheduled KW per ton of cooling capacity at full load with either R-514A or R-513A refrigerants. Chiller performance shall be rated in accordance with the latest edition of AHRI Standard 550.

C. Machine shall consist of motor-compressor assembly, cooler, condenser, refrigerant transfer unit, lubrication system, microprocessor control system, and all controls necessary for automatic machine operation. Initial operating charges of refrigerant and lubricating oil shall be furnished for field installation. The unit shall also be furnished

with other standard components such as transfer unit, purge unit, etc., to suit the particular unit and field installation conditions. All appurtenances shall be factory installed, wired, piped, and insulated, unless specifically indicated otherwise herein.

D. Structural steel shipping skids shall be furnished with the machine to facilitate transfer of machine from transporting conveyance to job site and to provide the most effective lifetime support for the machine. Chiller shall be installed on a structural steel base providing a level foundation. Include vibration eliminators where and as recommended and provided by the manufacturer, to include, as a minimum, elastomeric pads made of resilient cross-ribbed neoprene with steel support plates placed at each support point. Additionally, provide sole plates, leveling pads, and jacking screws under the support plates and isolation pads.

E. The unit shall be factory insulated on all cold surfaces and on adjacent surfaces as required to prevent any sweating. Use 1-1/2-inch-thick, or two layers of 3/4 inch thick, Armaflex II, paint to be all one (1) color to match unit color. Thermal conductivity shall not exceed 0.28 BTU-inch/hour-square feet-Deg.F. Contractor may field apply a second layer of insulation to comply with this requirement, however, the unit shall be initially insulated with a minimum of 3/4 inch thick insulation. Evaporator water boxes may be field insulated.

F. VARIABLE SPEED DRIVE (VSD)

1. The centrifugal water chiller shall be furnished with a liquid cooled variable speed drive (VSD) as shown on the drawings. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
2. The VSD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VSD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future.
3. The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96.
4. The VSD shall be solid state, microprocessor based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBT transistors.
5. Power semi-conductor and capacitor cooling shall be from a liquid cooled heatsink.
6. The centrifugal water chiller shall be furnished with a refrigerant cooled variable speed drive (VSD) to minimize maintenance and maximize cooling efficiency. If a water cooling design is used, especially an open loop condenser water design, a cleanable shell and tube heat exchanger must be supplied. Plate and frame heat exchangers are not allowed. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.

7. The VSDs shall each be furnished in a NEMA 1 metal enclosure having as minimum a short circuit withstand rating of 65,000 amps per UL 508. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
    a. Enclosure shall include a lockable, door-mounted circuit breaker with shunt trip and AIC rating of 65,000 amps.
    b. The entire chiller package shall be UL/CUL listed.
8. The VSD shall be tested to ANSI/UL Standard 508 and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.
9. Compliance to recommendations stated in IEEE 519-1992.
    a. The VSD design shall include a harmonic attenuation device to limit the total demand distortion (TDD) in current at the VSD to less than or equal to 5 % as measured at the VSD input. If optional unit or remote harmonic devices are used to meet the less than or equal to 5% TDD, then the losses associated with these devices shall be included in the AHRI certified chiller selection. The chiller manufacturer must account for all electrical losses in the Kw and NPLV values submitted.
    b. Factory verification of performance and harmonics: If optional unit or remote harmonic attenuation devices are used to meet the less than 5% TDD requirement, the devices must be tested in the factory with the chiller and unit mounted VSD. In addition the less than or equal to 5% TDD must be demonstrated and chiller mounted meters or displays are NOT allowed. The distortion assessment and verification must be conducted by technicians using specific power quality instrumentation. If the chiller VSD-harmonic device fails to meet the 5% TDD level, the manufacturer shall rework the drive-harmonic device and re-test at their expense. If the VSD-harmonic device continues to fail, the manufacturer shall pay a penalty of $ 22,000.00. In addition the manufacturer shall be responsible for costs incurred on the job to obtain the additional harmonic attenuation to meet the less than or equal to 5% TDD level.
10. Input shall be nominal 480 volts, three phase, 60 hertz AC power, ± 10 percent of nominal voltage.
11. Line frequency 38-60 hertz.
12. The VSD shall include the following features:
    a. All control circuit voltages are physically and electrically isolated from power circuit voltage.
    b. 150% instantaneous torque available for improved surge control.
    c. Soft start, adjustable linear acceleration, coast-to-stop.

d. Adjustable current limiting and UL approved electronic motor overload protection.
e. Insensitivity to incoming power phase sequence.
f. VSD and motor protection from the following faults: - Output line-to-line short circuit protection -Line-to-ground short circuit protection - Phase loss at AFD input - Phase reversal / Imbalance - Over-voltage - Under-voltage - Over temperature

13. The following VSD status indicators shall be available to facilitate startup and maintenance: - Output speed in hertz and rpm - Input line voltage - Input line kW - Output/load amps - Average current in percent RLA - Load power factor - Fault - VSD transistor temperature
14. Service Conditions - at full output power. No external venting or heat exchangers shall be required.
    a. Operating ambient temperature 32°F-104°F.
    b. Room ambient up to 95% relative humidity.
    c. Elevation to 3300 feet (1000 meters). For every 300 feet above 3300 feet, the rated output current shall be decreased by one percent.

2.2 COMPRESSOR AND MOTOR

1. The compressor shall be centrifugal.
2. Low pressure refrigerant machines shall be provided when available.
3. Chiller should be able to unload to 15 percent of design tonnage with constant entering water temperature. The minimum unloading point shall be demonstrated at the time of the factory performance test. The machine shall be modified to include hot gas bypass if the minimum load cannot be met.
4. Compressor assembly shall be vibration tested at the factory. Vibration shall not exceed 0.15 inches per second. The test data shall be recorded and provided to the customer for approval.
5. The motor shall be hermetic and either suction or liquid refrigerant cooled. Hot gas motor cooling is not acceptable. If an open drive motor is provided, a motor-compressor shaft seal leakage containment system shall be provided.
    a. An oil reservoir shall collect any oil and refrigerant that leaks past the seal.
    b. A float device shall be provided to open when the reservoir is full, directing the refrigerant/oil mixture back into the compressor housing.
    c. Manufacturer shall warrant the shaft seal, reservoir, and float valve system against leakage of oil and refrigerant to the outside of the chiller for a period of 5 years from initial start-up, including parts and labor to replace a defective seal and any refrigerant required to trim the charge to original specifications. Inspections shall be performed a minimum of once a year.

d. Motors shall have winding RTD's for temperature sensing on each phase. These temperatures shall be furnished to the unit control panel for monitoring and alarm.
e. Manufacturers with speed increasing transmissions shall not exceed 10,000 RPM compressor speeds and shall annually inspect the gears and all bearings. A report shall be forwarded to the owner each year over the first five years to confirm completion.
f. The impellers shall be fully shrouded and made of a high strength aluminum alloy. Impellers shall be dynamically balanced and over-speed tested at 1.25 times impeller shaft speed.

B. Motor shall be built for connection to either a star-delta closed transition or solid-state type reduced voltage starter, furnished by the chiller manufacturer. Starter shall not allow starting current to exceed 333% of fully loaded current draw of chiller. Starters shall be unit mounted at the factory and shall be integrated with the variable frequency drive.

C. Compressor shall be of high performance, single, two or three stage centrifugal impeller design suitable for either R-514A or R-513A and include variable inlet guide vanes. Motor, transmission and compressor may be hermetically sealed. Journal bearings may be pressure lubricated.

D. Each compressor shall be provided with a factory installed forced feed lubrication system to deliver oil under pressure to bearings, transmission gears, and all rotating surfaces to include the following:

1. Motor driven oil pump.
2. Refrigerant Cooled Oil cooler.
3. Oil pressure regulator.
4. Replaceable external Oil filter, serviceable without removing refrigerant charge.
5. Oil pump starter, factory mounted on the chiller and factory wired to pump motor and control circuit.
6. Automatic water regulating control valve.
7. Thermostatically controlled oil heater located in oil reservoir.
8. Reservoir oil temperature gauge.
9. Oil pump and heater shall be provided with a separate 460 volt, 3 phase, 60 Hz. power source served from and thru the unit mounted starter/drive.

E. Compressor motors shall be of the hermetic or open drive single speed non-reversing, continuous duty, squirrel cage induction type suitable for the voltage shown on the equipment schedule. Full load operation of the motor shall not exceed name plate rating, FLA, at design conditions. Motor design speed shall not exceed 3,600 rpm at 60 Hz. Hermetic motors shall be suitable for operation in a refrigerant atmosphere and shall be cooled by atomized sub-cooled refrigerant in contact with the motor windings. Open motors shall be suitable for operation in a Mechanical Room atmosphere. Each

motor shall be arranged for service or removal with only minor compressor disassembly and without breaking of main refrigerant piping connections.

F. EVAPORATOR AND CONDENSER

1. Evaporator and condenser shall be horizontal shell and tube type and be provided with water boxes having vents, drains, and covers to permit tube cleaning in the space shown. Suitable tappings shall be provided in the water boxes and nozzles for control sensors and gauges. Water boxes shall be designed for 150 lb. maximum working pressure.
2. Machine construction and safety devices shall conform to the most recent ANSI B9.1 Code.
3. The shells and tube sheets shall be steel with fabricated steel water boxes.
4. Tubing shall be copper, high-efficiency type, with integral internal and external fins. Tubes shall be nominal 3/4 inch O.D. with wall thickness of 0.028 inches (22 gauge) measured at the root of the fin. Tubes shall be rolled into tube sheets and expanded into support sheets and shall be individually replaceable.
5. Units shall be designed to prevent liquid refrigerant from entering the compressor. Tubes shall be removable from either end of the heat exchanger without affecting strength and durability of the tube sheet and without causing leakage in adjacent tubes.

G. Cooler and condenser shall be horizontal shell and tube type and be provided with water boxes having vents, drains, and covers to permit tube cleaning in the space shown. Suitable tappings shall be provided in the water boxes and nozzles for control sensors and gauges. Water boxes shall be designed for 150 lb. maximum working pressure. Machine construction and safety devices shall conform with the most recent ANSI B9.1 Code. The shells and tube sheets shall be steel with fabricated steel water boxes. Tubing shall be copper, high-efficiency type, with integral internal and external fins. Tubes shall be nominal 3/4 inch O.D. with wall thickness of 0.028 inches (22 gauge) measured at the root of the fin. Tubes shall be rolled into tube sheets and expanded into support sheets and shall be individually replaceable. Units shall be designed to prevent liquid refrigerant from entering the compressor. Tubes shall be removable from either end of the heat exchanger without affecting strength and durability of the tube sheet and without causing leakage in adjacent tubes. Provide weld neck flanged nozzles for cooler and condenser piping connectors.

H. A refrigerant pump-out system shall be installed for the chiller system suitable for the high-pressure refrigerant used. Pump out system shall include compressor and drive, piping, wiring, motor starter, and a refrigerant storage vessel. The storage vessel shall be external to the unit shells and shall be large enough to hold the entire refrigerant charge. A single pump-out system with sufficient capacity for the largest chiller, may be used in a multiple chiller application. Storage receivers shall be ASME Code constructed and stamped and be furnished with relief device(s) in accordance with ANSI B9.1 Safety Code. Transfer unit and receiver shall be furnished with all

necessary controls for manual operation, and shall be factory mounted, piped, and wired. Separate Pump out Systems not required when condensers can store the entire refrigerant charge and refrigerant can be isolated therein.

I. A high efficiency purge unit shall be installed for R-514A refrigerant chillers complying with all current EPA requirements. Purge unit shall be fully factory mounted, piped, and wired.

J. Capacity control shall be modular and fully automatic. Module shall regulate chilled water temperature and prevent motor overload by control of the compressor guide vane positioner. Capacity modulation shall be from 100% to 10% of full load under normal operating conditions without causing surging or safety shutdown and without the use of hot gas bypass.

K. Controls shall be by a fully automatic solid state electronic microprocessor. Capacity control shall include inlet vane operator with pilot positioner. Furnish the following features:

1. Evaporator Entering/Leaving Water Temperature Indication; Deg. F.
2. Condenser Entering/Leaving Water Temperature Indication; Deg. F.
3. Evaporator/Condenser Refrigerant Pressure/or Temperature Indication; PSIG/Deg. F.
4. Oil Pressure/Temperature Indication; Low Oil Pressure Safety; PSIG/Deg. F.
5. Evaporator/Condenser Saturation Temperature Indication; Deg. F.
6. Motor Current Percent Indication; Motor Overcurrent Safety; % Full Load Amps.
7. Compressor Discharge Temperature Indication; High Discharge Temperature Safety; Deg. F.
8. Chilled Water Set point Indication and Adjustment; Deg. F.
9. Electrical Current Limit Set point Indication and Adjustment; Amperes.
10. Self Diagnostics
11. Motor Controller Fault Indication
12. Sensor Failure Indication
13. Unit Overvoltage Safety; Volts.
14. Unit Undervoltage Safety; Volts.
15. Bearing High Temperature Safety; Deg. F.
16. Low Refrigerant Temperature Safety; Deg. F.
17. High Condenser Pressure; PSIG.
18. High Motor Temperature; Deg. F.

All sensors and controls shall be factory furnished, installed, pre-piped, pre-wired, tested, and calibrated. Where required for interlock to other equipment, provide pre-wired connections for labeled terminal strips. Indication shall be by LED. Provide 24 hour battery back-up to retain all alarms and set point information. All safeties listed above shall automatically shut down unit when tripped, and shall require manual reset. This shall cause an alarm indication.

L. Controls shall be so arranged that machine cannot start unless inlet vanes are closed. The controls shall provide for a smooth pull-down of loop temperature to prevent power demand spikes.

M. Controls shall be fully automatic and shall be fail-safe. They shall include all safety controls that are standard with the manufacturer of the unit. The control center shall contain all standard components including switches, push buttons, pilot lights, and gauges.

N. Motor shall be protected against drawing more than rated full load amperes.

O. Demand limiter device shall be provided so that maximum current may be set to any percentage between 40% and 100% of full load amperes.

P. Controls shall ensure thorough lubrication of compressor, prior to start and during coast-down after machine stop.

Q. After units shut-down, controls shall prevent machine restart until after a safe preset time. When shut-down, indicate time remaining until next allowed re-start at microprocessor display.

R. Motor driven non-resettable elapsed time meter shall be furnished to provide total machine operating hours.

S. Structural steel shipping skids shall be furnished with the machine to facilitate transfer of machine from transporting conveyance to job site and to provide the most effective lifetime support for the machine. Chiller shall be installed on a structural steel base providing a level foundation. Include vibration eliminators where and as recommended and provided by the manufacturer, to include as a minimum elastomeric pads made of resilient cross-ribbed neoprene with steel support plates placed at each support point. Additionally, provide sole plates, leveling pads, and jacking screws under the support plates and isolation pads.

T. The factory unit mounted variable frequency drive shall be a closed transition star-delta or solid state starter providing single phase and 3 phase overload protection within a NEMA 1 enclosure with flush mounted 3 phase ammeter and voltmeter with four position switches and control transformer. Alternately, this capability may be provided in the chiller control panel. Provide hinged door with lock and 2 keys. Pre-wire all refrigerant auxiliaries at the factory including 120 volt, or 24 volt, single phase control circuiting.

U. The unit shall be factory insulated on all cold surfaces and on adjacent surfaces as required to prevent any sweating. Use 1-1/2 inch thick, or two layers of 3/4 inch thick, Armaflex II, paint to be all one (1) color to match unit color. Thermal conductivity

shall not exceed 0.28 BTU-inch/hour-square feet-Deg. F. Contractor may field apply a second layer of insulation to comply with this requirement, however, the unit shall be initially insulated with a minimum of 3/4 inch thick insulation. Cooler water boxes may be field insulated.

V. Water flow sensing devices shall be provided for field installation in both chilled and condensing water lines which shall prove flow before the unit can operate. Each unit shall have externally mounted field installed, factory furnished, chilled and condenser water flow switches which shall prove sufficient flow before the unit can operate. Use differential pressure type switches rated for outdoor installation equal to a Johnson Controls, Inc. Model F61MG-1C or approved equal by McDonnell & Miller. Flow switch shall be vapor-proof SPDT, NEMA 4X switch, rated for 150 PSIG differential water pressure, rated for ambient temperatures from -20 Deg. F. to +250 Deg. F. Switch shall have 1" NPT connection for upright mounting in horizontal pipe. Paddle type switches are not allowed.

1. Alternately, a thermal dispersion flow switch, standard with the chiller manufacturer may be used which may be field or factory installed. Thermal dispersion flow switches shall be remote solid state flow monitoring systems.
2. Switches shall be equal to the "**ifm**" flow switch and shall use a remotely mounted extended length type 316 stainless steel efector (flow measuring probe) which shall be adjustable (for pipe sizes 4" and larger in diameter.
3. Switches shall have no moving parts, have a cabinet mounted control monitor, 30 feet of cable, ½" adaptor, be powered by 120 VAC, include terminal strips for ease of connection, Din-rail mountable control monitor, visual indication of flow, include LEDs for monitoring status of temperature and line breaks and include a potentiometer adjustment for calibration purposes.

W. When the unit is energized, the oil pump shall be energized, provided protective devices are satisfied. The oil pump shall run during the machine coast down period before it shuts off. Provide momentary contacts for the oil pump to permit manual operation of pump when the compressor is off.

X. Provide automatic restart feature after a power failure/interruption to attempt a minimum of three (3) restarts after a time delay, adjustable, between restarts.

Y. Provide a refrigerant sensing device to determine unsafe concentrations of the refrigerant used and contacts to indicate "safe" and "unsafe" condition to energize a purge ventilation system and to report an alarm to the Energy Management System.

Z. Furnish a safety rupture disc for field piping to atmosphere.

AA. Provide manufacturer furnished BacNET MS/TP interface card. District to provide data drop at chiller for IP interface. Controls Contractor to integrate chiller controller into EMS system. Manufacturer to provide list of all available points to allow district to advise which points they would like to map to the front-end Energy Management

System (EMS) graphics. Controls contractor shall include in their scope of work the integration of these points into the EMS system and associated mapping of these points and related graphical interface.

BB. Acceptable Manufacturers:

1. York

2.3 MACHINE ROOM SAFETY SYSTEM

A. A ventilation system and controls shall be furnished under other sections of these specifications to meet the ventilation requirements of the most recent version of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 15.

B. For Group A1 refrigerant machines (R-134A and R-513A) furnish one (1) oxygen deprivation sensor and transmitter to detect oxygen levels below 19.5 percent by volume, adjustable, down to 5%, within the immediate area of the machine. In lieu of this sensor, provide separate refrigerant specific sensors and transmitters for each machine, same as noted in Paragraph 2.2.C.

C. For Group B1 refrigerant machines (R-514A) furnish a refrigerant specific sensor and transmitter for each machine to detect refrigerant concentrations as low as one (1) part per million (PPM), adjustable, within the immediate area of the machine.

D. Both oxygen deprivation and refrigerant specific sensors shall independently transmit a signal to a gas alarm monitor which shall energize the Mechanical Ventilation System and activate audible and visual alarms.

E. Gas alarm monitoring panels shall be designed for refrigerant Machine Room applications and have the following features:

1. Seven (7) segment, four (4) digit LED Display of each sensor reading to include:
    a. Gas Concentration in percent (%) by volume, or PPM, for each sensor.
    b. Peak Gas Concentration in percent (%) by volume, or PPM, for each sensor.
    c. Each Gas Type Sensor is being monitored, simultaneously, when multiple gas type sensors are utilized.
    d. Two (2) stage alarm level setting for each sensor.
    e. Alarm indication.
    f. Select button to scroll sensor information and to set-up system parameters.
    g. System malfunction indicator.
    h. Auto-Zero self-calibration system.
2. Alarm Panels shall be expandable to add up to three (3) additional sensors.
3. Provide locking panel cover. Cover shall be a NEMA Type-1 enclosure.
4. System shall automatically calibrate itself.

5. System shall be capable of monitoring a minimum of six (6) separate gas sensors, each to as low as 1 PPM.
6. Provide output alarm relays to:
    a. Energize Ventilation System.
    b. Energize Visual Alarms.
    c. Energize Audible Alarms.
    d. Report alarm condition to Energy Management System.
    e. Minimum of two (2) other relays for other alarms and safety controls.
7. Provide fault indication on panel face.
8. Acceptable manufacturers:
    a. General Analysis Corporation SAM-I, or approved equals by:
    b. Yokogawa HGM-300.
    c. Genesis International, Sherlock 802.

F. Audible Alarm Devices

1. Audible Alarm devices shall be heavy-duty, industrial, tone-selectable, stand-alone, signaling devices capable of producing volume controlled, high decibel tones.
2. Provide up to ten (10) distinctive, field selectable tones, via solid state microprocessor circuitry, for each device.
3. All devices shall be of weatherproof design, fully enclosed, and be made of heavy-duty zinc cast construction with a baked enamel finish.
4. Devices shall be available in 24 Volt DC, 120 VAC, or 240 VAC as required for the specific application. Unless indicated otherwise use 120 VAC devices. Maximum operating current shall not exceed 0.25 amps at 120 VAC.
5. Devices shall be suitable for mounting on a flush wall box utilizing a concealed wiring adaptor kit or for direct wall mounting.
6. Devices shall be UL listed for indoor and outdoor applications.
7. Each device shall deliver up to 110 decibels at ten (10) feet.
8. The speaker portion of the device shall be adjustable to allow directional control of the signal.
9. Provide a maximum of two (2) audible alarm devices.
10. Devices shall be an Edwards "Adapt-a-tone" or Genesis International.

G. Visual Alarm Devices

1. Visual Alarm Devices shall be heavy-duty, industrial, beacons, capable of producing bright flashing lights.
2. All devices shall be of weatherproof design, fully enclosed, and be made of a heavy-duty cast zinc base, suitable as a junction box, with shatter resistant Lexan lenses. Lenses shall have special optics for efficient light dispersal.
3. Lamps shall have bayonet bases on bulbs with yellow or amber lenses.
4. Devices shall be UL listed for indoor and outdoor applications.
5. Devices shall be suitable for surface mounting, pipe mounting or mounting to a four inch (4") octagon box.

6. All flashing lights shall be suitable for 120 VAC and have a maximum operating current of 0.25 amps.
7. Provide a minimum of two (2) visual alarms.
8. Visual Alarm Devices shall be Edwards "Adapt-a-beacon" or Genesis International, flashing lights.

H. Self-Contained Breathing Apparatus

1. Self-Contained Breathing Apparatus (SCBA) shall be designed for personnel rescue operations and for emergency work performance in a Machine Room environment.
2. SCBA shall be NIOSH approved and meet Federal Standard 30-CFR, Part II for open-circuit SCBA's.
3. Air Cylinders shall be designed for a pressure of 4500 psig, be manufactured of Kevlar and have a rating for a 60 minute supply of air. Cylinders shall have the following accessories:

    a. Comfortable, wide strap, harness.
    b. Remote air pressure gauge.
    c. Low air supply warning.
    d. Low maintenance pneumatics requiring no calibration.
    e. Companion face mask.
    f. Face mask hose and fittings.
    g. Mask mounted demand control valve.
    h. Neoprene, secure seal, face mask.
    i. Shatterproof visor suitable for working in with scratch resistant coating.
    j. Communications option package with voice amplification system (65dB to 100dB)
    k. Provide carrying case, user manual and poster, and a complete maintenance manual.

4. Provide one (1) SCBA's which shall be mounted outside of the Chiller Room where designated by the Owner or where shown on the Drawings.
5. Acceptable Manufacturer: International Safety Instruments (ISI) "Vanguard".

I. Each refrigeration system shall be provided with an easily legible, permanent sign that is securely attached, easily accessible, and indicates the following:

1. Name and address of the installer.
2. Proper name and amount of refrigerant.
3. Lubricant identify and amount.
4. Field test pressure applied.

J. Each refrigeration system that contains more than 100 pounds of refrigerant shall be provided with durable signs that have letters not less than 0.5 inch in height and identify the following:

1. Valves or switches that control refrigerant flow.
2. Switches that control ventilation.
3. Switches that control operation of the refrigeration compressor(s).
4. The kind of refrigerant or secondary coolant contained in the exposed piping outside the machinery room, as applicable.
5. Valves or piping adjacent to valves shall be identified in accordance with ANSI A13.1, "Scheme for Identification of Piping Systems".

PART 3 - EXECUTION

3.1 DELIVERY AND PROTECTION

A. Deliver all equipment to the site at the specified date as indicated in Division 1, and as required to meet the scheduled completion date.

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.

3.2 INSTALLATION

A. Install unit in accordance with the manufacturer’s instructions.

B. Install connection to electrical service. Include connections to oil pump and control panel if required.

3.3 OPERATING PROCEDURES AND REQUIREMENTS

A. Four (4) copies of the operating and service instructions in illustrated and bound form shall be furnished by the manufacturer.

B. At machine start up the manufacturer shall furnish skilled factory trained personnel to supervise, check out performance, make any required adjustments, place the unit in service, and instruct the Owner's personnel for a full period of one (1) eight (8) hour day. Services shall include:

1. Leak Testing.
2. Refrigerant Pressure Testing.
3. System Evacuation (for low pressure machines).
4. System Dehydration (for low pressure machines).
5. Charge Chiller with Operating Charge of Refrigerant and Oil.

C. In addition to on-site training, manufacturer shall provide a minimum of one-day of training for up to four (4) district maintenance personnel at manufacturer’s local training facility on specific operation of the chiller.

D. The manufacturer of the water chiller shall provide complete wiring diagrams to be supplied to the Electrical Systems installer and temperature controls installer and shall provide drawings indicating all required external wiring and arrangements of wiring connections to include machine room safety systems.

E. Factory authorized service personnel and routine repair parts shall be locally available within 24 hours of a trouble call.

3.4 WARRANTY

A. Transfer the full Warranty to Owner to include all parts and labor for a full one year period after the cooling system is put into sustained operation to obtain building cooling effect and accepted as a completed installation by the Owner which shall begin at "Substantial Completion".

B. Transfer any and all other warranties as applicable over to the Owner at the completion of construction, "Substantial Completion", including the extended four (4) year compressor warranty under Alternate No. 2.

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 assembles, 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 condulet 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 assembles 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 on less on centers for sizes 2-1/2 inches and greater and 9 feet or less on centers for sizes 2 inch and smaller.

D. Fasten single runs of conduit to the structure with one-hole pipe straps and beam clamps or hang on rod hangers.

E. Support multiple runs of conduit and raceways from continuous channel inserts or from trapeze hangers constructed of rod hangers and channels.

F. Fasten single conduits to rod hangers with adjustable lay-in pipe hangers or for 2 inches and smaller conduits with Series 6H pipe hangers.

G. Fasten conduits to channels with pipe channel straps.

H. Support conduits and raceways within 3 feet of each end of each bend, of each termination, and at other intervals to maintain horizontal and vertical alignment without sag and deformation.

I. Do not use cable, strap, and wire hangers as fasteners.

J. Provide riser clamps for conduits at floor lines. Provide wire and cable supports in pull boxes for risers in accordance with NEC Section 300-19 and Table 300-19 (a).

K. Install supports to permit equally distributed expansion and contraction of conduits and raceways with expansion joints. Use guides or saddles and U-bolts and anchors designed for equal effectiveness for both longitudinal and transverse thrusts.

L. Do not 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