HVAC MODIFICATIONS TO WEBB COUNTY JAIL

SCOPE OF WORK
Project: BID 2011 – 07 REBID HVAC MODIFICATIONS TO WEBB COUNTY JAIL

OWNER: WEBB COUNTY
ENGINEER: UNITECH ENGINEERING

Book Specifications

Notice to Bidders
Scope of Work
Proposal Form
Terms and Conditions of Invitation to Bids
Conflicts Disclosure Statement
Insurance
Bid Bond and Performance Bond
Proof of No Delinquent Taxes Owed to Webb County
Bidders Information

15010 SUMMARY OF MECHANICAL WORK
15050 BASIC MECHANICAL MATERIALS AND METHODS
15060 HANGERS AND SUPPORTS
15083 PIPE INSULATION
15110 VALVES
15181 HYDRONIC PIPING
15185 HYDRONIC PUMPS
15682 SCROLL CHILLERS
15725 AIR HANDLING UNITS
15900 ALTERNATE 2/FACILITY MANAGEMENT SYSTEM
15990 TESTING, ADJUSTING, AND BALANCING

Drawings

COVER SHEET, MO, D1, D2, D3, D4, M1, M2, M3, M4, M5, M6, M7

ALL WORK WAS SIGNED AND SEALED ON JUNE 6, 2011

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

6/6/2011

Public Notice

Notice is hereby given that the County of Webb is now accepting sealed bids for the Webb County Jail HVAC System. Bids must be prepared in written form and submitted to the following locations.

Bid 2011- 07 "Webb County Jail HVAC System"

One (1) original and three (3) copies must be submitted in sealed envelopes to the Office of the Webb County Clerk. Sealed envelope must be marked (Sealed-Bid) with bid number on the front lower left-hand corner envelope.

Bids will be hand-delivered or mailed to the following:

Webb County Clerk
Webb County Justice Center
1110 Victoria St. Suite 202
Laredo, Texas 78042

Bids must be delivered no later than **2:00 P.M. Monday, July 18, 2011** at which time all bids received will be opened and read to the public. Bids not received before the time specified will not be considered.

Pre-Bid conference will be held on Monday, July 11, 2011,at 1:30 P.M. at the Webb County Purchasing Department, 1110 Washington Suite 101, Laredo, Texas.

If any additional information is requested please contact, Leticia Gutierrez, at 956-523-4127. Interested bidders may obtain copies of bidding documents at 1110 Washington Suite 101 for $50.00 nonrefundable with check payable to Webb County or visit our Web-site for a copy of bid notice and specifications, under purchasing department www.webbcountytx.gov .

The County of Webb reserves the right to reject any and all bids, or to select the best bid that will serve in the best interest of Webb County.

Dr Cecilia Moreno

Dr. Cecilia May Moreno
Purchasing Agent

Advertise: Monday, July 4, 2011
Monday, July 11, 2011

THIS FORM MUST BE INCLUDED WITH BID; PLEASE CHECK OFF EACH ITEM THAT APPLIES AND SIGN

"Sealed Bid"

Bid No. 2011-07 "REBID Webb County Jail HVAC System"

- ☐ **Notice to Bidders**
- ☐ **Scope of Work**
- ☐ **Prices (required)**
- ☐ **Terms and Conditions of Invitations for Bids**
- ☐ **Conflicts Disclosure Statement**
- ☐ **Insurance**
- ☐ **Bid Bond and Performance Bond**
- ☐ **Proof of No Delinquent Taxes Owed To Webb County**
- ☐ **Bidders Information (must be signed)**

_____

Signature of person
Completing this form

HVAC MODIFICATIONS TO WEBB COUNTY JAIL-REBID

SCOPE OF WORK
Project: BID 2011 – 07 HVAC MODIFICATIONS TO WEBB COUNTY JAIL

SUMMARY: Provide new chillers, pumps, air handling equipment, piping, and controls to Webb County Jail.
The project will be constructed based and drawings and specifications listed below. All addenda will be included in the construction documents:

Book Specifications

Notice to Bidders
Scope of Work
Proposal Form
Terms and Conditions of Invitation to Bids
Conflicts Disclosure Statement
Insurance
Bid Bond and Performance Bond
Proof of No Delinquent Taxes Owed to Webb County
Bidders Information

15010 SUMMARY OF MECHANICAL WORK
15050 BASIC MECHANICAL MATERIALS AND METHODS
15060 HANGERS AND SUPPORTS
15083 PIPE INSULATION
15110 VALVES
15181 HYDRONIC PIPING
15185 HYDRONIC PUMPS
15682 SCROLL CHILLERS
15725 AIR HANDLING UNITS
15900 FACILITY MANAGEMENT SYSTEM (ALTERNATE 2)
15990 TESTING, ADJUSTING, AND BALANCING

Drawings

COVER SHEET, MO, D1, D2, D3, D4, M1, M2, M3, M4, M5, M6, M7,M1ALT

ALL WORK WAS SIGNED AND SEALED ON May 8, 2011

END OF SECTION

PROPOSAL FORM FOR COMPETITIVE SEALED BID
Project: BID 2011 – 07 REBID HVAC MODIFICATIONS TO WEBB COUNTY JAIL

PART 1 - The Undersigned proposes to furnish all labor, services, materials, tools, and necessary equipment for the construction of the renovation of HVAC to the Webb County Jail, and to perform the work required for the construction of said project at the location set out by the Drawings, Project Manual and Specifications, in strict accordance with the Contract Documents for the complete work.

In submitting this Bid, it is understood that the Bid may not be altered or withdrawn for forty-five {45} and that the Owner has reserved the right to reject any and all Proposals.

The Undersigned certifies that this Bid is made in good faith, without collusion or connection with any other person, persons, partnership, company, firm, association, or corporation offering on this work, for the following sum or prices to wit:

HVAC MODIFICATIONS TO WEBB COUNTY JAIL

1. MATERIALS AND LABOR $_____ ($) DOLLARS
2. COST OF CHILLERS $_____ ($) DOLLARS
3. COST OF AIR HANDLING UNITS $_____ ($) DOLLARS

TOTAL BASE BID (ADD 1, 2, AND 3) $_____ ($) DOLLARS

ALTERNATE 1 (CHILLER 1, MIALT)

ADD TO BASE BID $_____($) DOLLARS

ALTERNATE 2 (NEW CONTROL SYSTEM)

ADD TO BASE BID $_____($) DOLLARS

The Undersigned hereby declares that he has visited the site and has carefully examined the Drawings, Specifications, Contract Documents and BID Documents related to the Work covered by his proposal.

Upon receipt of *"NOTICE TO PROCEED"*, the Undersigned will immediately execute the formal contract (Agreement).

The Undersigned agrees to commence work within ten (10) days of Notice to Proceed and to substantially complete the work on or before 120 days after issuance of permit.

The Contract required will be that Standard Form of the American Institute of Architects and shall provide for payment on accounts of ***ninety (90%)*** percent of the value monthly.

The Proposal, the Agreement, the Drawings, the General Conditions, Supplementary General Conditions, the Specifications and any Addenda shall all become a part of the Contract.

I hereby acknowledge receipt of the following Addendum:

_____

5

HVAC MODIFICATIONS TO WEBB COUNTY JAIL - REBID

BONDING COMPANY (IES):

_____

(Name and address)

If awarded this contract, the offerer intends to use the following subcontractors:

ELECTRICAL: _____.

PLUMBING: _____.

AIR CONDITIONING: _____.

Respectfully Submitted:

BY: _____.

FIRM: _____. If corporation affix seal here

TITLE: _____.

DATE: _____.

END OF SECTION

COUNTY OF WEBB

Terms and Conditions of Invitations for Bids

1. GENERAL CONDITIONS:

Bidders are required to submit their proposals upon the following expressed conditions:

(A) Bidders shall thoroughly examine the drawings, specification schedule, instructions and all other contract documents.

(B) Bidders shall make all investigations necessary to thoroughly inform themselves regarding plant and facilities for delivery of materials and equipment as required by the bid conditions. No plea of ignorance by the bidder of conditions that exist or that may hereafter exist as a result of failure to fulfill in every detail the requirements of the contract documents of the County or the compensation of the vendor.

(C) Bidders are advised that all County contracts be subject to all legal requirements provided for in county, state and federal statutes and regulations.

2. PREPARATION OF BIDS:

Bids will be prepared in accordance with the following:

(A) All information required by the bid form shall be furnished. The bidder shall print or type his name and manually sign the schedule and each continuation sheet on which an entry is made.

(B) Unit prices shall be shown and where there is an error in extension of prices, the unit price shall govern.

(C) Alternate bids will not be considered unless authorized by the Invitation for Bids.

(D) Proposed delivery time must be shown and shall include Sundays and holidays.

(E) Bidders will not include Federal taxes or State of Texas limited sales excise and use taxes in bid prices since the County of Webb is exempt from payment of such taxes. An exemption certificate will be signed where applicable upon request.

3. DESCRIPTION OF SUPPLIES:

Any catalog or manufacturer's reference used in describing an item is merely descriptive, and not restrictive, unless otherwise noted, and is used only to indicate type and quality of material. Bidders are required to state exactly what they intend to furnish otherwise they shall be required to furnish the items as specified.

4. SUBMISSION OF BIDS:

(A) Bids and changes thereto shall be enclosed in sealed envelopes addressed to the Webb County Clerk. The name and address of the bidder, the date of the bid opening and the material or service bid on shall be placed on the outside of the envelope.

(B) Bids must be submitted in the forms furnished. Telegraphic bids will not be considered. Bids, however, may be modified by telegraphic notice provided such notice is received before the time and date set for the bid opening.

(C) Samples, when required, must be submitted within the time specified, at no expense to the County of Webb. If not destroyed or used up during testing, samples will be returned upon request at the bidder's expense.

5. REJECTION OF BIDS:

(A) The Purchasing Agent may reject a bid if it is not satisfactory to Commissioners' Court because:

(1) The bidder misstates or conceals any material fact in the bid or if,

(2) The bid does not strictly conform to the law or the requirements of the bid, or if,

(3) The bid is conditional, except that the bidder may qualify his bid for acceptance by the County on an "All or None" basis or a "low item" basis. An "All or None" basis bid must include all items upon which bids are invited.

(B) No bid submitted herein shall be considered if the bidder owes any delinquent taxes to the County of Webb at the time bids are opened. In the event that the successful bidder herein subsequently becomes delinquent in the payment of his or its County taxes, such fact shall constitute grounds for cancellation of the contract.

(C) No bid submitted herein shall be considered unless the bidder warrants that upon execution of a contract with the County of Webb, he will not engage in employment practices which have the effect of discriminating against employees or prospective employees because of race, color, sex, creed, or national origin and will submit such report as the County may thereafter require to assure compliance.

(D) The County may, however, reject all bids whenever it is deemed in the best interest of the County to do so, and may reject any part of a bid unless the bid has been qualified as provided in 5 (a) 3 above. The County may also waive any minor informalities or irregularities in any bid.

6. WITHDRAWAL OF BIDS:

Bids may not be withdrawn after the time set for the bid opening, unless approved by Commissioners' Court.

7. LATE BIDS OR MODIFICATIONS:

Bids and modifications received after the time set for the bid submission will not be considered.

8. CLARIFICATIN OR OBJECTION TO BID SPECIFICATIONS:

If any person contemplating submitting a bid for this contract is in doubt as to the true meaning of the specifications, or other bid documents or any part thereof, he may submit to the Purchasing Agent on or before five days prior to scheduled opening a request for clarification. All such requests for information shall be made in writing and the person submitting the request will be responsible for its prompt delivery. Any interpretation of the bid, if made, will be made only by Addendum duly issued. A copy of such Addendum will be mailed or delivered to each person receiving a set of bids. The County will not be responsible for any other explanation or interpretation of the proposed bid made or given prior to the award of the contract. Any objections to the specifications and requirements as set forth in this bid must be filed in writing with the Purchasing Agent on or before five days prior to the scheduled opening.

9. DISCOUNTS:

(A) Prompt payment discounts will be considered in making the award provided the period of the discount offered is sufficient to permit payment within such period in the regular course of business.

(B) Concerning any discount offered, time will be computed from the date of receipt of supplies or services or from the date a correct invoice is received, whichever is the later date. Payment is deemed to be made on the date of mailing of the check.

10. AWARD OF CONTRACT:

(A) The contract will be awarded to the lowest responsible bidder whose bid, conforming to the Invitation for Bids, is most advantageous to the County price and other factors considered.

(B) The County reserves the right to accept any item or group of items of this bid, unless the bidder qualified his bid by specific limitations. Re Par. 5 (a) 3 above.

(C) A written award of acceptance mailed or otherwise furnished to the successful bidder results in a binding contract without further action by either party.

(D) Prices must be quoted F.O.B. Webb County with all transportation charges prepaid, unless otherwise specified in the Invitation for Bids.

(E) Delivery time and prompt payment discounts, including time allowed for payment, will be considered in breaking of tie bids.

11. PERFORMANCE DEPOSIT:

(A) The successful bidder(s) must furnish the County of Webb a performance deposit in the amount set forth in the Invitation for Bids. This deposit is not to be submitted with bids, but must be presented to the Purchasing Department upon notification.

(B) The County of Webb will not enter a contract or issue a purchase order until the successful bidder has complied with the performance deposit provisions.

(C) The performance deposit shall be in the form of a bond, certified check upon a State or National Bank or Trust Company signed by a duly authorized officer, thereof, or a certificate of deposit from such bank or trust company. All such bonds, checks and certificate of deposit shall be drawn payable to the order to the Webb County Treasurer and submitted to the Purchasing Agent's Office.

(D) The performance deposit of the successful bidder(s) shall be returned by the County upon completion of the contract and final acceptance of all items in accordance with conditions thereof.

(E) Failure of vendor to perform any of the services by this contract, within ten days of receipt of written demand for performance from County, or failure of vendor to correct or replace defective goods or products, within ten days from receipt of written demand will therefore, shall constitute a total breach of this contract, and shall be cause for termination. In the event of such termination the performance deposit shall be retained by the County of Webb as liquidated damages, based upon mutual agreement and understanding between vendor and County at the time this bid is solicited, submitted and accepted, that the County of Webb is a governmental agency engaged in public projects, and that the measurement of damages which might result from a breach of the terms and specifications herein is difficult or impossible to determine. Provided, however, that if in the opinion of the Purchasing Agent and the Commissioners' Court the failure of vendor to perform the conditions of this contract is occasioned by or is the result of acts or events over which the vendor has no control, said performance deposit may in whole or in part, as may be determined by the Purchasing Agent and the Commissioners' Court, be returned to the vendor. It is understood that such determination shall be entirely discretionary with the Purchasing Agent and the Commissioners' Court.

12. WORKERS' COMPENSATION INSURANCE COVERAGE:

The Workers' Compensation Commission has adopted Rule 110.110 effective with all bids advertised after September 1, 1994. The TWCC has stated that it is aware that a statutory requirement for workers' compensation insurance coverage is not being met. Therefore, Rule110.110 requires that all bidders be covered under workers' compensation insurance to achieve compliance from both contractor(s) and governmental entities. **Attachment A** is provided in accordance with the requirements on governmental entities. Please read carefully and prepare your bid in full compliance to TWCC Rule 110.110. Failure to provide the required certificates upon submission of a bid could result in your bid being declared non-responsive.

CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor or other person doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 1491, 80th Leg., Regular Session.

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

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

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

OFFICE USE ONLY

Date Received

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

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.**

(The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)

3 **Name of local government officer with whom filer has employment or business relationship.**

_____

Name of Officer

This section (item 3 including subparts A, B, C & D) must be completed for each officer with whom the filer has an employment or other business relationship as defined by Section 176.001(1-a), Local Government Code. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer named in this section receiving or likely to receive taxable income, other than investment income, from the filer of the questionnaire?

☐ Yes ☐ No

B. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer named in this section AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No

C. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership of 10 percent or more?

☐ Yes ☐ No

D. Describe each employment or business relationship with the local government officer named in this section.

4

_____ _____

Signature of person doing business with the governmental entity Date

Adopted 06/29/2007

Insurance

The Contractor shall not commence work under this contract until he has obtained all the insurance required under the paragraph and such insurance has been approved by owner.

a. Compensation Insurance: The Contractor shall procure and shall maintain during the life of this contract Worker's Compensation Insurance as required by the State of Texas for all of his employees to be engaged in work at the site of the project under this contract and, in case of any such work sublet, the Contractor shall require the subcontractor similarly to provide Worker's Compensation Insurance for all of the employees to be engaged in such work unless such employees are covered by the protection afforded by the Contractor's Worker's Compensation Insurance.
b. Contractor's Public Liability and Property Damage Insurance and Vehicle Liability Insurance: The Contractor shall procure and shall maintain during the life of this contract Contractor's Public Liability Insurance, Contractor's Property Damage Insurance and Vehicle Liability Insurance in the following amounts:
    1. Contractor's Public Liability Insurance: $1,000,000.00
    2. Contractor's Property Damage Insurance: $1,000.000.00
    3. Vehicle Liability Insurance: $1,000,000.00
c. Proof of Insurance: The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates and date of expiration of policies. Such certificates shall also contain substantially the following statement: "The insurance covered by this certificated will not be canceled or materially altered, except after ten (10) days written notice has been received by the Owner."

NOTICE TO ALL BIDDERS

The Texas Workers' Compensation Commission has adopted Rule 110.110 effective with all bids advertised after September 1, 1994 and these changes affect your bid on this project.

The TWCC has stated that it is aware that statutory requirements provided for workers' compensation insurance coverage is not being met. Rule 110.110 is designed to achieve compliance from both contractors and governmental entities... This affects both of us on this project.

Providing false or misleading certificates of coverage, failing to provide or maintain required coverage, or failing to report any change that materially affects the coverage may subject the contractor(s) or other persons providing services on this project to legal penalties. This affects your subcontractors.

Therefore, the attached is provided in accordance with the requirements on governmental entities. Please read carefully and prepare your bid in full compliance to TWCC Rule 110.110. Failure to provide the required certificates upon submission of a bid could result in your bid being declared non-responsive.

According to TWCC, "This rule does not create any duty or burden on anyone which the law does not establish." Therefore, the county should not experience any increase in cost because of the need to comply with the Texas Worker's Compensation laws.

_____

Dr. Cecilia May Moreno
Webb County Purchasing Agent

Insurance Requirements for Bids:
Revised October 13, 2010

NON CONSTRUCTION BIDS:

Insurance Requirements

The successful bidder(s) shall furnish the County with original copies of valid insurance policies herein required upon execution of the contract and shall maintain said policies in full force and effect at all times during the term of this contract.

(a) Commercial General Liability insurance at minimum combined single limits of $1,000,000_per-occurrence and $2,000,000 general aggregate for bodily injury and property damage, Coverage must be amended to provide for an each-project aggregate limit of insurance. An alternative would be to have separate limits for all lines of General Liability coverage for each project.

(b) Workers Compensation insurance at statutory limits, including Employers Liability coverage a minimum limits of $1,000,000 each-occurrence each accident/$1,000,000 by disease each-occurrence/$1,000,000 by disease aggregate.

(c) Commercial Automobile Liability insurance at minimum combined single limits of $1,000,000_per-occurrence for bodily injury and property damage, including owned, non-owned, and hired car coverage.

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

(e) A Comprehensive General Liability insurance form may be used in lieu of a Commercial General Liability insurance form. In this event, coverage must be written on an occurrence basis, at limits of $1,000,000 each-occurrence, combined single limit, and coverage must include a broad form Comprehensive General Liability Endorsement.

(f) With reference to the foregoing insurance requirement, Contractor shall specifically endorse applicable insurance policies as follows:

1. The County of Webb shall be named as an additional insured with respect to General Liability and Automobile Liability.
2. All liability policies shall contain no cross liability exclusions or insured versus insured restrictions.
3. A waiver of subrogation in favor of the County of Webb shall be contained in the Workers compensation, and all liability policies.
4. All insurance policies shall be endorsed to require the insurer to immediately notify the County of Webb of any material change in the insurance coverage.
5. All insurance policies shall be endorsed to the effect that the County of Webb will receive at least sixty- (60) days' notice prior to cancellation or non-renewal of the insurance.

6. All insurance policies, which name The County of Webb as an additional insured, must be endorsed to read as primary coverage regardless of the application of other insurance.
7. Required limits may be satisfied by any combination of primary and umbrella liability insurances.
8. Contractor may maintain reasonable and customary deductibles, subject to approval by the County of Webb.
9. Insurance must be purchased from insurers that are financially acceptable to the County of Webb. Insurer must be rated A- or greater by AM Best Rating with an admitted carrier licensed by the Texas Department of Insurance.

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

1. Sets forth all endorsements and insurance coverage's according to requirements and instructions contained herein.
2. Shall specifically set forth the notice-of-cancellation or termination provisions to The County of Webb.

(h) Upon request, Contractor shall furnish The County of Webb with certified copies of all insurance policies.

CONSTRUCTION BIDS:

INSURANCE REQUIREMENTS

When required and specified in the County of Webb bid specifications, the successful bidder(s) shall furnish the County with original copies of valid insurance policies herein required upon execution of the contract and shall maintain said policies in full force and effect at all times during the term of this contract.

(a) Commercial General Liability insurance at minimum combined single limits of $1,000,000_per-occurrence and $2,000,000 general aggregate for bodily injury and property damage, which coverage shall include products/completed operations ($1,000,000 products/ completed operations aggregate), and XCU (Explosion, Collapse, Underground) hazards. Coverage for products/completed operations must be maintained for at least two (2) years after the construction work has been completed. Coverage must be amended to provide for an each-project aggregate limit of insurance. An alternative would be to have separate limits for all lines of General Liability coverage for each project.

(i) Workers Compensation insurance at statutory limits, including Employers Liability coverage a minimum limits of $1,000,000 each-occurrence each accident/$1,000,000 by disease each-occurrence/$1,000,000 by disease aggregate.

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

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

(l) A Comprehensive General Liability insurance form may be used in lieu of a Commercial General Liability insurance form. In this event, coverage must be written on an occurrence basis, at limits of $1,000,000 each-occurrence, combined single limit, and coverage must include a broad form Comprehensive General Liability Endorsement, products/completed operations, XCU hazards, and contractual liability.

(m) With reference to the foregoing insurance requirement, Contractor shall specifically endorse applicable insurance policies as follows:

10. The County of Webb shall be named as an additional insured with respect to General Liability and Automobile Liability.
11. All liability policies shall contain no cross liability exclusions or insured versus insured restrictions.
12. A waiver of subrogation in favor of the County of Webb shall be contained in the Workers compensation, Builders Risk, and all liability policies.
13. All insurance policies shall be endorsed to require the insurer to immediately notify The County of Webb of any material change in the insurance coverage.
14. All insurance policies shall be endorsed to the effect that The County of Webb will receive at least sixty- (60) days' notice prior to cancellation or non-renewal of the insurance.
15. All insurance policies, which name The County of Webb as an additional insured, must be endorsed to read as primary coverage regardless of the application of other insurance.
16. Required limits may be satisfied by any combination of primary and umbrella liability insurances.
17. Contractor may maintain reasonable and customary deductibles, subject to approval by The County of Webb.
18. Insurance must be purchased from insurers that are financially acceptable to the County of Webb. Insurer must be rated A- or greater by AM Best Rating with an admitted carrier licensed by the Texas Department of Insurance.

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

3. Sets forth all endorsements and insurance coverage's according to requirements and instructions contained herein.
4. Shall specifically set forth the notice-of-cancellation or termination provisions to The County of Webb.

(o) Upon request, Contractor shall furnish The County of Webb with certified copies of all insurance policies.

§110.110. Reporting Requirements for Building or Construction Projects for Governmental Entities.

(a) The following words and terms, when used in this rule, shall have the following meanings, unless the context clearly indicates otherwise. Terms not defined in this rule shall have the meaning defined in the Texas Labor Code, if so defined.

(1) Certificate of coverage (certificate) –A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or workers' compensation 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 (including those subject to a coverage agreement) providing services on a project, for the duration of the project.

(2) Building or construction—Has the meaning defined in the Texas Labor Code, §406.09(e)(1).

(3) Contractor –A person bidding for or awarded a building or construction project by a governmental entity.

(4) Coverage—Workers' compensation insurance meeting the statutory requirements of the Texas Labor Code, §401.011(44).

(5) Coverage agreement—A written agreement on form TWCC-81, form TWCC-82, form TWCC-83, or form TWCC-84, filed with the Texas Workers' Compensation Commission which establishes a relationship between the parties for purposes of the Texas Workers' Compensation Act, pursuant to the Texas Labor Code, Chapter 406, Subchapter F and G, as one of employer/employee and establishes who will be responsible for providing workers' compensation coverage for persons providing services on the project.

(6) Duration of the project—Includes, the time from the beginning of work on the project until the work on the project has been completed and accepted by the governmental entity.

(7) Persons providing services on the project ("subcontractor" in §406.096 of the Act)—With the exception of persons excluded under subsection (h) and (i) of this section, includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the contractor

and regardless of whether that person has employees. This includes but is not limited to independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity furnishing persons to perform services on the project. "Services" includes but not limited to providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

(8) Project—Includes the provision of all services related to a building or construction contract for a governmental entity.

(b) Providing or causing to be provided a certificate of coverage pursuant to this rule is a representation by the insured that all employees of the insured who are providing services on the project are covered by workers' compensation coverage, that the coverage is based on proper reporting of classification codes and payroll amounts, and that all coverage agreements have 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 certificates of coverage, or failing to provide or maintain required coverage, or failing to report any change that materially affects the provision of coverage may subject the contractor or other person providing services on the project to administrative penalties, criminal penalties, civil penalties, or other civil actions.

(c) A governmental entity that enters into a building or construction contract on a project shall:

(1) include in the bid specifications, all the provisions of paragraph (7) of this subsection, using the language required by paragraph (7) of this subsection;

(2) as part of the contract, using the language required by paragraph (7) of this subsection, require the contractor to perform as required in subsection (d) of this section;

(3) obtain from the contractor a certificate of coverage for each person providing services on the project, prior to that person beginning work on the project;

(4) obtain form the contractor a new certificate of coverage showing extension of coverage:

(A) before the end of the current coverage period, if the contractor's current certificate of coverage shows that the coverage period ends during the duration of the project; and

(B) no later than seven days after the expiration of the coverage for each other person providing services on the project whose current certificate shows that the coverage period ends during the duration of the project; and

(5) retain certificates of coverage on file for the duration of the project and for three years thereafter,

(6) provide a copy of the certificates of coverage to the commission upon request and to any person entitled to them by law; and

(7) use the language contained in the following Figure 1 for bid specifications and contracts, without any additional words or changes, except those required to accommodate the specific document in which they are contained or to impose stricter standards of documentation:

Article _____ Workers' Compensation Insurance coverage.

A. Definitions:

Certificate of coverage ("certificate ") – A copy of a certificate of insurance, a certificate of authority to self-insure issued by the 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, for the duration of the project.

Duration of the project – includes the time from the beginning of the work on the project until the contractor's/person's work on the project has been completed and accepted by the governmental entity.

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

hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

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

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

D. If the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

E. The contractor shall obtain from each person providing services on a project, and provide to the governmental entity:

(1) a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and

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

F. The contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter.

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

H. The contractor shall post on each project site a notice, in the text, form and manner prescribed by the 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.

I. the contractor shall contractually require each person with whom it contracts to provide services on a project, to:

(1) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the project, for the duration of the project;

(2) provide to the contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;

(3) provide the contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(4) obtain from each other person with whom it contracts, and provide the contractor;

(A) a certificate of coverage, prior to the other person beginning work on the project; and

(B) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(6) notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(7) contractually require each person with whom it contracts, to perform as required by paragraphs (1)-(7), with the certificates of coverage to be provided to the person for whom they are providing services.

J. By signing this contract or providing or causing to be provided a certificate of coverage, the contactor is representing to the governmental entity that all employees of the contractor who will provide services on the project will be covered by 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 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.

K. The contractor's failure to comply with any of these provisions is a breach of contract by the contractor which entitles 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.

(d) A contractor shall:

(1) provide coverage for its employees providing services on a project, for the duration of the project based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements;

(2) provide a certificate of coverage showing workers' compensation coverage to the governmental entity prior to beginning work on the project;

(3) provide the governmental entity, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project;

(4) obtain from each person providing services on a project, and provide to the governmental entity:

(A) a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and

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

(5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(6) notify the governmental entity 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;

(7) post a notice on each project site informing all persons providing services on the project that they are required to be covered, and stating how a person may verify current coverage and report failure to provide coverage. This notice does not satisfy other posting requirements imposed by the Act or other commission rules. This notice must be printed with a title in at least 30 point bold type and text in at least 19 point normal type, and shall be in both English and Spanish and any other language common to the worker population. The text for the notices shall be the following text provided by the commission on the sample notice, without any additional words or changes.

"REQUIRED WORKERS' COMPENSATION COVERAGE"

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

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

(8) contractually require each person with whom it contracts to provide services on a project to:

(A) provide coverage based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements for all of its employees providing services on the project, for the duration of the project;

(B) provide a certificate of coverage to the contractor prior to that person beginning work on the project;

(C) include in all contracts to provide services on the project the language in subsection (e)(3) of this section;

(D) provide the contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(E) obtain from each other person with whom it contracts, and provide to the contractor:

(i) a certificate of coverage, prior to the other person beginning work on the project; and

(ii) prior to the end of the coverage period, a new certificate of coverage showing extension of the coverage period, if the coverage period if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(F) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(G) notify the governmental entity in writing by certified mail or personal delivery, within ten days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(H) contractually require each other person with whom it contracts, to perform as required by subparagraph (A)-(H) of this paragraph, with the certificate of coverage to be provided to the person for whom they are providing services.

(e) A person providing services on a project, other than a contractor, shall:

(1) provide coverage for its employees providing services on a project, for the duration of the project based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements;

(2) provide a certificate of coverage as required by its contract to provide services on the project, prior to beginning work on the project;

(3) have the following language in its contract to provide services on the project: "By signing this contract or providing or causing to be provided a certificate of coverage, the person signing this contract is representing to the governmental entity that all employees of the person signing this contract who will provide services on the project will be covered by 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 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 actions."

(4) provide the person for whom it is providing services on the project, prior to the end of the coverage period shown on its current certificate of coverage, a new certificate showing extensions of coverage, if the coverage period shown on the certificate of coverage ends during the duration of the project:

(5) obtain from each person providing services on a project under contract to it, and provide as required by its contract:

(A) a certificate of coverage, prior to the other person beginning work on the project; and

(B) prior to the end of the coverage period, a new certificate of coverage showing extensions of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(6) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;

(7) notify the governmental entity in writing by certified mail or personal delivery, of any change that materially affects the provision of coverage of any person providing services on the project and send the notice within ten days after the person knew or should have known of the change; and

(8) contractually require each other person with whom it contracts to:

(A) provide coverage based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements for all of its employees providing services on the project, for the duration of the project;

(B) provide a certificate of coverage to it prior to that other person beginning work on the project:

(C) include in all contracts to provide services on the project the language in paragraph (3) of this subsection;

(D) provide, prior to the end of the coverage period, a new certificate of coverage showing extension of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(E) obtain from each other person under contract to it to provide services on the project, and provide as required by its contract;

(i) a certificate of coverage, prior to the other person beginning work on the project; and

(ii) prior to the end of the coverage period, a new certificate of coverage showing extension of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the contract;

(F) retain all required certificates on file for the duration of the project and for one year thereafter;

(G) notify the governmental entity in writing by certified mail or personal delivery, within ten days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(H) contractually require each person with whom it contracts, to perform as required by this subparagraph and subparagraphs (A)-(G) of this paragraph, with the certificates of coverage to be provided to the person for whom they are providing services.

(f) If any provision of this rule or its application to any person or circumstance is held invalid, the invalidity does not affect other provisions or applications of this rule that can be given effect without the invalid provision or application, and to this end the provision of this rule declared to be severable.

(g) This rule is applicable for building or construction contracts advertised for bid by a governmental entity on or after September 1, 1994. This rule is also applicable for those building or construction contracts entered into on or after September 1, 1994, which are not required by law to be advertised for bid.

(h) The coverage requirement in this rule does not apply to motor carriers who are required pursuant to Texas Civil Statutes, Article 667c, to register with the Texas Department of Transportation and who provide accidental insurance overage pursuant to Texas Civil Statutes 667c, §4(j).

(i) The coverage requirement in this rule does not apply to sole proprietors, partners, and corporate officers who meet the requirements of the Act, §406.097(c), and who are explicitly excluded from coverage in accordance with the Act, §406.097(a) (as added by House Bill 1089, 74th Legislature, 1995, §1.20). This subsection applies only to sole proprietors, partners, and corporate executive officers who are excluded from coverage in an insurance policy or certificate of authority to self-insure that is delivered, issued for delivery, or renewed on or after January 1, 1996.

The provisions of this §110.110 adopted to be effective September 1, 1994, 19 TexReg 5715; amended to be effective November 6, 1995, 20 TexReg 8609.

Bid Bond

A bid bond in the amount of 5% of the Bid issued by an acceptable surety shall be submitted with each bid. A certified check or Band Draft payable to the Frant Recipient or negotiable U.S. Government Bonds (as per value) may be submitted in lieu of the Bid Bond.

Performance and Payment Bond

Performance and Payment Bonds, Requires all prime contractors which enter into a formal contract in excess of $25,000 with the State, any department, board, agency, municipality, county, school district or any division or subdivision thereof, to obtain a Payment Bond in the amount of the contract before commencing with work and performance bond for public works contracts in excess of $100,000.

The failure of the successful bidder to execute the agreement and supply the the required bonds within ten (10) days after the prescribed forms are presented for signature, or within such extended period as the Grant Recipient may grant, shall constitute a default and the Grand Recipient may, at its option either award the contract to next lowest responsible bidder, or re-advertise for bids. In either case, the Grant Recipient may charge against the bidder the difference between the amount of the bid, and the amount for which a contract is subsequently executed irrespective of whether this difference exceeds the amount of the bid bond. If a more favorable bid is received through re-advertisement, the defaulting bidder shall have no claim against the Grant Recipient for a refund.

PROOF OF NO DELINQUENT TAXES OWED TO WEBB COUNTY

This is to certify that _____ owes no delinquent property taxes to Webb County.

_____ owes no property taxes as a business in Webb County.
(Business Name)

_____ owes no property taxes as a resident of Webb County.
(Business Owner)

_____
Person who can attest to the above information

*** SIGNED DOCUMENT AND PROOF OF NO DELINQUENT OR OWED TAXES TO WEBB COUNTY.**

HVAC MODIFICATIONS TO WEBB COUNTY JAIL-REBID

Bidder Information

Name of Company_____

Address:_____

Phone: _____

Email Address:_____

Signature of Person Authorized to Sign Bid:

_____
Signature

_____
Print Name

_____
Title

Bid must complete this document in its entirety in order for it to be valid.

HVAC MODIFICATIONS TO WEBB COUNTY JAIL

REGISTRATON NUMBER F-1842

UNITECH ENGINEERING
733 N. WARE RD., SUITE D
MCALLEN, TEXAS 78501

THIS DOCUMENT IS RELEASED UNDER THE AUTHORITY OF ROBERTO DE LA CRUZ, P.E. 85431 ON 5/06/2011

DIVISION 15 – MECHANICAL

15010 SUMMARY OF MECHANICAL WORK
15050 BASIC MECHANICAL MATERIALS AND METHODS
15060 HANGERS AND SUPPORTS
15083 PIPE INSULATION
15110 VALVES
15181 HYDRONIC PIPING
15185 HYDRONIC PUMPS
15682 SCROLL CHILLERS
15725 AIR HANDLING UNITS
15900 Alternate 2 / FACILITY MANAGEMENT SYSTEM
15990 TESTING, ADJUSTING, AND BALANCING

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
PROFESSIONAL ENGINEER

6/6/2011

SECTION 15010

SUMMARY OF MECHANICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and other Division 15 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.

Mechanical Contract Documents, were prepared for the Project by:

Unitech Engineering, Inc
733 N. Ware Road, Ste. D
Phone Number: (956) 585.9495
Contact Person: Robert De La Cruz, PE

C. General Scope of Work: HVAC/ELECTRICAL: Provide all materials and labor associated with a complete operational installation of renovation to HVAC systems including, but not limited to:

1. Remove existing chillers, ahu, and controls.
2. Provide new chillers, pumps, fan coil, and ahu units on 2-4 floors.
3. Provide new DDC controls as alternate.
4. Provide new chilled water valves, accessirues
5. Electrical: Provide all materials and labor to provide power to equipment being modified or installed on this project.
   a. Conduit, Wiring, Circuit panels, breakers, Fixtures
   b. Provide new starters for all new pumps and fan coil/ac units.
   c. Provide and activate new smoke detectors for FC 1 through 12 and AC 1 through 6.
   d. VFD for pump 1 (P1) shall have a NEMA 3R enclosure.
2. Asbestos analysis and abatement will be by Webb County
3.

1.3 COORDINATION

A. All mechanical work shall be done under sub-contract to a General Contractor. Mechanical Contractor shall coordinate all work through General Contractor, even in areas where only mechanical work is to take place.

B. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.

C. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

D. Fully coordinate with electrical contractor for providing power to mechanical equipment.

E. Mechanical Contractor is responsible for all control wiring including thermostat(s). This includes all conduit, wire, and accessories both low voltage and source voltage for the controls' system. Mechanical Contractor will provide all the necessary actuators, relays, software, hardware, and all necessary accessories required for a fully functional controls' system.

1.5 UTILITIES

1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.6 CONTRACTOR USE OF PREMISES

A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy and use by the public.
2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:

1. Temporary fencing around construction areas.
2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
3. Temporary fencing around equipment while site work is in progress.

1.7 BETTERMENT FUND

1.7.1 Provide $25,000 as part of bid for improvements to project.

1.7.2 Provide an allowance of $3,000 for repair and alterations to existing controls

1.8 SUBMITTALS

1. To extradite the submittal process more efficiently, **do not piece-meal the submittals**. Submit entire mechanical, electrical and plumbing in a bound enclosure. This will eliminate delays and mistakes in the submittal process.

END OF SECTION

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete base construction requirements.
3. Escutcheons.
4. Dielectric fittings.
5. Flexible connectors.
6. Mechanical sleeve seals.
7. Equipment nameplate data requirements.
8. Nonshrink grout for equipment installations.
9. Field-fabricated metal and wood equipment supports.
10. Installation requirements common to equipment specification sections.
11. Cutting and patching.
12. Touchup painting and finishing.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

   1. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.

B. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are

important to efficient flow of the Work. Include the following:

1. Planned piping layout, including valve and specialty locations and valve-stem movement.
2. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
3. Sizes and location of required concrete pads and bases.
4. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
5. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.5 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes, ductwork, equipment, and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate with Webb County Jail for access to project. Contractor will work on approved schedule from Webb County Director. Schedule may require hours of construction that are not typical.

B. Coordinate mechanical equipment installation with other building components.

C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8.

H. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 OPERATION PRIOR TO ACCEPTANCE

A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.

B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.

C. The date of acceptance by the Engineer, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.9 SPACE AND EQUIPMENT ARRANGEMENT

A. The size of each item of mechanical equipment shown on the Drawings is based on the dimensions of a particular manufacturer as indicated. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared when required by the engineer to indicate a suitable arrangement.

B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.

C. Provide access panels acceptable to the Engineer for equipment that is concealed above ceiling space.

D. Large equipment assemblies or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. Provisions shall be implemented by the Contractor to insure that the equipment will not be damaged in any way during the associated construction procedures.

1.10 START-UP OF EQUIPMENT AND SYSTEMS

A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up service (rendered by the manufacturer) shall be provided.

B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.

1.11 INSTRUCTION OF OWNER'S PERSONNEL

A. Provide the services of competent engineers or technicians acceptable to the Engineer to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or

his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.

B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.

C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include piping diagrams, valve identification charts, control and interlocking wiring diagrams, manufacturers' operation and maintenance manuals, parts lists (with sources identified), and other data as appropriate for each system, and as required elsewhere in the Specifications to be furnished to the Owner prior to final acceptance of the project.

D. Provide the Owner with three (3) complete sets of all maintenance manuals, pamphlets, brochures or instructions. This material shall be catalogued, indexed and bound into books.

1.12 ACCEPTABLE MANUFACTURERS

A. Provide equipment and materials from listed manufacturers listed within this specification. Deviations from this specification will not be acceptable. When one manufacturer is listed, alternate materials and equipment may be provided "equal to" the listed. When more than one manufacturer is listed, equipment and material must be provided by one of the listed manufacturers.

PART 2 - PRODUCTS

2.1 STANDARD PRODUCTS

A. Each item of equipment furnished under this Division of the Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same kind or class of equipment are required, these shall be the products of a single manufacturer; however, the component parts of the equipment need not be the products of one manufacturer.

B. Materials and equipment shall be of the base quality normally used in good commercial practice, and shall be the products of reputable domestic manufacturers unless otherwise specified. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.

2.2 QUALITY AND CLASSIFICATION OF MATERIALS

A. Materials and equipment shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site, but shall be replaced with new materials or equipment identical with those damaged.

B. Wherever a UL standard has been established for a particular type of material or equipment, each such material or equipment provided on this project shall meet the requirements of the UL standard in every way and shall be UL listed and labeled.

2.3 LOCAL PARTS AND SERVICE

A. Each item of equipment furnished on this project shall have local representation, factory-authorized service, and an adequate stock of repair parts. "Local"

shall be defined, for this purpose, as "within 50 miles of the project site."

2.4 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.5 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dielectric Unions:

   a. Watts Industries, Inc.; Water Products Div.
   b. Zurn Industries, Inc.; Wilkins Div.

2. Mechanical Sleeve Seals:

   a. Calpico, Inc.
   b. Metraflex Co.
   c. Thunderline/Link-Seal.

2.6 PIPE AND PIPE FITTINGS

A. Refer to individual Division 15 piping Sections for pipe and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.7 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.

F. Brazing Filler Metals: AWS A5.8.

1. BCuP Series: Copper-phosphorus alloys.
2. BAg1: Silver alloy.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements: Manufacturer's standard solvent cements for the following:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
2. PVC to ABS Piping Transition: ASTM D 3138.

I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.

K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.8 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

2.9 MECHANICAL SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.10 PIPING SPECIALTIES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

   a. Underdeck Clamp: Clamping ring with set screws.

B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.

1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
2. OD: Completely cover opening.
3. Cast Brass: One piece, with set screw.

   a. Finish: Rough brass.
   b. Finish: Polished chrome-plate.

4. Cast-Iron Floor Plate: One-piece casting.

2.11 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining,

40

noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psig, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 15 piping Sections specify unique piping installation requirements.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

C. Install piping at indicated slope.

D. Install components with pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install fittings for changes in direction and branch connections.

L. Install couplings according to manufacturer's written instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

41

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Build sleeves into new walls and slabs as work progresses.
3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
   b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 7 for materials.
5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

Q. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe or pipe insulation and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 7 for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to

remove burrs and restore full ID. Join pipe fittings and valves as follows:

a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
c. Align threads at point of assembly.
d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:

a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
b. PVC Nonpressure Piping: ASTM D 2855.
c. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.

9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.

a. Plain-End Pipe and Fittings: Use butt fusion.
b. Plain-End Pipe and Socket Fittings: Use socket fusion.

W. Piping Connections: Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT AND MATERIAL INSTALLATION - COMMON REQUIREMENTS

A. Install equipment and material to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment and ductwork giving right of way to piping installed at required slope.

F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 PAINTING AND FINISHING

A. Refer to Division 9 for paint materials, surface preparation, and application of paint.

B. Do not paint piping specialties with factory-applied finish.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig, 28-day compressive-strength concrete and reinforcement or as specified in Division 3.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.6 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.7 GROUTING

A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 15060

HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

B. Related Sections include the following:

1. Division 5 Sections for materials for attaching hangers and supports to building structure.
2. Division 13 Sections on fire-suppression piping for fire-suppression pipe hangers.
3. Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for vibration isolation and seismic restraint devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.5 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.

1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pipe Hangers:

a. Miro Industries
b. Grinnell Corp.
c. Michigan Hanger Co., Inc.

2.2 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.3 MISCELLANEOUS MATERIALS

A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
3. Extension Hinged Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.

D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger

rods to various types of building attachments.

4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. C-Clamps (MSS Type 23): For structural shapes.
5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
6. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
7. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching tobottom of steel I-beams for heavy loads, with link extensions.
8. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Field assemble and install according to manufacturer's written instructions.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional

attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

I. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.9.

2. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION

SECTION 15083

PIPE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Sections include the following:

1. Division 15 Section "Duct Insulation" for insulation for ducts and plenums.
2. Division 15 Section "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
3. Division 15 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for insulation application.

C. Coordinate installation and testing of steam or electric heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after testing piping systems, Duct systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mineral-Fiber Insulation:
   a. CertainTeed Manson.
   b. John Mansville
   c. Owens-Corning Fiberglas Corp.
   d. Schuller International, Inc.
2. Flexible Elastomeric Thermal Insulation:
   a. Armstrong World Industries, Inc.
   b. Rubatex Corp.

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.

2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.

3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.

4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.

B. Flexible Elastomeric Thermal Insulation used on Refrigerant Piping: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Adhesive: As recommended by insulation material manufacturer.

2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- (0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.

2. Adhesive: As recommended by insulation material manufacturer.

D. Aluminum Jacket: Factory cut and rolled to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.

1. Finish and Thickness: Smooth finish, 0.010 inch (0.25 mm) thick.

2. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.

3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).

1. Tape Width: 4 inches (100 mm).

B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

1. Aluminum: 0.007 inch (0.18 mm) thick.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for

installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

G. Keep insulation materials dry during application and finishing.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the least number of joints practical.

J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments. Insulation around hanger or pipe clamp will not be acceptable.

2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

N. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and

outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.

3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

   a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.

2. Apply insulation for exterior applications tightly joined to interior insulation ends.

3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

4. Seal metal jacket to roof flashing with vapor-retarder mastic.

P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.

2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.

3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at

least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.

3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.

3. Apply insulation to flanges as specified for flange insulation application.

4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.

2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.

2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.

3. Apply insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.

3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.

1. Draw jacket material smooth and tight.

2. Apply lap or joint strips with the same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

C. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.7 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.

2. Fire-suppression piping.

3. Drainage piping located in crawl spaces, unless otherwise indicated.

4. Below-grade piping, unless otherwise indicated.

5. Chrome-plated pipes and fittings, unless potential for personnel injury.

6. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.8 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic hot and recirculated hot water.

1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).

2. Insulation Material: Mineral fiber with a minimum of K of 0.24 at 75 degrees F.

3. Insulation Thickness: Apply the following insulation thicknesses:

   a. Tempered hot water piping to be provided with 1" insulation.

4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

B. Service: Domestic cold water.

1. Operating Temperature: 35 to 60 deg F (2 to 15 deg C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses: 1"

   a. Tempered cold water piping to be provided with ½" insulation.

4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

C. Service: Rainwater conductors.

1. Operating Temperature: 32 to 100 deg F (0 to 38 deg C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses: 1-1/2"
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

D. Service: Roof drain bodies.

1. Operating Temperature: 32 to 100 deg F (0 to 38 deg C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: 1-1/2"
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

E. Service: Condensate drain piping.

1. Operating Temperature: 35 to 75 deg F (2 to 24 deg C).
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: ½"
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

F. Service: Exposed sanitary drains and domestic water supplies and stops for fixtures for the disabled.

1. Operating Temperature: 35 to 120 deg F (2 to 49 deg C).
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: ½"
4. Field-Applied Jacket: PVC P-trap and supply covers.
5. Vapor Retarder Required: No.
6. Finish: Painted.

G. Service: Chilled-water supply and return.

1. Operating Temperature: 35 to 75 deg F (2 to 24 deg C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses: 2"
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finish: None.

H. Service: Refrigerant suction and hot-gas piping.

1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses: 1"
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.

6. Finish: None.

3.9 EXTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic water.

1. Operating Temperature: 35 to 140 deg F (15 to 60 deg C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses: 1"
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.

B. Service: Refrigerant suction.

1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses: 1"
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.

C. Service: Chilled-water supply and return.

1. Operating Temperature: 35 to 75 deg F (2 to 24 deg C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses: 2"
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.

END OF SECTION

SECTION 15110

VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following general-duty valves:

1. Copper-alloy ball valves.
2. Bronze check valves.
3. Bronze gate valves.
4. Cast-iron gate valves.

B. Related Sections include the following:

1. Division 2 piping Sections for general-duty and specialty valves for site construction piping.
2. Division 13 fire-suppression piping and fire pump Sections for fire-protection valves.
3. Division 15 Section "Mechanical Identification" for valve tags and charts.
4. Division 15 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

1. Exceptions: , sanitary waste, and storm drainage piping valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do

not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.

   b. Grinnell Corporation.

   c. Hammond Valve.

   d. Milwaukee Valve Company.

   e. NIBCO INC.

   f. Red-White Valve Corp.

   g. Watts Industries, Inc.; Water Products Div.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Handwheel: For valves other than quarter-turn types.

2. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Valve Grooved Ends: AWWA C606.

1. Solder Joint: With sockets according to ASME B16.18.

   a. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, gate, and globe valves; below 421 deg F (216 deg C) for ball valves.

2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

A. Copper-Alloy Ball Valves, General: MSS SP-110.

B. One-Piece, Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 400-psig (2760-kPa) minimum] [600-psig (4140-kPa)] CWP rating.

C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.

2.4 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Type 1, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with bronze disc and seat.

C. Type 1, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with bronze disc and seat.

2.5 BRONZE GATE VALVES

A. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.

B. Type 1, Class 125, Bronze Gate Valves: Bronze body with nonrising stem and

bronze solid wedge and union-ring bonnet.

2.6 CAST-IRON GATE VALVES

A. Cast-Iron Gate Valves, General: MSS SP-70, Type I.

B. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.

C. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

2.7 CAST-IRON PLUG VALVES

A. Cast-Iron Plug Valves, General: MSS SP-78.

B. Class 125 or 150, lubricated-type, cast-iron plug valves.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, gate, or plug valves.

2. Throttling Service: Ball, butterfly, or globe valves.

3. Pump Discharge: Swing check, lift-disc check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Chilled-Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 400-psig (2760-kPa) CWP rating, copper alloy.

2. Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Flanged, [150-psig (1035-kPa)] [175-psig (1207-kPa)] CWP rating, ferrous alloy, with EPDM liner.

3. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: 175-psig (1207-kPa) CWP rating.

D. Domestic Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, [400-psig (2760-kPa)]CWP rating, copper alloy.

2. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 150, ferrous alloy.

3. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class [125] [150], bronze.

4. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 125, gray iron.

5. Gate Valves, NPS 2 (DN 50) and Smaller: Type [1] [2], Class 150] , bronze.

6. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 125, bronze-mounted cast iron.

E. Specialty Hydronic Piping Valves

1. Calibrated Balancing Valves, NPS 2 (DN 50) and Smaller: Brass body, ball type, 125-psig (860-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

END OF SECTION

SECTION 15181

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping, and hydronic specialties for chilled-water cooling; makeup water for these systems; blowdown drain lines; and condensate drain piping.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
2. Division 15 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
3. Division 15 Section "Valves" for general-duty gate, globe, ball, butterfly, and check valves.
4. Division 15 Section "Meters and Gages" for thermometers, flow meters, and pressure gages.
5. Division 15 Section "Mechanical Identification" for labeling and identifying hydronic piping.
6. Division 15 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
7. Division 15 Section "HVAC Instrumentation and Controls" for temperature-control valves and sensors.

1.3 SUBMITTALS

A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.

B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Maintenance Data: For hydronic specialties to include in maintenance manuals specified in Division 1.

D. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with

requirements for firestopping specified in Division 7.

1.6 EXTRA MATERIALS

A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ~~Grooved Mechanical Joint Fittings and Couplings:~~
   - ~~a. Mueller Industries~~
   - ~~b. Grinnell Corporation.~~
   - ~~c. Victaulic Company of America.~~
2. Expansion Tanks:
   - a. Amtrol, Inc.
   - b. Armstrong Pumps, Inc.
   - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
   - d. Taco, Inc.
3. Air Separators and Air Purgers:
   - a. Amtrol, Inc.
   - b. Armstrong Pumps, Inc.
   - c. ITT Bell & Gossett; ITT Fluid Technology Corp.

B. Chemicals and Aqua Pass Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, side-stream filter cartidge and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).

C. Wrought-Copper Fittings: ASME B16.22.

D. Wrought-Copper Unions: ASME B16.22.

E. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.

F. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe, NPS 2 (DN 50) and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40, black steel, plain ends.

B. Steel Pipe, NPS 2-1/2 through NPS 12 (DN 65 through DN 300): ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.

C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.

D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.

E. Malleable-Iron Unions: ASME B16.39; Classes 150.

F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Class 125; raised ground face, and bolt holes spot faced.

G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.

3. Facings: Raised face.

I. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.5 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 240 deg F (116 deg C) operating temperature; with NPS 1/4 (DN 8) discharge connection and NPS 1/2 (DN 15) inlet connection.

C. Expansion Tanks: Welded carbon steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible [diaphragm] [bladder] securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

D. Tangential-Type Air Separators: Welded black steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into expansion tank; tangential inlet and outlet connections; threaded connections for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger; threaded blowdown connection. Provide units in sizes for full-system flow capacity.

E. In-Line Air Separators: One-piece cast iron with an integral weir designed to decelerate system flow to maximize air separation at a working pressure up to 175 psig (1206 kPa) and liquid temperature up to 300 deg F (149 deg C).

F. Air Purgers: Cast-iron body with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal. Maximum working pressure of 150 psig (1035 kPa) and temperature of 250 deg F (121 deg C).

G. Y-Pattern Strainers: 125-psig (860-kPa) working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 (DN 65) and larger, threaded connections for NPS 2 (DN 50) and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

H. Basket Strainers: 125-psig (860-kPa) working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.

I. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment.

J. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F (121 deg C) and pressures up to 150 psig (1035 kPa).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Chilled Water, NPS 2 (DN 50) and Smaller: Schedule 40 steel pipe with threaded joints.

B. Chilled Water, NPS 2-1/2 (DN 65) and Larger: Schedule 40 steel pipe with welded. JOINTS,

C. Condensate Drain Lines: Type L (Type B) drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:

1. Shutoff Duty: Gate, ball, and butterfly valves.
2. Throttling Duty: Ball and butterfly valves.

B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

3.3 PIPING INSTALLATIONS

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.

B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

F. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the top of the main pipe.

G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

H. Anchor piping for proper direction of expansion and contraction.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. **Chilled Water Pipe Supports on Roof -Miro Industries – Model #6-RAH-RS SS or equal**

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).

65

3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).

4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).

6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).

7. NPS 4 (DN 100): Maximum span, 12 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

8. NPS 6 (DN 150): Maximum span, 12 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).

9. NPS 8 (DN 200): Maximum span, 12 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).

2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).

3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, and welded joints in steel piping.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install automatic air vents at high points of system piping, and elsewhere as required for system air venting.

B. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install drain valve on units NPS 2 (DN 50) and larger.

C. Install combination air separator and strainer in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install blowdown piping with gate valve; extend to nearest drain.

D. Install bypass chemical/filter feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.

E. Install expansion tanks. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with butterfly or ball valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.

D. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to the following:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot

sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush system with clean water. Clean strainers.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

6. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

7. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.

8. Check expansion tanks to determine that they are not air bound and that system is full of water.

9. Subject piping system to hydrostatic test pressure that is 1.5 times the design pressure but not less than 100-psig (690-kPa). Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."

10. After hydrostatic test pressure has been applied for at least 30 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

3.9 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.

2. Check pump for proper direction of rotation.

3. Set automatic fill valves for required system pressure.

4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.

6. Check operation of automatic bypass valves.

7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.

3.10 CLEANING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION

SECTION 15185

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following categories of hydronic pumps for hydronic systems:

1. End-suction pumps.

1.3 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities; shipping, installed, and operating weights; furnished specialties; final impeller dimensions; and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For pumps to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. UL Compliance: Fabricate and label pumps to comply with UL Standards.

B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexible-Coupled, End-Suction Pumps:

a. Bell & Gossett.

b. PACO Pumps.

c. Taco; Fabricated Products Div.

2.2 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Pump shall be rated for outdoor use.

C. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.

D. Motors Indicated to Be Energy Efficient: Minimum efficiency as indicated according to IEEE 112, Test Method B. Include motors with higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B, if efficiency is not indicated.

E. Provide pumps with a minimum of 125% shut-off head.

F. Impellor diameter shall not exceed 90% of the diameter available for a given casing size.

2.3 FLEXIBLE-COUPLED, END-SUCTION PUMPS

A. Description: Base-mounted, centrifugal, flexible-coupled, end-suction, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for 175-psig (1200-kPa) minimum working pressure and a continuous water temperature of 225 deg F (107 deg C).

1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.

2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.

3. Wear Rings: Replaceable, bronze casing ring.

4. Shaft and Sleeve: Steel shaft with bronze sleeve.

5. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.

6. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.

7. Coupling Guard: Steel, removable, and attached to mounting frame.

8. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.

9. Motor: Secured to mounting frame, with adjustable alignment.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle or straight pattern, 175-psig (1200-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig (1200-kPa) pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.

1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Install pumps according to manufacturer's written instructions.

B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps.

D. Set base-mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches (19 to 38 mm) between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are the same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install suction diffuser and shutoff valve on suction side of base-mounted pumps.

F. Install triple-duty valve on discharge side of base-mounted pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install temperature and pressure-gage connector plugs in suction and discharge piping around each pump.

I. Install electrical connections for power, controls, and devices.

J. Electrical power and control wiring and connections are specified in Division 16 Sections.

K. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.

2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."

3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 15682
AIR COOLED SCROLL CHILLERS

PART 1 - GENERAL

PART 1: 1.01 GENERAL

1.01 SUMMARY

A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for air cooled scroll compressor chillers.

1.02 REFERENCES

A. Comply with applicable Standards/Codes of ARI 550/590-2003 ANSI/ASHRAE 15, ETL, cETL, NEC, and OSHA as adopted by the State.

B. Units shall meet the efficiency standards of ASHRAE Standard 90.1, October 2001.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with the specifications.

B. Submittals shall include the following:

1. Dimensioned plan and elevation view drawings, required clearances, and location of all field connections

2. Summary of all auxiliary utility requirements such as electricity, water, etc. Summary shall indicate quality and quantity of each required utility.

3. Single line schematic drawing of the field power hookup requirements, indicating all items that are furnished.

4. Schematic diagram of control system indicating points for field interface/connection.

5. Diagram shall fully delineate field and factory wiring.

6. Certification of factory-run test of chiller unit signed by company officer.

7. Installation manuals.

1.04 QUALITY ASSURANCE

A. Qualifications: Equipment manufacturer must specialize in the manufacture of the products

specified and have five years experience with the type of equipment.

B. Regulatory Requirements: Comply with the codes and standards specified.

C. Chiller manufacturer plant must be ISO9002 Registered.

1.05 DELIVERY AND HANDLING

A. Chillers shall be delivered to the job site completely assembled (except units with remote evaporators) and charged with refrigerant and oil by the manufacturer.

B. Comply with the manufacturer's instructions for rigging and handling equipment.

1.06 WARRANTY

A. The refrigeration equipment manufacturer's guarantee shall be for a period of five years from date of equipment start-up but not more than 68 months from shipment. The guarantee shall provide for repair or replacement due to failure by material and workmanship that prove defective within the above period. Warranty shall cover parts, labor and refrigerant.

1.07 MAINTENANCE

A. Maintenance of the chillers shall be the responsibility of the owner and performed in accordance with the manufacturer's instructions.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. McQuay International

B. YORK

C. CARRIER

2.02 UNIT DESCRIPTION

A. Provide and install as shown on the plans factory-assembled, factory-charged, air-cooled, R-410A, scroll-compressor packaged water chillers in the quantity specified. Each chiller shall consist of hermetic tandem or triple scroll compressor sets (total four or six compressors), direct expansion evaporator, air-cooled condenser section,

microprocessor-based control system and all components necessary for optimum full and part load operation.

2.03 DESIGN REQUIREMENTS

A. General: Provide a complete scroll compressor packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02 and any local codes in effect.

B. Performance: Refer to the schedule of performance on the drawings. The chiller shall be capable of stable operation to a minimum of 50 percent of full load without hot gas bypass. Performance shall be in accordance with ARI Standard 550/590.

C. Acoustics: Sound pressure levels for the unit shall not exceed the following specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with ARI Standard 370.

Sound Pressure (at 30 fe							
63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
66	66	66	62	59	54	49	44
Sound Power							
63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
93	93	93	89	86	81	76	71

2.04 CHILLER COMPONENTS

A. Compressors: The compressors shall be sealed hermetic, scroll type with crankcase oil heater and suction strainer. Compressor shall have a forced-feed lubrication system with a reversible oil pump and oil charge. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads.

B. Evaporator

1. Standard Package -
   a. The evaporator shall be a compact, high efficiency, dual circuit, copper-brazed plate-to-plate type heat exchanger consisting of

parallel stainless steel plates.

b. The evaporator shall be protected with an electric resistance heater and insulated with 3/4"(19mm) thick closed-cell polyurethane insulation. This combination shall provide freeze protection down to -20° F (-29° C) ambient air temperature.

c. The water-side working pressure shall be a minimum of650 psig (4500 kPa). Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing contractor. Evaporators shall be designed and constructed according to, and listed by, Underwriters Laboratories (UL).

C. Condenser

1. Standard Package Condenser -

a. The condenser coils shall consist of 3/8 inch (10mm) seamless copper tubes mechanically bonded into plate-type fins. The fins shall have full drawn collars to completely cover the tubes.

b. A subcooling coil shall be an integral part of the main condenser coil. Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. They shall be equipped with a heavy-gauge fan guard. Fan motors shall be TEAO, three-phase, direct-drive, 1140 rpm.

D. Refrigerant Circuit

1. Standard Package - The refrigerant circuit shall include a refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), thermal

expansion valve, and insulated suction line.

E. Construction - Unit casing and all structural members and rails shall be fabricated of steel and painted to meet ASTM B117, 500-hour salt spray test.

F. Control System - A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Power and starting components shall include factory circuit breaker of fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and unit power terminal blocks for connection to remote disconnect switch. Terminals shall also be provided for power supply to the evaporator heater circuit. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.

G. An advanced DDC microprocessor unit controller with a 4-line by 20-character liquid crystal display provides the operating and protection functions. The controller shall take pre-emptive limiting action in case of high discharge pressure or low evaporator pressure.The controller shall contain the following features as a minimum:

1. Equipment Protection - The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

2. Shutdown Alarms

   a. No evaporator water flow
   b. Sensor failures
   c. Low evaporator pressure
   d. Evaporator freeze protection

e. High condenser pressure
f. Outside ambient temperature
g. Motor protection system
h. Phase voltage protection (Optional)

3. Limit Alarms

   a. Condenser pressure stage down, unloads unit at high discharge pressures
   b. Low ambient lockout, shuts off unit at low ambient temperatures
   c. Low evaporator pressure hold, holds stage #1 until pressure rises
   d. Low evaporator pressure unload, shuts off one compressor

4. Unit Enable Selection - Enables unit operation from either local keypad, digital input, or BAS

5. Equipment Protection - The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

6. Unit Mode Selection - Selects standard cooling, ice, glycol, or test operation mode

7. Analog Inputs - Reset of leaving water temperature, 4-20 mA

8. Digital Inputs

   a. Unit off switch
   b. Remote start/stop
   c. Flow switch
   d. Ice mode switch, converts operation and setpoints for ice production
   e. Motor protection

9. Digital Outputs

   a. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
   b. Evaporator pump; field wired, starts pump when unit is set to start

10. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

11. Building Automation System (BAS) Interface

    a. Factory mounted DDC controller(s) shall support operation on a BACnet®, Modbus® or LONMARK ® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.

    b. BACnet MS/TP master (Clause 9)

    c. BACnet IP, (Annex J)

    d. BACnet ISO 8802-3, (Ethernet)

    e. LONMARK FTT-10A. The unit controller shall be LONMARK® certified.

    f. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

    g. For chillers communicating over a LONMARK network, the corresponding LONMARK eXternal Interface File (XIF) shall be provided with the chiller submittal data.

    h. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet

Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.05 OPTIONS AND ACCESSORIES

A. The following options are to be included:

1. Single- point power connection to non-fused disconnect switch, with individual circuit breakers

2. Phase loss with under/over voltage protection and with LED indication of the fault type.

3. 115 Volt convenience outlet, unit powered.

4. BACNet or LON communication card. Coordinate type with successful controls contractor.

5. Suction and discharge service valves.

6. The following accessories are to be included:

   a. Spring vibration isolators for field installation
   b. Chilled water flow switch to be field mounted in the chilled water line and field wired to terminals in the control panel

B. Install in strict accordance with manufacturer's requirements, shop drawings, and contract documents.

C. Adjust and level chiller in alignment on supports.

D. Coordinate electrical installation with electrical contractor.

E. Coordinate controls with control contractor.

F. Install a field-supplied strainer in the chilled water return line at the evaporator inlet; 40-mesh on units with brazed-plate evaporators or 20-mesh on shell-and-tube evaporators.

2.06 START-UP

A. Install proper charge of refrigerant and oil.

B. Provide testing and starting of machine, and instruct the Owner in its proper operation and maintenance.

END OF SECTION

SECTION 15725 - AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Air handling units.

1.02 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AMCA 99 - Standards Handbook.

C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

E. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.

F. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

G. ARI 430 - Central-Station Air-Handling Units.

H. ARI 435 - Application of Central-Station Air-Handling Units.

I. ASTMB117 - Standard Practice for Operating Salt Spray Apparatus.

J. NEMA MG1 - Motors and Generators.

K. NFPA 70 - National Electrical Code.

L. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

M. UL 723 - Test for Surface Burning Characteristics of Building Materials.

N. UL 900 - Test Performance of Air Filter Units.

O. UL 1995 - Standard for Heating and Cooling Equipment.

P. UL 94 - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 SUBMITTALS

A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and

connection requirements. Computer generated fan curves for each air handling unit shall be submitted with specific design operating point noted. A computer generated psychometric chart shall be submitted for each cooling coil with design points and final operating point clearly noted.

B. Product Data.

1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.

2. Provide data of filter media, filter performance data, filter assembly, and filter frames.

3. Manufacturer's Installation Instructions.

1.04 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include instructions for lubrication and filter, motor, and drive replacement.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Air Handler products specified in this section must show a minimum five years documented experience and complete catalog data on total product.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept products on site on factory-installed shipping skids. Inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are approved for use. No substitutions.

1. McQuay - 'Destiny' Air Handler is the basis of design, including standard product features and all special features required per plans and specifications.
2. YORK
3. CARRIER

2.02 AIR HANDLER TYPE AND ARRANGEMENT

A. The air handler shall be furnished as a horizontal draw-through cooling coil only type.

2.03 AIR HANDLER CASING

A. Air handler casing shall be constructed with a corrosion resistant aluminum frame with 1" thick, double wall panels with minimum R-6 insulation. Extruded aluminum frame and polymeric corner pieces are required for casing protection and rigidity. Unit panels shall consist of injected polyurethane foam insulation sandwiched between galvanized steel exterior and interior sheets. Formed "thermal break" panels shall have a plastic molded edge to eliminate inner and outer panels from contacting each other.

1. Panels shall be fastened to frame with perimeter screws with a neoprene gasket in-between the panel and the frame to minimize air leakage and prevent thermal bridging from unit interior to unit exterior. Hinged and latched access panels for blower and filter sections shall be furnished on the drive side to allow access to unit interior. Blower panel shall be furnished two, quarter-turn open-to-close, latch assemblies, one tooled flathead screw type and one with lever handle operation. Filter access panels shall be provided with hinges and two, quarter-turn open-to-close latch assemblies on the drive side only.

2.04 SUPPLY FAN

A. The supply fan shall be a DWDI forward-curved type. Fan assemblies including fan, motor and sheaves shall be dynamically balanced by the manufacturer on all three planes at all bearing supports. Manufacturer must ensure maximum fan RPM is below the first critical speed.

B. Fan and motor assembly shall be mounted on vibration type isolators inside cabinetry.

C. Units shall be certified in accordance with the central station air handling units certification program that is based on ARI Standard 430.

2.05 BEARINGS AND DRIVES

A. Basic load rating computed in accordance with AFBMA - ANSI Standards, L-50 life at 200,000 hours heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.

B. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

C. V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch sheaves selected so required RPM is obtained with sheaves set at mid-position and rated based on motor horsepower. Contractor to furnish fixed sheaves at final RPM as determined by balancing contractor.

2.06 ELECTRICAL

A. Motor shall be a premium efficiency open drip-proof type. Electrical characteristics shall be as shown on the schedule.

B. Air handler power connections and any control devices shall be field provided.

2.07 COOLING AND HEATING SECTIONS

A. Access to coils for service and cleaning shall be provided. Coil headers and return bends shall be fully encased within unit casing. Coil connections shall be factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and inner liner where each pipe extends through the unit casing to minimize air and condensate leakage.

B. Cooling Coils.

1. Cooling performance shall be as specified on the unit schedule.

2. Water coil fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Seamless copper tubes shall be mechanically expanded into the fins to provide a continuous primary-to-secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins. Coil casing shall be constructed of stainless steel.

3. Water coils shall be provided with headers of seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain. Coil connections shall be copper sweat connections with connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain connections shall be furnished on the coil connection,

external to the cabinet. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point.

4. Drainpan shall be constructed from stainless steel, pitched and sloped in direction of airflow to drain connection to allow for condensate drainage. Drainpan shall be positioned above 1" thick insulated double wall panel. Condensate drain connections shall be provided on both sides of drain pan. Secondary drain connection shall be provided.

5. Coil casing shall be constructed of Stainless steel.

2.08 FILTER SECTION

A. Filter section shall be a 2-inch deep flat type furnished with MERV 6 pleated type filter.

B. Filter media shall be UL 900 listed, Class I or Class II.

PART 3: EXECUTION

3.01 INSTALLATION

A. The air handler shall be installed per manufacturer's Installation & Maintenance instructions.

END OF SECTION 15725

Section 15900
FACILITY MANAGEMENT SYSTEM

HVAC MODIFICATIONS TO WEBB COUNTY JAIL
REBID

Section 15900

FACILITY MANAGEMENT SYSTEM
HVAC MODIFICATIONS TO WEBB COUNTY JAIL
ALTERNATE #2

Contents

23 09 23 Direct-Digital Control System for HVAC

PART 1: GENERAL 1
1.0 Section Includes 1
1.1 Products Furnished But Not Installed Under This Section 1
1.2 Products Installed But Not Furnished Under This Section 1
1.3 Products Not Furnished or Installed but integrated with the Work of this Section 1
1.4 Related Sections 1
1.5 Description 2
1.6 Approved Control Systems 2
1.7 Quality Assurance 2
1.8 Codes and Standards 3
1.9 System Performance 3
1.10 Submittals 5
1.11 Warranty 7
1.12 Ownership of Proprietary Material 8
PART 2: PRODUCTS 9
2.0 Section Includes 9
2.1 Materials 9
2.2 Communication 9
2.3 Operator Interface 10
2.4 Controller Software 14
2.5 Controllers 16
2.6 Input and Output Interface 17
2.7 Power Supplies and Line Filtering 18
2.8 Auxiliary Control Devices 19
2.9 Wiring and Raceways 23
2.10 Fiber Optic Cable System 23
PART 3: EXECUTION 24
3.0 Section Includes 24
3.1 Examination 24
3.2 Protection 25
3.3 Coordination 25
3.4 General Workmanship 26
3.5 Field Quality Control 26

Section 15900

FACILITY MANAGEMENT SYSTEM
HVAC MODIFICATIONS TO WEBB COUNTY JAIL
ALTERNATE #2

3.6 Existing Equipment 26
3.7 Wiring 23
3.8 Communication Wiring 28
3.9 Fiber Optic Cable 28
3.10 Installation of Sensors 29
3.11 Flow Switch Installation 29
3.12 Actuators 30
3.13 Warning Labels 30
3.14 Identification of Hardware and Wiring 30
3.15 Programming 31
3.16 Control System Checkout and Testing 31
3.17 Control System Demonstration and Acceptance 32
3.18 Cleaning 33
3.19 Training 33

23 09 93 Sequence of Operations for HVAC Controls

PART 1: GENERAL 1
1.1 Single Zone Unit 1
1.2 Multizone - AHU 4
1.3 Multizone - Zone Damper 7
1.4 Chiller Interface 9
1.5 Chilled Water Loop Pumps 10
1.6 Point Summary 12
APPENDIX A: Glossary of Terms ..... **Error! Bookmark not defined.**
APPENDIX B: Abbreviations ..... **Error! Bookmark not defined.**

23 09 23 Direct-Digital Control System for HVAC

PART 1: GENERAL

1.0 Section Includes

1.1 Products Furnished But Not Installed Under This Section

1.2 Products Installed But Not Furnished Under This Section

1.3 Products Not Furnished or Installed but integrated with the Work of this Section

1.4 Related Sections

1.5 Description

1.6 Approved Control Systems

1.7 Quality Assurance

1.8 Codes and Standards

1.9 System Performance

1.10 Submittals

1.11 Warranty

1.12 Ownership of Proprietary Material

1.1 Products Furnished But Not Installed Under This Section

- None

1.2 Products Installed But Not Furnished Under This Section

- None

1.3 Products Not Furnished or Installed but integrated with the Work of this Section

- None

1.4 Related Sections

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

1.5 Description

A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
B. The system shall directly control HVAC equipment as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints as specified in the sequence.
C. Provide for future system expansion to include monitoring of occupant card access, fire alarm, and lighting control systems.
D. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends, and alarms specified in Section 23 09 93 – "Sequence of Operations for HVAC Controls" shall be BACnet objects.
E. Provide a new desktop computer with software to operate controls system. Location of computer to be determined by owner.

1.6 Approved Control Systems

A. The following are approved control system suppliers, manufacturers, and product lines:
    1. Automated Logic Corporation
    2. Johnson Controls
B. The above list does not indicate order of preference. Inclusion on this list does not guarantee acceptance of products or installation. Control systems shall comply with the terms of this specification.
    1. The Contractor shall use only operator workstation software, controller software, custom application programming language, and controllers from the corresponding manufacturer and product line unless Owner approves use of multiple manufacturers.
    2. Other products specified herein (such as sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

1.7 Quality Assurance

A. Installer and Manufacturer Qualifications
    1. Installer shall have an established working relationship with Control System Manufacturer.
    2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.8 Codes And Standards

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
   1. National Electric Code (NEC)

1.9 System Performance

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
   1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
   2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
   3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
   4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
   5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 sec.
   6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
   7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
   8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
   9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
   10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15°C (±0.25°F)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO_2)	±50 ppm

Note 1: Accuracy applies to 10% - 100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

1.10 Submittals

A. Product Submittal Requirements: Meet requirements of Section 01 30 00 on Shop Drawings, Product Data, and Samples. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 3 prints of each drawing on 11" x 17" paper. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals within 12 weeks of contract award on the following:
   1. Direct Digital Control System Hardware
      a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
      b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
         i. Direct digital controllers (controller panels)
         ii. Transducers and transmitters
         iii. Sensors (include accuracy data)
         iv. Actuators
         v. Valves
         vi. Relays and switches
         vii. Control panels
         viii. Power supplies
         ix. Batteries
         x. Operator interface equipment
         xi. Wiring
      c. Wiring diagrams and layouts for each control panel. Show termination numbers.
      d. Floor plan schematic diagrams indicating field sensor and controller locations.
      e. Riser diagrams showing control network layout, communication protocol, and wire types.
   2. Central System Hardware and Software
      a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
      b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
         i. Central Processing Unit (CPU) or web server
         ii. Monitors
         iii. Keyboards
         iv. Power supplies
         v. Battery backups
         vi. Interface equipment between CPU or server and control panels

vii. Operating System software
viii. Operator interface software
ix. Color graphic software
x. Third-party software

c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.
d. Network riser diagrams of wiring between central control unit and control panels.

3. Controlled Systems
   a. Riser diagrams showing control network layout, communication protocol, and wire types.
   b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
   c. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
   d. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
   e. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified in Section 23 09 93. Indicate alarmed and trended points.
4. Description of process, report formats, and checklists to be used in Section 23 09 23 Article 3.17 (Control System Demonstration and Acceptance).
5. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

B. Schedules
   1. Schedule of work provided within one month of contract award, indicating:
      a. Intended sequence of work items
      b. Start date of each work item
      c. Duration of each work item
      d. Planned delivery dates for ordered material and equipment and expected lead times
      e. Milestones indicating possible restraints on work by other trades or situations
   2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Submit three copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
   1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 6 prints of each drawing on 11" x 17" paper.
   2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 09 23 Article 3.17 (Control System Demonstration and Acceptance).
   3. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:
      a. As-built versions of submittal product data.

b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
g. Graphic files, programs, and database on magnetic or optical media.
h. List of recommended spare parts with part numbers and suppliers.
i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
k. Licenses, guarantees, and warranty documents for equipment and systems.
l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

1.11 Warranty

A. Warrant work as follows:
1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Engineer will certify in

writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.

4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.12 Ownership Of Proprietary Material

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
   1. Graphics
   2. Record drawings
   3. Database
   4. Application programming code
   5. Documentation

PART 2: PRODUCTS

2.0 Section Includes

2.1 Materials

2.2 Communication

2.3 Operator Interface

2.4 Controller Software

2.5 Controllers

2.6 Input and Output Interface

2.7 Power Supplies and Line Filtering

2.8 Auxiliary Control Devices

2.9 Wiring and Raceways

2.10 Fiber Optic Cable System

2.1 Materials

A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 Communication

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
B. Install new wiring and network devices as required to provide a complete and workable control network. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
    1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller

information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 23 09 93. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.

F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.3 Operator Interface

A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information.

B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J.

C. Hardware. Each workstation or web server shall consist of the following:

1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 23 09 23 Paragraph 1.9. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Section 23 09 93, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server or workstations shall be IBM-compatible PCs with a minimum of:
   a. Intel Core 2 Duo 3 GHz processor
   b. 2 GB RAM
   c. 250 GB hard disk providing data at 100 MB/sec
   d. 16x CD-RW/DVD drive
   e. Serial, parallel, and network communication ports and cables required for proper system operation

D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:

1. Log In and Log Out. System shall require user name and password to log in to operator interface.
2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.

4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software.
1. Operating System. Web server shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows 7, Vista, Windows XP Pro, Red Hat Linux, or Sun Solaris.
2. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
    a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
    b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
    c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
    d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Adobe Flash).

F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If

furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
3. System Configuration. Operators shall be able to configure the system.
4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
5. Security. System shall require a user name and password to view, edit, add, or delete data.
    a. Operator Access. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object.
    b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
    c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section

23 09 93 – Sequence of Operations for HVAC Controls. Trends shall be BACnet trend objects.

12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports. Furnish the following standard system reports:
    a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
    b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
    c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
        i. Alarm History.
        ii. Trend Data. Operator shall be able to select trends to be logged.
        iii. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
16. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
17. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
    a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."
    b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.

c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
    i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
    ii. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

G. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.
H. Operator Workstation: Web server or workstation shall conform to BACnet Operator Workstation (B-OWS) device profile or BACnet Advanced Workstation (B-AWS) as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-OWS or B-AWS in the BACnet Testing Laboratories (BTL) Product Listing.

2.4 Controller Software

A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.15.c (Operator Activity).
C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:
    1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).

2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.

D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).
F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).
G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
H. Demand Limiting.
1. System shall monitor building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer.
2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls. When demand drops below adjustable levels, system shall restore loads as specified.

I. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.
J. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.
K. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
L. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
M. Energy Calculations.
1. System shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

N. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
O. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
P. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.

2.5 Controllers

A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 23 09 23 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

B. BACnet.
   1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
   2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
   3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
   4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
   5. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
   6. BACnet Communication.
      a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
      b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
      c. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
      d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
      e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
      f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Communication.

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
   1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
   2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

E. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.

F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

G. Serviceability.
   1. Controllers shall have diagnostic LEDs for power, communication, and processor.
   2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
   3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

H. Memory.
   1. Controller memory shall support operating system, database, and programming requirements.
   2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
   3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

J. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 Input and Output Interface

A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
F. Binary Outputs. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 Power Supplies And Line Filtering

A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
    1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
        a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
        b. Line voltage units shall be UL recognized and CSA listed.
B. Power Line Filtering.
    1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
    b. Dielectric strength of 1000 V minimum
    c. Response time of 10 nanoseconds or less
    d. Transverse mode noise attenuation of 65 dB or greater

e. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 Auxiliary Control Devices

A. Motorized Control Dampers.
   1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
      a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
      b. Other modulating dampers shall be opposed-blade.
      c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
   2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminum with reinforced corner bracing.
   3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
   4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
   5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m ^{2} (10 cfm per ft^2) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
   6. Sections. Damper sections shall not exceed 125 cm - 150 cm (48 in. - 60 in.). Each section shall have at least one damper actuator.
   7. Linkages. Dampers shall have exposed linkages.
B. Electric Damper and Valve Actuators.
   1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
   2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
   3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
   4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
   5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
C. Control Valves.
   1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
   2. Type. Provide two- or three-way control valves for two-position or modulating service as shown.
   3. Water Valves.
      a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.

b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
   i. Two-way: 150% of total system (pump) head.
   ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
c. Ports. Valves providing modulating service shall have equal percentage ports.
d. Sizing.
   i. Two-position service: line size.
   ii. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).
   iii. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).
e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
   i. Water zone valves: normally open.
   ii. Heating coils in air handlers: normally open.
   iii. Chilled water control valves: normally closed.
   iv. Other applications: as scheduled or as required by sequences of operation.

4. Steam Valves.
   a. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide minimum close-off pressure rating equal to 150% of operating (inlet) pressure.
   b. Ports. Valves providing modulating service shall have linear ports.
   c. Sizing.
      i. Two-position service: select pressure drop equal to 10%-20% of inlet psig.
      ii. Modulating service at 100 kPa (15 psig) or less: select pressure drop equal to 80% of inlet psig.
      iii. Modulating service at 101-350 kPa (16-50 psig): select pressure drop equal to 50% of inlet psig.
      iv. Modulating service at over 350 kPa (50 psig): select pressure drop as scheduled on drawings.

D. Binary Temperature Devices.
   1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
   2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
   3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.
   1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
   2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m^2(10 ft^2) of duct cross-section.
   3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
   4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
   5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Humidity Sensors.
   1. Duct and room sensors shall have a sensing range of 20%-80%.
   2. Duct sensors shall have a sampling chamber.
   3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°C-75°C (40°F-170°F).
   4. Humidity sensors shall not drift more than 1% of full scale annually.

G. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
   1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
   2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

H. Relays.
   1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
   2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

I. Override Timers.
   1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

J. Current Transmitters.
   1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.
   2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
   3. Unit shall be split-core type for clamp-on installation on existing wiring.

K. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

L. Voltage Transmitters.
1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

M. Voltage Transformers.
1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

N. Power Monitors.
1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of ±2% at 1.0 power factor or ±2.5% at 0.5 power factor.

O. Current Switches.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

P. Pressure Transducers.
1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

Q. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

R. Pressure-Electric (PE) Switches. PE switches shall be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating

pressure rated for 0-175 kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).

1. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.
2. Switches shall be open type (panel-mounted). Exception: Switches shall be enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
3. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

S. Local Control Panels.

1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.9 Wiring And Raceways

A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.

B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

2.10 Fiber Optic Cable System

A. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.

B. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

PART 3: EXECUTION

3.0 Section Includes

3.1 Examination

3.2 Protection

3.3 Coordination

3.4 General Workmanship

3.5 Field Quality Control

3.6 Existing Equipment

3.7 Wiring

3.8 Communication Wiring

3.9 Fiber Optic Cable

3.10 Installation of Sensors

3.11 Flow Switch Installation

3.12 Actuators

3.13 Warning Labels

3.14 Identification of Hardware and Wiring

3.15 Programming

3.16 Control System Checkout and Testing

3.17 Control System Demonstration and Acceptance

3.18 Cleaning

3.19 Training

3.20 Sequence of Operation

3.21 Points List

3.1 Examination

A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 Protection

A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 Coordination

A. Site.
    1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
    2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
B. Submittals. See Section 23 09 23 Article 1.10 (Submittals).
C. Test and Balance.
    1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
    2. Train Test and Balance Contractor to use control system interface tools.
    3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
    4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
D. Life Safety.
    1. Duct smoke detectors required for air handler shutdown are provided under Division 28. Interlock smoke detectors to air handlers for shutdown as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.
    2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23. Interlock smoke dampers to air handlers as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.
    3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 28.
E. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.

1. Communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).
2. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation described in Section 23 09 93 Appendix A regardless of where within the contract documents those products are described.
3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 General Workmanship

A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 Field Quality Control

A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.8 (Codes and Standards).
B. Continually monitor field installation for code compliance and workmanship quality.
C. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.6 Existing Equipment

A. Wiring. Interconnecting control wiring shall be removed and shall become Contractor's property unless specifically noted or shown to be reused.
B. Local Control Panels. Remove and deliver existing control panels to Owner.
C. Repair. Unless otherwise directed, Contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Notify Engineer in writing immediately of existing equipment that requires maintenance.
D. Indicator Gauges. Ensure operation of and recalibrate for reasonable accuracy or replace existing gauges.
E. Room Thermostats. Remove and deliver existing room thermostats to Owner unless otherwise noted. Patch and finish holes and marks left by removal to match existing walls.
F. Electronic Sensors and Transmitters. Remove and deliver existing sensors and transmitters to Owner.

G. Controllers and Auxiliary Electronic Devices. Remove and deliver existing controllers and auxiliary electronic devices to Owner.
H. Damper Actuators, Linkages, and Appurtenances: Remove and deliver existing damper actuators, linkages and appurtenances to Owner.
I. Control Valves. Replace existing control valves with new. Deliver removed control valves to Owner.
J. Existing System Operating Schedule. Existing mechanical system may be disabled during this work.
K. Maintain fan scheduling using existing or temporary time clocks or control systems throughout the control system installation.
L. Modify existing starter control circuits if necessary to provide hand-off-auto control of each controlled starter. Furnish new starters or starter control packages as required.
M. Patch holes and finish to match existing walls.
N. At Owner's request, items to be delivered to Owner shall instead be properly disposed of. Hazardous materials shall be disposed of under Division 02.

3.7 Wiring

A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.
B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.
C. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
D. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
E. Install wiring in raceway where subject to mechanical damage and at levels below 3 m (10ft) in mechanical, electrical, or service rooms.
F. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
G. Do not install wiring in raceway containing tubing.
H. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 3 m (10 ft) intervals.
I. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
J. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
K. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
L. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
M. Use color-coded conductors throughout.
N. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

O. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
P. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
Q. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
R. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
S. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
T. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.8 Communication Wiring

A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
G. Label communication wiring to indicate origination and destination.
H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
I. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:
    1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)
    2. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
    3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
    4. An MS/TP EIA-485 network shall have no T connections.

3.9 Fiber Optic Cable

A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.10 Installation of Sensors

A. Install sensors according to manufacturer's recommendations.
B. Mount sensors rigidly and adequately for operating environment.
C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m^2 (1 ft^2) of coil area.
G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
I. Differential Air Static Pressure.
    1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
    2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
    3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
    4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
    5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
    6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.11 Flow Switch Installation

A. Use correct paddle for pipe diameter.
B. Adjust flow switch according to manufacturer's instructions.

3.12 Actuators

A. General. Mount actuators and adapters according to manufacturer's recommendations.
B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
   1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
   2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, then tighten linkage.
   3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
   4. Provide necessary mounting hardware and linkages for actuator installation.
C. Valve Actuators. Connect actuators to valves with adapters approved by actuator manufacturer.

3.13 Warning Labels

A. Affix permanent warning labels to equipment that can be automatically started by the control system.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows.

CAUTION
This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows.

CAUTION
This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.14 Identification of Hardware and Wiring

A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.
C. Permanently label or code each point of field terminal strips to show instrument or item served.
D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.

E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
F. Label room sensors related to terminal boxes or valves with nameplates.
G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
H. Label identifiers shall match record documents.

3.15 Programming

A. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Section 23 09 93 (Sequences of Operation). If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 23 09 93 may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
B. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented. Text-based programs shall be modular, structured, and commented to clearly describe each section of the program.
    1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 09 93. Program documentation or comment statements shall reflect language used in sequences of operation.
    2. System Programming. Provide system programming necessary for system operation.
C. Operator Interface.
    1. Standard Graphics. Provide graphics as specified in Section 23 09 23 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List in Section 23 09 93. Point information on graphics shall dynamically update.
    2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 23.

3.16 Control System Checkout and Testing

A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
    1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 09 23.
    2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
    3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
    4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.

5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
8. Alarms and Interlocks.
    a. Check each alarm with an appropriate signal at a value that will trip the alarm.
    b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
    c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.17 Control System Demonstration and Acceptance

A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.17 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.
    1. Engineer will be present to observe and review system demonstration. Notify Engineer at least 10 days before system demonstration begins.
    2. Demonstration shall follow process submitted and approved under Section 23 09 23 Article 1.10 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.
    3. Demonstrate actual field operation of each sequence of operation as specified in Section 23 09 93. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
    4. Demonstrate compliance with Section 23 09 23 Part 1 (System Performance).
    5. Demonstrate compliance with sequences of operation through each operational mode.
    6. Demonstrate complete operation of operator interface.
    7. Demonstrate each of the following.
        a. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
        b. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
        c. Building fire alarm system interface.

d. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 09 93. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 09 23 Article 2.3 Paragraph E.11 (Trend Configuration).

8. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance.

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 09 23 Article 1.10 (Submittals).

3.18 Cleaning

A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

3.19 Training

A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.

23 09 93 Sequence of Operations for HVAC Controls

PART 1: GENERAL

1.0 Section Includes

1.1 Single Zone Unit

1.2 Multizone - AHU

1.3 Multizone - Zone Damper

1.4 Chiller Interface

1.5 Chilled Water Loop Pumps

1.6 Point Summary

1.1 Single Zone Unit (typical of 18)

Run Conditions - Scheduled:
The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - A 74°F (adj.) cooling setpoint
  - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
  - A 85°F (adj.) cooling setpoint.
  - A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Optimal Start:
The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Supply Air Smoke Detection:
The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.

Supply Fan:
The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cooling Coil Valve:
The controller shall measure the zone temperature and modulate the cooling coil valve to maintain its cooling setpoint.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

The cooling coil valve shall open to 50% (adj.) whenever the freezestat (if present) is on.

Electric Heating Stage:
The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

Supply Air Temperature:
The controller shall monitor the supply air temperature.

Alarms shall be provided as follows:

- High Supply Air Temp: If the supply air temperature is greater than 120°F (adj.).
- Low Supply Air Temp: If the supply air temperature is less than 45°F (adj.).

ALTERNATE 2/REBID HVAC MODIFICATIONS TO WEBB COUNTY JAIL

	Hardware Points				Software Points					
Point Name	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic
Zone Temp	x							x		x
Supply Air Temp	x							x		x
Cooling Valve		x						x		x
Supply Air Smoke Detector			x					x	x	x
Supply Fan Status			x					x		x
Supply Fan Start/Stop				x				x		x
Heating Stage 1				x				x		x
Schedule							x			
Heating Setpoint								x		x
Cooling Setpoint								x		x
High Zone Temp									x	
Low Zone Temp									x	
Supply Fan Failure									x	
Supply Fan in Hand									x	
Supply Fan Runtime Exceeded									x	
High Supply Air Temp									x	
Low Supply Air Temp									x	
Totals	2	1	2	2	0	0	1	9	8	9

Total Hardware (7) Total Software (18)

1.2 Multizone - AHU (typical of 1)

Run Conditions - Requested:
The unit shall run whenever:

- Any zone is occupied.
- OR a definable number of unoccupied zones need heating or cooling.

Supply Fan:
The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cold Deck - Cooling Supply Air Temperature Setpoint - Optimized:
The cooling supply air temperature setpoint shall be reset using a trim and respond algorithm based on zone cooling requirements. If there is a demand for cooling then the setpoint shall be reset to a lower value (adj.). If the demand for cooling decreases then the setpoint shall reset to a higher value (adj.). Once the zones are satisfied then the setpoint shall gradually moderate over time to reduce cooling energy use.

The supply air temperature setpoint shall be reset based on zone cooling requirements as follows:

- The initial supply air temperature setpoint shall be 55°F (adj.).
- As cooling demand increases, the setpoint shall incrementally reset down to a minimum of 53°F (adj.).
- As cooling demand decreases, the setpoint shall incrementally reset up to a maximum of 72°F (adj.).

Cold Deck - Cooling Stage:
The controller shall measure the cooling supply air temperature and stage the cooling to maintain its setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the supply fan status is on.

Alarms shall be provided as follows:

- High Cooling Supply Air Temp: If the cooling supply air temperature is 5°F (adj.) greater than setpoint.

Hot Deck - Heating Supply Air Temperature Setpoint - Optimized:
The heating supply air temperature setpoint shall be reset using a trim and respond algorithm based on zone heating requirements. If there is a demand for heating then the setpoint shall be reset to a higher value (adj.). If the demand for heating decreases then the setpoint shall reset to a lower value (adj.). Once the zones are satisfied then the setpoint shall gradually moderate over time to reduce heating energy use.

The supply air temperature setpoint shall be reset based on zone heating requirements as follows:

- The initial supply air temperature setpoint shall be 82°F (adj.).
- As heating demand increases, the setpoint shall incrementally reset up to a maximum of 90°F (adj.).
- As heating demand decreases, the setpoint shall incrementally reset down to a minimum of 72°F (adj.).

Hot Deck - Electric Heating Stage:
The controller shall measure the heating supply air temperature and stage the heating to maintain its setpoint. To prevent short cycling, the stage shall have a user definable (adj.) minimum runtime.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the supply fan status is on.

Alarms shall be provided as follows:

- High Heating Supply Air Temp: If the heating supply air temperature is greater than 120°F (adj.).
- Low Heating Supply Air Temp: If the heating supply air temperature is 5°F (adj.) less than setpoint.

Return Air Temperature:
The controller shall monitor the return air temperature and use as required for economizer control (if present).

Alarms shall be provided as follows:

- High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

	Hardware Points				Software Points					
Point Name	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic

ALTERNATE 2/REBID HVAC MODIFICATIONS TO WEBB COUNTY JAIL

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Cooling Supply Air Temp	×							×		×
Heating Supply Air Temp	×							×		×
Return Air Temp	×							×		×
Supply Fan Status			×					×		×
Supply Fan Start/Stop				×				×		×
Cooling Stage 1				×				×		×
Heating Stage 1				×				×		×
Cooling Supply Air Temp Setpoint					×			×		×
Heating Supply Air Temp Setpoint					×			×		×
Supply Fan Failure									×	
Supply Fan in Hand									×	
Supply Fan Runtime Exceeded									×	
Compressor Runtime Exceeded									×	
High Cooling Supply Air Temp									×	
High Heating Supply Air Temp									×	
Low Heating Supply Air Temp									×	
Low Return Air Temp									×	
High Return Air Temp									×	
Totals	**3**	**0**	**1**	**3**	**2**	**0**	**0**	**9**	**9**	**9**

Total Hardware (7) **Total Software (20)**

1.3 Multizone - Zone Damper (typical of 10)

Run Conditions - Scheduled:
The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - A 74°F (adj.) cooling setpoint
  - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
  - A 85°F (adj.) cooling setpoint.
  - A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Damper Control:
The cooling and heating deck zone dampers shall modulate in sequence to maintain zone temperature cooling and heating setpoints.

Discharge Air Temperature:
The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:

- High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).
- Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

	Hardware Points				Software Points					
Point Name	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic
Zone Temp	×							×		×
Discharge Air Temp	×							×		×
Zone Damper		×								
Cold Deck Damper Position					×			×		×
Hot Deck Damper Position					×			×		×
Schedule							×			
Heating Setpoint								×		×
Cooling Setpoint								×		×
High Zone Temp									×	
Low Zone Temp									×	
High Discharge Air Temp									×	
Low Discharge Air Temp									×	

ALTERNATE 2/REBID HVAC MODIFICATIONS TO WEBB COUNTY JAIL

	Hardware Points				Software Points					
Point Name	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic
Totals	2	1	0	0	2	0	1	6	4	6

Total Hardware (3) Total Software (13)

1.4 Chiller Interface (typical of 1)

- **Interface:**

  The physical device required to provide integration capabilities from an equipment vendor's product to the control system. The equipment vendor most normally furnishes the interface device. An example of an interface is the chilled water temperature reset interface card provided by the chiller manufacturer in order to allow the control system to integrate the chilled water temperature reset function into the control system.

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Chiller kW					×			×		×
Chilled Water Supply Temp Setpoint					×			×		×
Operating Hours					×					×
Chilled Water Supply Temp					×			×		×
Chilled Water Return Temp					×			×		×
Condenser Water Supply Temp					×			×		×
Condenser Water Return Temp					×			×		×
Evaporator Refrigerant Pressure					×			×		×
Condenser Refrigerant Pressure					×			×		×
Oil Differential Pressure					×			×		×
Oil Temp					×			×		×
Chiller Status						×		×		×
Chilled Water Flow Status						×		×		×
Condenser Water Flow Status						×		×		×
Totals	**0**	**0**	**0**	**0**	**11**	**3**	**0**	**13**	**0**	**14**

Total Hardware (0) **Total Software (27)**

1.5 Chilled Water Loop Pumps P-1,P-2,P-3

Chilled Water Pump System - Run Conditions:
The chilled water pumps shall be enabled whenever:

- A definable number of chilled water coils need cooling.
- AND the outside air temperature is greater than 54°F (adj.).

To prevent short cycling, the chilled water pump system shall run for and be off for minimum adjustable times (both user definable).

The pumps shall run for freeze protection anytime the outside air temperature is less than 38°F (adj.).

Chilled Water Pump Operation P-2, P-3:
The two chilled water pumps shall operate in when corresponding chillers call for cooling.

The designated lead pump shall rotate upon one of the following conditions (user selectable):

- manually through a software switch
- if pump runtime (adj.) is exceeded
- daily
- weekly
- monthly

Alarms shall be provided as follows:

- Chilled Water Pump 2
    - Failure: Commanded on, but the status is off.
    - Running in Hand: Commanded off, but the status is on.
    - Runtime Exceeded: Status runtime exceeds a user definable limit.

- Chilled Water Pump 3
    - Failure: Commanded on, but the status is off.
    - Running in Hand: Commanded off, but the status is on.
    - Runtime Exceeded: Status runtime exceeds a user definable limit.

Chilled Water Differential Pressure Control: P-1. This pump provides chilled water via the existing Central plant. It will operate on time schedule. Also, this pump will provide emergency chilled water if chillers 2 or 3 fail.
The controller shall measure chilled water differential pressure and control the chilled water flow based on pressure at AC-6. The chilled water pump is to maintain its chilled water differential pressure setpoint. The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions.

If the chilled water differential pressure drops below a setpoint of 12lb_f/in^2 (adj).

ALTERNATE 2/REBID HVAC MODIFICATIONS TO WEBB COUNTY JAIL

Alarms shall be provided as follows:

- High Chilled Water Differential Pressure: If the chilled water differential pressure is greater than $18 lb_f/in^2$ (adj.).
- Low Chilled Water Differential Pressure: If the chilled water differential pressure is less than $10 lb_f/in^2$ (adj.).

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Chilled Water Differential Pressure	×							×		×
Chilled Water Pump 1 Status			×					×		×
Chilled Water Pump 2,3 Status			×					×		×
Chilled Water Pump 1 Start/Stop				×				×		×
Chilled Water Pump 2,3 Start/Stop				×				×		×
Chilled Water Differential Pressure Setpoint					×					×
Chilled Water Pump 1 Failure									×	
Chilled Water Pump 2,3 Failure									×	
Chilled Water Pump 1 Running in Hand									×	
Chilled Water Pump 2,3 Running in Hand									×	
Chilled Water Pump 1 Runtime Exceeded									×	
Chilled Water Pump 2,3 Runtime Exceeded									×	
High Chilled Water Differential Pressure									×	
Low Chilled Water Differential Pressure									×	
Totals	**1**	**0**	**2**	**2**	**1**	**0**	**0**	**5**	**8**	**6**
	Total Hardware (5)							**Total Software (14)**		

1.6 Point Summary

		Hardware Points				Software Points					
Equipment Name	Qty	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic
Single Zone Unit (Typical of 18)	Each	2	1	2	2	0	0	1	9	8	9
	Total (x18)	36	18	36	36	0	0	18	162	144	162
Multizone - AHU (Typical of 1)	Each	3	0	1	3	2	0	0	9	9	9
	Total (x1)	3	0	1	3	2	0	0	9	9	9
Multizone - Zone Damper (Typical of 10)	Each	2	1	0	0	2	0	1	6	4	6
	Total (x10)	20	10	0	0	20	0	10	60	40	60
Chiller Interface (Typical of 1)	Each	0	0	0	0	11	3	0	13	0	14
	Total (x1)	0	0	0	0	11	3	0	13	0	14
Chilled Water Loop Pumps (Typical of 3)	Each	1	0	2	2	1	0	0	5	8	6
	Total (x3)	3	0	6	6	3	0	0	15	24	18
Project Totals		62	28	43	45	36	3	28	259	217	263

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of the activities and procedures specified in this Section.

B. Related Sections include the following:

1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

M. AABC: Associated Air Balance Council.

N. CTI: Cooling Tower Institute.

O. NEBB: National Environmental Balancing Bureau.

P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

C. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

A. Agent Qualifications for larger projects: Engage a testing, adjusting, and balancing agent certified by AABC.

B. Agent Qualifications for smaller projects: Engage a testing, adjusting, and balancing agent certified by NEBB.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.

2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."

E. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

F. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

G. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

H. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.

2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 1.

D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine strainers for clean screens and proper perforations.

M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine equipment for installation and for properly operating safety interlocks and controls.

O. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.

2. Dampers and valves are in the position indicated by the controller.

3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.

4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.

5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.

6. Sensors are located to sense only the intended conditions.

7. Sequence of operation for control modes is according to the Contract Documents.

8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.

9. Interlocked systems are operating.

10. Changeover from heating to cooling mode occurs according to design values.

P. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.

2. Hydronic systems are filled, clean, and free of air.

3. Automatic temperature-control systems are operational.

4. Equipment and duct access doors are securely closed.

5. Balance, fire dampers are open.

6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.

B. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

2. Measure static pressure across each air-handling unit component.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

4. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.

1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.

2. Check expansion tank liquid level.

3. Check makeup-water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation and set at design flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.

7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 HYDRONIC SYSTEMS' BALANCING PROCEDURES

A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.

2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake

horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.

E. Adjust balancing stations to within specified tolerances of design flow rate as follows:

1. Determine the balancing station with the highest percentage over design flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.

3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 VARIABLE-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

Systems installed with self-contained pressure independent control valves shall not require hydronic system balancing.

A. terminals and proceed as specified above for hydronic systems.

3.9 PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance the primary system crossover flow first, then balance the secondary system.

3.10 MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating if high-efficiency motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.11 CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of design flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator water entering and leaving temperatures, pressure drop, and water flow.

2. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by the chiller manufacturer.
3. Power factor if factory-installed instrumentation is furnished for measuring kW.
4. The kW input if factory-installed instrumentation is furnished for measuring kW.
5. Capacity: Calculate in tons of cooling.
6. Air-Cooled Chillers: Verify condenser-fan rotation and record fan data, including number of fans and entering- and leaving-air temperatures.

3.12 CONDENSING UNITS

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.13 HEAT-TRANSFER COILS

A. Electric-Heating Coils: Measure the following data for each coil:
1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperatures at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kW at full load.
6. Fuse or circuit-breaker rating for overload protection.

3.14 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure outside-air, wet- and dry-bulb temperatures.

3.15 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.16 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Supply and Exhaust Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.17 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:
    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.

c. Make and type.

d. Model number and unit size.

e. Manufacturer's serial number.

f. Unit arrangement and class.

g. Discharge arrangement.

2. Motor Data: Include the following:

a. Make and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm (L/s).

b. Total system static pressure in inches wg (Pa).

c. Fan rpm.

d. Discharge static pressure in inches wg (Pa).

e. Cooling coil static-pressure differential in inches wg (Pa).

f. Heating coil static-pressure differential in inches wg (Pa).

g. Outside airflow in cfm (L/s).

h. Return airflow in cfm (L/s).

i. Outside-air damper position.

j. Return-air damper position.

G. Electric-Coil Test Reports: For electric duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data: Include the following:

a. System identification.

b. Location.

c. Coil identification.

d. Capacity in Btuh (kW).

e. Number of stages.

f. Connected volts, phase, and hertz.

g. Rated amperage.

2. Test Data: Include design and actual values for the following:

a. Heat output in Btuh (kW).

b. Airflow rate in cfm (L/s).

c. Air velocity in fpm (m/s).

d. Entering-air temperature in deg F (deg C).

e. Leaving-air temperature in deg F (deg C).

f. Voltage at each connection.

g. Amperage for each phase.

H. Fan Test Reports: For exhaust fans, include the following:

1. Fan Data: Include the following:

a. System identification.

b. Location.

c. Make and type.

d. Model number and size.

e. Manufacturer's serial number.

f. Arrangement and class.

2. Motor Data: Include the following:

a. Make and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm (L/s).

b. Total system static pressure in inches wg (Pa).

c. Fan rpm.

d. Discharge static pressure in inches wg (Pa).

e. Suction static pressure in inches wg (Pa).

I. Packaged Chiller Reports: For each chiller, include the following:

1. Unit Data: Include the following:

a. Unit identification.

b. Make and model number.

c. Manufacturer's serial number.

d. Refrigerant type and capacity in gal. (L).

e. Starter type and size.

f. Starter thermal protection size.

2. Condenser Test Data: Include design and actual values for the following:

a. Refrigerant pressure in psig (kPa).

b. Refrigerant temperature in deg F (deg C).

c. Entering-water temperature in deg F (deg C).

d. Leaving-water temperature in deg F (deg C).

e. Entering-water pressure in feet of head or psig (kPa).

f. Water pressure differential in feet of head or psig (kPa).

3. Evaporator Test Reports: Include design and actual values for the following:

a. Refrigerant pressure in psig (kPa).

b. Refrigerant temperature in deg F (deg C).

c. Entering-water temperature in deg F (deg C).

d. Leaving-water temperature in deg F (deg C).

e. Entering-water pressure in feet of head or psig (kPa).

f. Water pressure differential in feet of head or psig (kPa).

4. Compressor Test Data: Include design and actual values for the following:

a. Make and model number.

b. Manufacturer's serial number.

c. Suction pressure in psig (kPa).

d. Suction temperature in deg F (deg C).

e. Discharge pressure in psig (kPa).

f. Discharge temperature in deg F (deg C).

g. Oil pressure in psig (kPa).

h. Oil temperature in deg F (deg C).

i. Voltage at each connection.

j. Amperage for each phase.

k. The kW input.

l. Crankcase heater kW.

m. Chilled water control set point in deg F (deg C).

n. Condenser water control set point in deg F (deg C).

o. Refrigerant low-pressure-cutoff set point in psig (kPa).

p. Refrigerant high-pressure-cutoff set point in psig (kPa).

5. Refrigerant Test Data: Include design and actual values for the following:

a. Oil level.

b. Refrigerant level.

c. Relief valve setting in psig (kPa).

d. Unloader set points in psig (kPa).

e. Percentage of cylinders unloaded.

f. Bearing temperatures in deg F (deg C).

g. Vane position.

h. Low-temperature-cutoff set point in deg F (deg C).

J. Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, include the following:

1. Unit Data: Include the following:

a. Unit identification.

b. Location.

c. Unit make and model number.

d. Manufacturer's compressor serial numbers.

e. Compressor make.

f. Compressor model and serial numbers.

g. Refrigerant weight in lb (kg).

2. Test Data: Include design and actual values for the following:

a. Entering-air, dry-bulb temperature in deg F (deg C).

b. Leaving-air, dry-bulb temperature in deg F (deg C).

c. Control settings.

d. Unloader set points.

e. Low-pressure-cutout set point in psig (kPa).

f. High-pressure-cutout set point in psig (kPa).

g. Suction pressure in psig (kPa).

h. Suction temperature in deg F (deg C).

i. Condenser refrigerant pressure in psig (kPa).

j. Condenser refrigerant temperature in deg F (deg C).

k. Oil pressure in psig (kPa).

l. Oil temperature in deg F (deg C).

m. Voltage at each connection.

n. Amperage for each phase.

o. The kW input.

p. Number of fans.

K. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.

1. Unit Data: Include the following:

a. Unit identification.

b. Location.

c. Service.

d. Make and size.

e. Model and serial numbers.

f. Water flow rate in gpm (L/s).

g. Water pressure differential in feet of head or psig (kPa).

h. Required net positive suction head in feet of head or psig (kPa).

i. Pump rpm.

j. Impeller diameter in inches (mm).

k. Motor make and frame size.

l. Motor horsepower and rpm.

m. Voltage at each connection.

n. Amperage for each phase.

o. Full-load amperage and service factor.

p. Seal type.

2. Test Data: Include design and actual values for the following:

a. Static head in feet of head or psig (kPa).

b. Pump shutoff pressure in feet of head or psig (kPa).

c. Actual impeller size in inches (mm).

d. Full-open flow rate in gpm (L/s).

e. Full-open pressure in feet of head or psig (kPa).

f. Final discharge pressure in feet of head or psig (kPa).

g. Final suction pressure in feet of head or psig (kPa).

h. Final total pressure in feet of head or psig (kPa).

i. Final water flow rate in gpm (L/s).

j. Voltage at each connection.

k. Amperage for each phase.

END OF SECTION

3.18 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

REBID
H.V.A.C. RENOVATIONS
TO
WEBB COUNTY JAIL
LAREDO, TEXAS

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER
6/6/2011

COMMISSIONER'S COURT

DANNY VALDEZ	COUNTY JUDGE
FRANK SCIARAFFA	PRECINCT 1
ROSAURA "WAWI" TIJERINA	PRECINCT 2
JERRY GARZA	PRECINCT 3
JAIME CANALES	PRECINCT 4

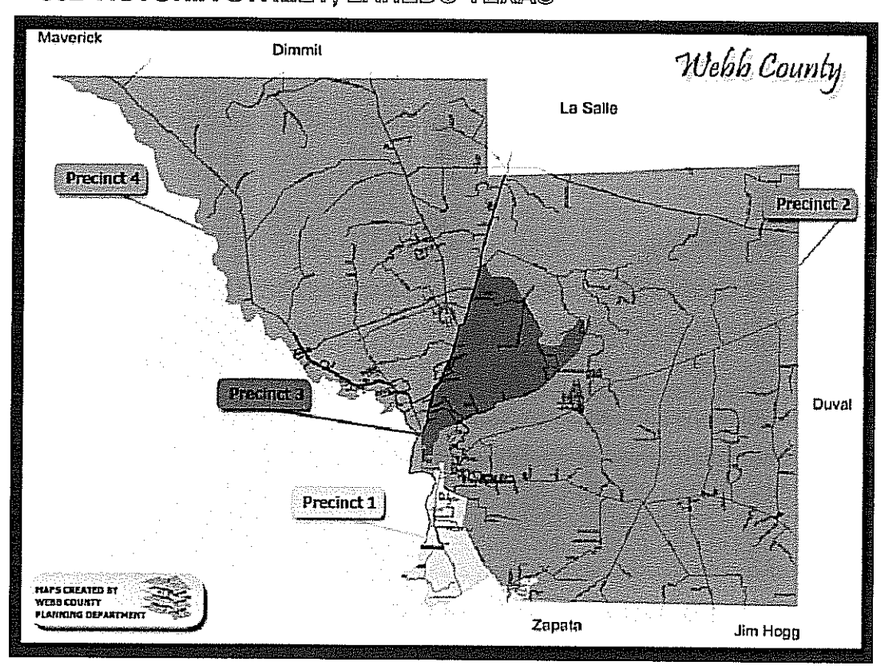
WEBB COUNTY SHERIFF

MARTIN CUELLAR

PROJECT ENGINEER

UNITECH ENGINEERING
ROBERT DE LA CRUZ P.E.

902 VICTORIA STREET, LAREDO TEXAS



LIST OF DRAWINGS

M0: MECHANICAL SYMBOLS & ABBREVIATIONS
D1: 1ST FLOOR PLAN DEMOLITION
D2: 2ND FLOOR PLAN DEMOLITION
D3: 3RD FLOOR PLAN DEMOLITION
D4: 4TH FLOOR PLAN DEMOLITION
M1: 1ST FLOOR PLAN H.V.A.C.
M2: 2ND FLOOR PLAN H.V.A.C.
M3: 3RD FLOOR PLAN H.V.A.C.
M4: 4TH FLOOR PLAN H.V.A.C.
M5: ROOF PLAN H.V.A.C.
M6: CHILLED WATER SCHEMATIC DIAGRAM
M7: SCHEDULES & DETAILS

REVISIONS BY:

WEBB COUNTY H.V.A.C. RENOVATIONS
LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: TS

MECHANICAL SYMBOLS & ABBREVIATIONS

[SOME SYMBOLS MAY NOT BE USED ON THIS PROJECT]

PIPING SYMBOLS

GENERAL

SYMBOL	DESCRIPTION
	VENTURI
	AUTOMATIC AIR VENT
	BACK FLOW PREVENTER
	BALL JOINT
	BASKET STRAINER ASSEMBLY
	BLIND FLANGE
B	STEAM TRAP B–INVERTED BUCKET FT–FLOAT & THERMOSTATIC
	CAP
	CONCENTRIC REDUCER
	ECCENTRIC REDUCER
EJ	EXPANSION JOINT
	FLEXIBLE CONNECTION (PIPE)
	FLOW DIRECTION
PS	PRESSURE SWITCH
FS	FLOW SWITCH
	GAUGE COCK CONNECTION
P	GAUGE COCK & PRESSURE GAUGE
	PIPE ANCHOR
	PIPE DROP
	PIPE RISER
	PIPING GUIDE
	REFRIGERANT SITE GLASS
	STRAINER (Y TYPE) W/ BLOWDOWN & CAP
	THERMOMETER
	DIAL THERMOMETER
	TEST WELL
	UNION
—CD—	CONDENSATE DRAIN
EXIST	EXISTING PIPING
—FOF—	FUEL OIL FILL
—FOR—	FUEL OIL RETURN
—FOS—	FUEL OIL SUPPLY
—FOV—	FUEL OIL VENT
	SPRING ISOLATOR – PIPE OR EQUIPMENT
	VIBRATION ISOLATOR
	PUMP (SCHEMATIC)
	TURBINE METER ASSEMBLY
	ORIFICE ASSEMBLY

AIR CONDITIONING

—CHR—	CHILLED WATER RETURN
—CHS—	CHILLED WATER SUPPLY
—RL—	REFRIGERANT LIQUID
—RS—	REFRIGERANT SUCTION
—D—	DRAIN LINE

PIPING SYMBOLS

HEATING

SYMBOL	DESCRIPTION
—HPC—	HIGH PRESSURE STEAM CONDENSATE
—LPC—	LOW PRESSURE STEAM CONDENSATE
—S15—	STEAM SUPPLY (PRESS. AS NOTED)
—PCR—	PUMPED CONDENSATE RETURN
—HWR—	HOT WATER RETURN
—HWS—	HOT WATER SUPPLY
—BFW—	BOILER FEED WATER
	THERMOSTATIC TRAP
	FLOAT & THERMOSTATIC TRAP

VALVES

	BALL VALVE
	BUTTERFLY VALVE
	CHECK VALVE
	EXPANSION VALVE
	FLOAT VALVE
	GATE VALVE
	GLOBE VALVE
	LIQUID SOLENOID VALVE
	MANUAL 3–WAY CONTROL VALVE
	MOTOR OPERATED, STRAIGHT THRU VALVE
	MOTOR OPERATED, 3–WAY CONTROL VALVE
	O.S.& Y. GATE VALVE
	PLUG VALVE
	PRESSURE REDUCING VALVE
	PRESSURE RELIEF VALVE
T&P	PRESSURE & TEMP. RELIEF VALVE
	THERMOSTATIC EXPANSION VALVE
	VALVE W/ HOSE THREAD

CONTROLS

T	THERMOSTAT – REMOTE BULB
T	THERMOSTAT
H	HUMIDISTAT
F	FIRESTAT
T	TEMPERATURE SENSOR
H	HUMIDITY SENSOR

DRAWING SYMBOLS

CHP–1	EQUIPMENT MARK NUMBER – CHP
2	KEYED NOTE 2
1 / M101	DETAIL REFERENCE: DETAIL NUMBER / SHEET NUMBER

DUCTWORK SYMBOLS

GENERAL

SYMBOL	DESCRIPTION
	ROUND DUCT SECTION
	FLAT OVAL DUCT SECTION
12"ø	12" DIA. ROUND DUCT
12"X24"	12" BY 24" FLAT OVAL DUCT
	SUPPLY DUCT SECTION, POSITIVE PRESS.
	EXH., RET., O.A. DUCT SECTION NEGATIVE PRESS.
12/8	DUCTWORK, FIRST NO. IS VISIBLE DIM.
	ACOUSTICALLY LINED DUCT
	FLEXIBLE CONNECTION (DUCT)
R D	CHANGE OF ELEVATION IN DIRECTION SHOWN R–RISE D–DROP
FD	FIRE DAMPER TYPE
SD	SMOKE DAMPER
FSD	FIRE & SMOKE DAMPER
	BRANCH DUCT WITH VOLUME DAMPER
	SIDEWALL REGISTER
	DUCT WITH TURNING VANES
	SPLITTER DAMPER
	DAMPER TYPE INDICATED
MD	MOTORIZED DAMPER TYPE INDICATED
	VANED ELBOW (PROVIDE ALL SQUARE OR RECTANGULAR ELBOWS W/ VANES EVEN IF SYMBOL IS MISSING)
	VANED ELBOW (SHORT RADIUS)
	STANDARD RADIUS ELBOW
	SUPPLY AIR DIFFUSER
	RETURN AIR GRILLE
	EXHAUST AIR GRILLE
	LINEAR SUPPLY AIR DEVICE
	LINEAR RETURN AIR DEVICE
	FLEXIBLE DUCT
	FAN (SCHEMATIC)
DPG	DIFFERENTIAL PRESSURE GAUGE

ABBREV.	DESCRIPTION
ABV	ABOVE
AC	ABOVE CEILING
A/C	AIR CONDITIONED
ACC	AIR COOLED CHILLER
AD	ACCESS DOOR
AF	AIR FOIL
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
AMCA	AIR MOVING AND CONDITIONING ASSOCIATION, INC.
AP	ACCESS PANEL
APPROX	APPROXIMATE
ARCH	ARCHITECTURAL
ARI	AIR CONDITIONING & REFRIGERATION INSTITUTE
ANSI	AMERICAN NATIONAL STANDARD INSTITUTE
ASMR	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING MATERIALS
AV	AUTOMATIC AIR VENT ASSEMBLY
B	BOILER
BB4	BASEBOARD ELECTRIC HEATER
BDD	BACK DRAFT DAMPER
BHP	BRAKE HORSEPOWER
BI	BACKWARD INCLINED
BLDG	BUILDING
BSMT	BASEMENT
BTU	BRITISH THERMAL UNIT
CFM	CUBIC FEET PER MINUTE
CH	CHILLER
CHP	CHILLED WATER PUMP
CLG	CEILING
CWP	CONDENSER WATER PUMP
CO	CLEANOUT
COND	CONDENSATE
CONN	CONNECTION
CONT	CONTINUATION
CP	CONTROLLABLE PITCH
CT	COOLING TOWER
CU	CONDENSING UNIT
CW	COLD WATER
℄	CENTER LINE
D	DRAIN
DB	DRY BULB
DCP	DATA COLLECTION PANEL
DG	DOOR GRILLE
DIA	DIAMETER
DN	DOWN
DWG	DRAWING
DX	DIRECT EXPANSION
E	EXHAUST (AIR DEVICE)
EA	EACH
EAT	ENTERING AIR TEMPERATURE
EDH	ELECTRIC DUCT HEATER
EF	EXHAUST FAN
ELEC	ELECTRICAL
ELEV	ELEVATION
EG	EXHAUST GRILLE
ENT	ENTERING
EQUIP	EQUIPMENT
ER	EXHAUST REGISTER
ESP	EXTERNAL STATIC PRESSURE
EWT	ENTERING WATER TEMPERATURE
EXH	EXHAUST
EXIST	EXISTING
F	DEGREES FAHRENHEIT
FC	FAN COIL
FD	FIRE DAMPER
FLEX	FLEXIBLE
FLG	FLANGE
FLR	FLOOR
FM	FACTORY MUTUAL
FO	FLAT OVAL DUCT
FPM	FEET PER MINUTE
FT	FEET, FOOT
FS	FLOW SWITCH
GAL	GALLON
GALV	GALVANIZED
GPM	GALLONS PER MINUTE
HB	HOSE BIBB
HP	HORSEPOWER
HR	HEAT PUMP (WATER SOURCE)
HR	HOUR
H	HIGH, HEIGHT
HVAC	HEATING/VENTILATING/ AIR CONDITIONING
HWP	HOT WATER PUMP
HZ	HERTZ

ABBREV.	DESCRIPTION
ID	INSIDE DIAMETER
IE	INVERT ELEVATION (FLOW LINE)
IN	INCHES
INSUL	INSULATION
IN WG	INCHES OF WATER
KW	KILOWATT(S)
L	LONG, LENGTH
LAT	LEAVING AIR TEMPERATURE
LB	POUND
LVR	LOUVER
MAX	MAXIMUM
MD	MANUAL DAMPER
MECH	MECHANICAL
MIN	MINIMUM
MS	MOTOR STARTER
NA	NOT APPLICABLE
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OAH	OUTSIDE AIR INTAKE HOOD
OBD	OPPOSED BLADE DAMPER
OC	ON CENTER
P	PUMP
PBD	PARALLEL BLADE DAMPER
PCHP	PRIMARY CHILLED WATER PUMP
PRESS	PRESSURE
PRV	PRESSURE REDUCING VALVE
PSIG	POUNDS PER SQUARE INCH (GAUGE)
PHL	PRESSURE HIGH LIMIT
R	RETURN (AIR DEVICE)
R–22	REFRIGERANT (TYPE AS NOTED)
RA	RETURN AIR
RE: 4M7.01	REFER TO DETAIL 4, SHEET M7.01
RET	RETURN
RG	RETURN GRILLE
RH	RELATIVE HUMIDITY
RHD	RELIEF HOOD
RPM	REVOLUTIONS PER MINUTE
RTU	ROOF TOP UNIT
S	SUPPLY (AIR DEVICE)
SA	SUPPLY AIR
SCH	SCHEDULE
SCHP	SECONDARY CHILLED WATER PUMP
SD	SMOKE DAMPER
SEC	SECOND
SF	SUPPLY FAN
SMACNA	SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION
SP	STATIC PRESSURE
SPEC	SPECIFICATION
SF	SQUARE FOOT
STD	STANDARD
STL	STEEL
SW	SWITCH
TEMP	TEMPERATURE
THL	TEMPERATURE HIGH LIMIT
TLL	TEMPERATURE LOW LIMIT
T'STAT	THERMOSTAT
TXV	THERMOSTATIC EXPANSION VALVE
TYP	TYPICAL
UF	UNDER FLOOR
UH	UNIT HEATER
UL	UNDERWRITERS LABORATORIES
V–12	CONTROL VALVE NUMBER
VB	VALVE BOX
VEL	VELOCITY
VENT	VENTILATE
VF	VENTILATION FAN
VOL	VOLUME
VOLT	VOLTAGE
W	WIDE, WIDTH
W/	WITH
WB	WET BULB
W/O	WITHOUT

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER
6/6/2011

REVISIONS BY:

WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11–003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M0

DEMOLITION

1ST FLOOR PLAN: H.V.A.C.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

6/6/2011

KEYED NOTES: MECHANICAL

1. REMOVE UNION, STRAINER, 3 WAY VALVE, PRESSURE/TEMP. TEST PLUG, THERMOMETER, "CIRCUIT-SETTER" CONST. FLOW VALVE, DRAINS, AND ALL BALL OR BUTTERFLY VALVES.
2. REMOVE DAMPER ACTUATORS SERVING MULITZONE UNIT.
3. REMOVE PUMP AND ALL PIPING CONNECTED TO PUMP. REMOVE CHEMICAL POT FEEDER, EXPANSION TANK, AIR SEPARATOR, AND ALL PUMP SPECIALTIES

KEYED NOTES: ELECTRICAL

1. REMOVE WIRE AND CONDUIT BACK TO NEAREST DISCONNECT.

REVISIONS BY:

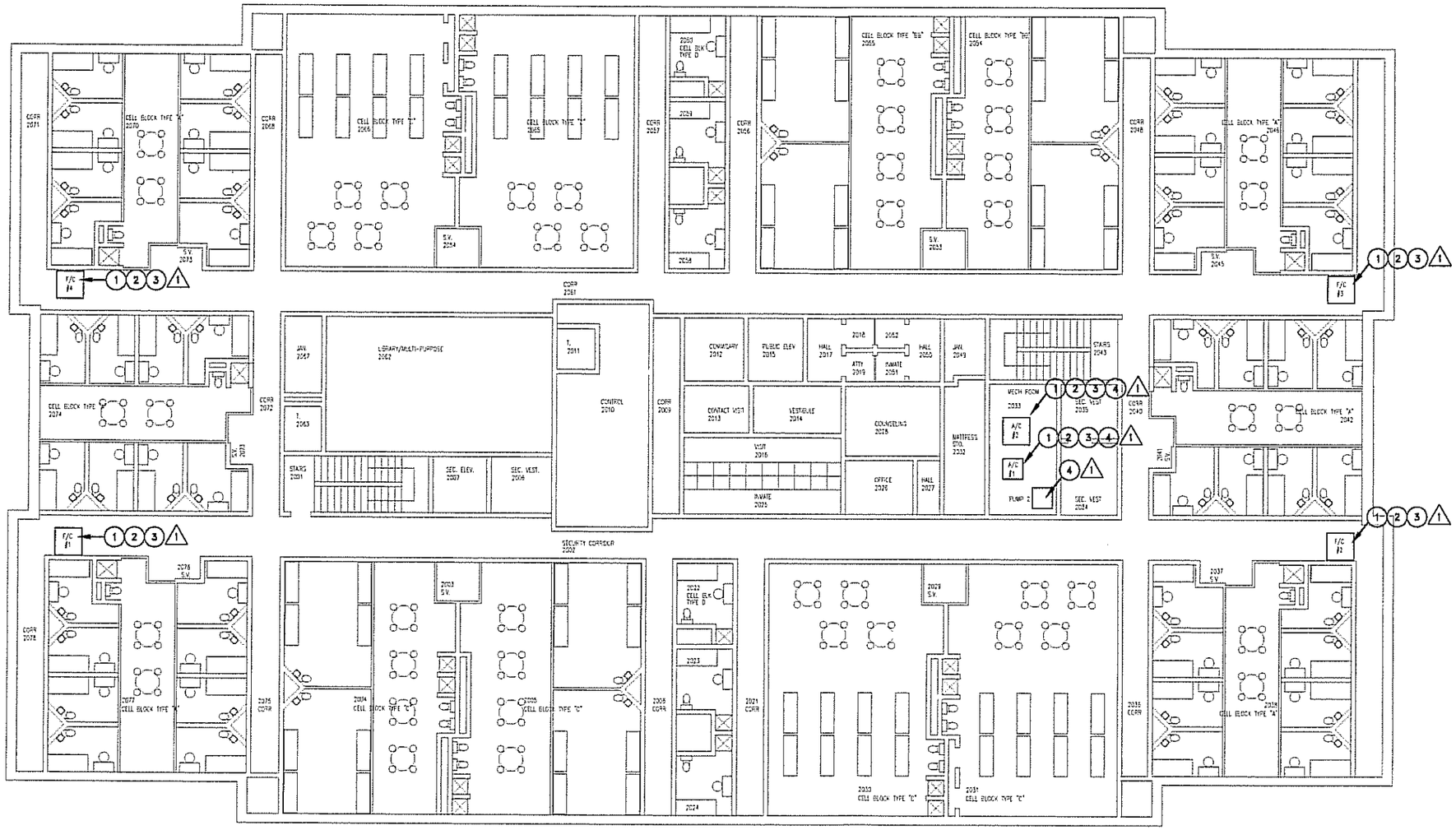
WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: D1



DEMOLITION

2ND FLOOR PLAN: H.V.A.C.

KEYED NOTES: MECHANICAL

1. REMOVE FAN COIL OR AIR HANDLING UNIT. MODIFY ACCESS PANEL AS REQUIRED.
2. REMOVE UNION, STRAINER, 3 WAY VALVE, PRESSURE/TEMP. TEST PLUG, THERMOMETER, "CIRCUIT-SETTER" CONST. FLOW VALVE, DRAINS, AND ALL BALL OR BUTTERFLY VALVES.
3. REMOVE HANGER AND SPRING ISOLATORS.
4. REMOVE ALL PIPING CONNECTED TO PUMPS AND FANCOIL UNIITS/AC UNITS. PIPING CONNECTED TO PUMP 1 WILL REMAIN. CAP OFF WHERE REQUIRED. REMOVE CHEMICAL POT FEEDER, EXPANSION TANK, AIR SEPARATOR, AND ALL PUMP SPECIALTIES

KEYED NOTES: ELECTRICAL

1. REMOVE WIRE AND CONDUIT BACK TO NEAREST DISCONNECT.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

6/6/2011

REVISIONS BY:

WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: D2

DEMOLITION

3RD FLOOR PLAN: H.V.A.C.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

4/6/2011

KEYED NOTES: MECHANICAL

1. REMOVE FAN COIL OR AIR HANDLING UNIT. MODIFY ACCESS PANEL AS REQUIRED.
2. REMOVE UNION, STRAINER, 3 WAY VALVE, PRESSURE/TEMP. TEST PLUG, THERMOMETER, "CIRCUIT-SETTER" CONST. FLOW VALVE, DRAINS, AND ALL BALL OR BUTTERFLY VALVES.
3. REMOVE HANGER AND SPRING ISOLATORS.
4. REMOVE ALL PIPING CONNECTED TO PUMPS AND FANCOIL UNITS/AC UNITS. PIPING CONNECTED TO PUMP 1 WILL REMAIN. CAP OFF WHERE REQUIRED. REMOVE CHEMICAL POT FEEDER, EXPANSION TANK, AIR SEPARATOR, AND ALL PUMP SPECIALTIES

KEYED NOTES: ELECTRICAL

1. REMOVE WIRE AND CONDUIT BACK TO NEAREST DISCONNECT.

REVISIONS BY:

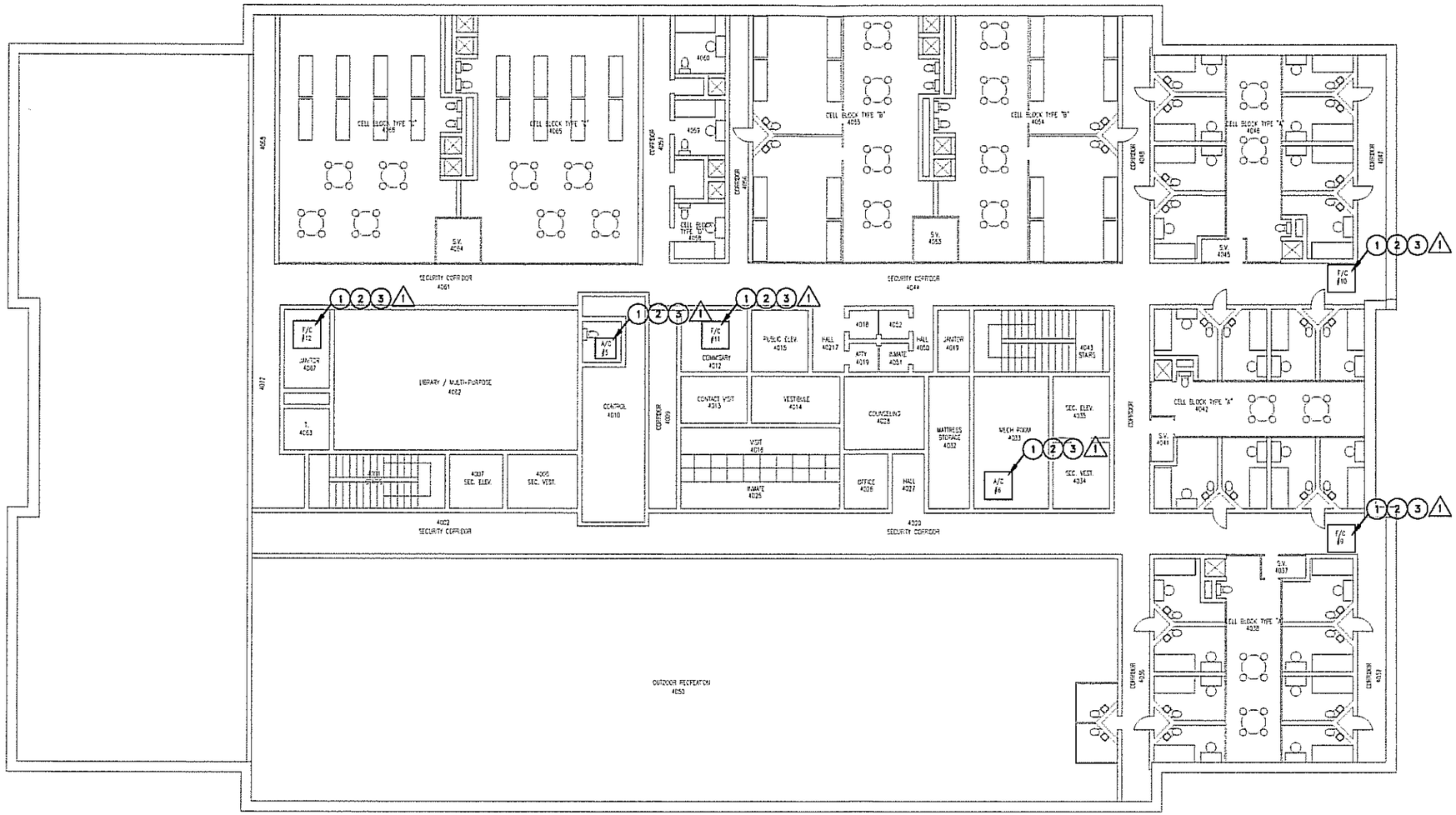
WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: D3



DEMOLITION

4TH FLOOR PLAN: H.V.A.C.

KEYED NOTES: MECHANICAL

1. REMOVE FAN COIL AND AIR HANDLING UNIT. MODIFY ACCESS PANEL AS REQUIRED.
2. REMOVE UNION, STRAINER, 3 WAY VALVE, PRESSURE/TEMP. TEST PLUG, THERMOMETER, "CIRCUIT-SETTER" CONST. FLOW VALVE, DRAINS, AND ALL BALL OR BUTTERFLY VALVES.
3. REMOVE HANGER AND SPRING ISOLATORS.

KEYED NOTES: ELECTRICAL

1. REMOVE WIRE AND CONDUIT BACK TO NEAREST DISCONNECT.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

6/6/2011

REVISIONS BY:

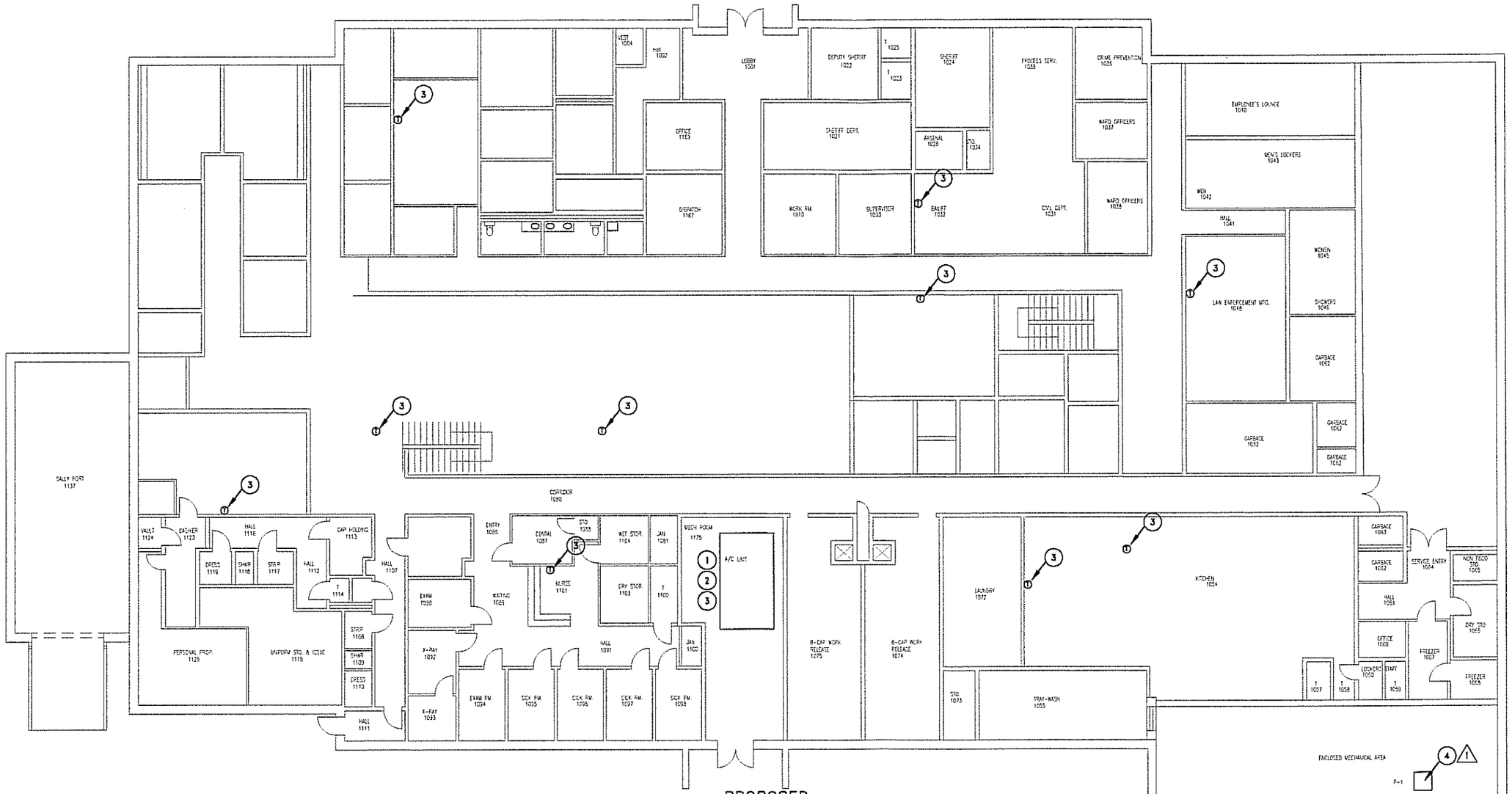
WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: D4



PROPOSED
1ST FLOOR PLAN: H.V.A.C.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED PROFESSIONAL ENGINEER
6/6/2011

KEYED NOTES: ELECTRICAL

1. PROVIDE NEW CONDUIT & WIRE. RECONNECT POWER TO EQUIPMENT. PROVIDE NEW 30AMP BREAKER, WIRE, AND CONDUIT. PROVIDE 1RUN #10, #10G, 1"C. PROVIDE AND INSTALL NEW 5 HP VDF. PRESSURE SENSOR AT AC 6.

MECHANICAL KEYED NOTES:

1. PROVIDE NEW CHILLED WATER VALVE AND ACCESSORIES. REFER TO SCHEMATIC ON SHEET M-6.
2. PROVIDE 10 NEW DAMPER ACTUATORS WITH DRIVE.
3. NEW TEMPERATURE SENSORS
4. PROVIDE NEW PUMP AND ACCESSORIES. REFER TO DETAILS 4 AND 5, SHEET M-7.

REVISIONS BY:

WEBB COUNTY H.V.A.C. RENOVATIONS
LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M1

PROPOSED

2ND FLOOR PLAN: H.V.A.C.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

6/6/2011

KEYED NOTES: ELECTRICAL

1. PROVIDE NEW CONDUIT & WIRE. RECONNECT POWER TO EQUIPMENT. PROVIDE NEW 20AMP BREAKER, WIRE, AND CONDUIT. PROVIDE 1RUN #10, #10G, 1"C.

MECHANICAL KEYED NOTES:

1. INSTALL NEW FAN COIL UNIT WITH NEW HANGARS, ROD, AND SPRING ISOLATORS. PROVIDE NEW TAPS IF REQUIRED FOR ALL THREAD RODS. REFER TO DETAIL 3, SHEET M-7.
2. PROVIDE NEW DUCT HEATER.
3. PROVIDE NEW CHILLED WATER VALVE AND ACCESSORIES. REFER TO SCHEMATIC ON SHEET M-6.
4. PROVIDE NEW PUMP AND ACCESSORIES. REFER TO DETAILS 4 AND 5, SHEET M-7 CONNECT CHILLED WATER PIPE FROM PUMP TO FAN COIL/AC.
5. NEW TEMPERATURE SENSORS.

REVISIONS BY:

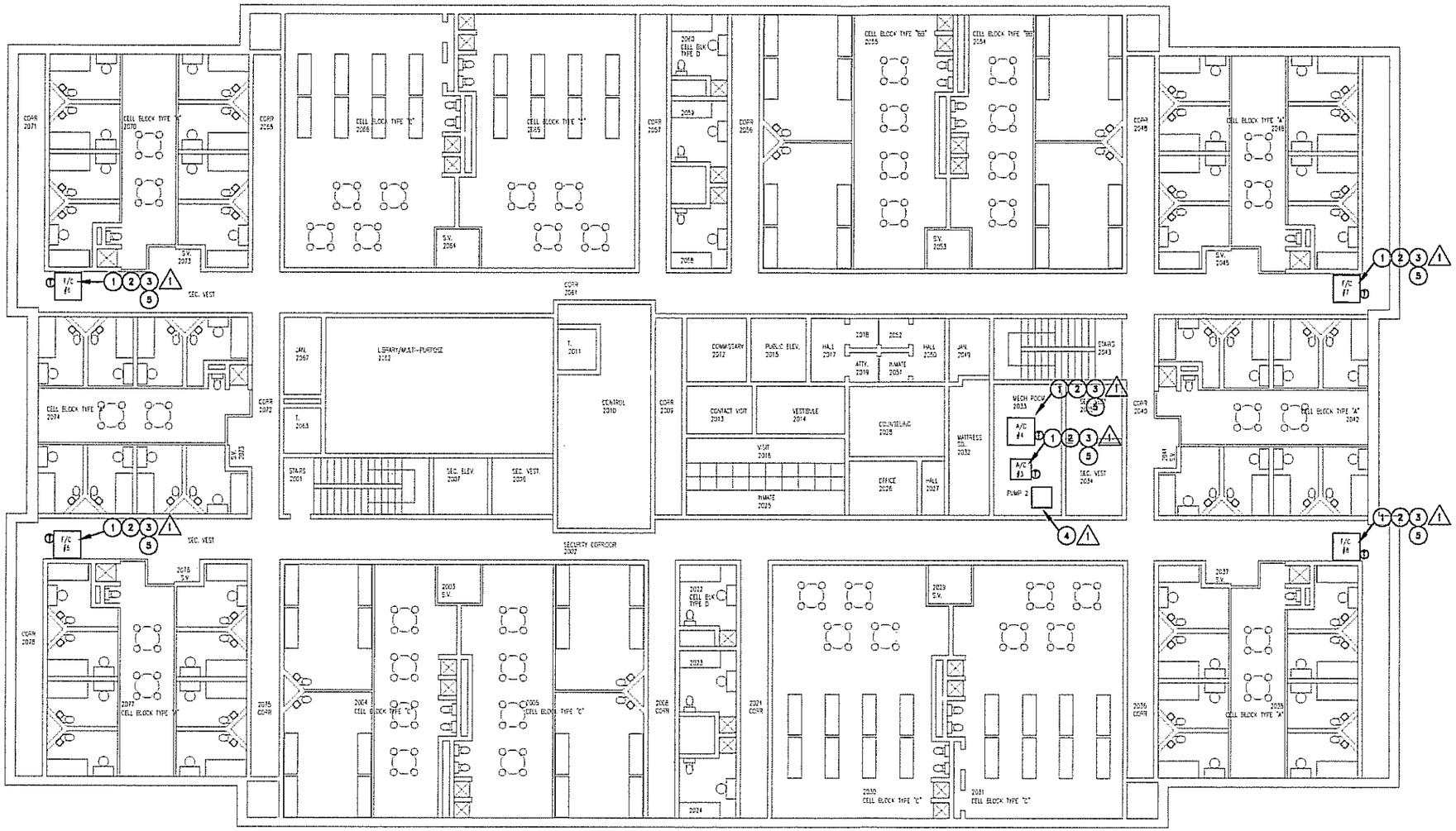
WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M2



PROPOSED

3RD FLOOR PLAN: H.V.A.C.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

6/6/2011

KEYED NOTES: ELECTRICAL

1. PROVIDE NEW CONDUIT & WIRE. RECONNECT POWER TO EQUIPMENT. PROVIDE NEW 20AMP BREAKER, WIRE, AND CONDUIT. PROVIDE 1RUN #10, #10G, 1"C.

MECHANICAL KEYED NOTES:

1. INSTALL NEW FAN COIL UNIT WITH NEW HANGARS, ROD, AND SPRING ISOLATORS. PROVIDE NEW TAPS IF REQUIRED FOR ALL THREAD RODS. REFER TO DETAIL 03.
2. PROVIDE NEW DUCT HEATER.
3. PROVIDE NEW CHILLED WATER VALVE AND ACCESSORIES. REFER TO SCHEMATIC ON SHEET M-6.
4. PROVIDE NEW PUMP AND ACCESSORIES. REFER TO DETAILS 4 AND 5, SHEET M-7 CONNECT CHILLED WATER PIPE FROM PUMP TO FAN COIL/AC.
5. NEW TEMPERATURE SENSORS.

REVISIONS BY:

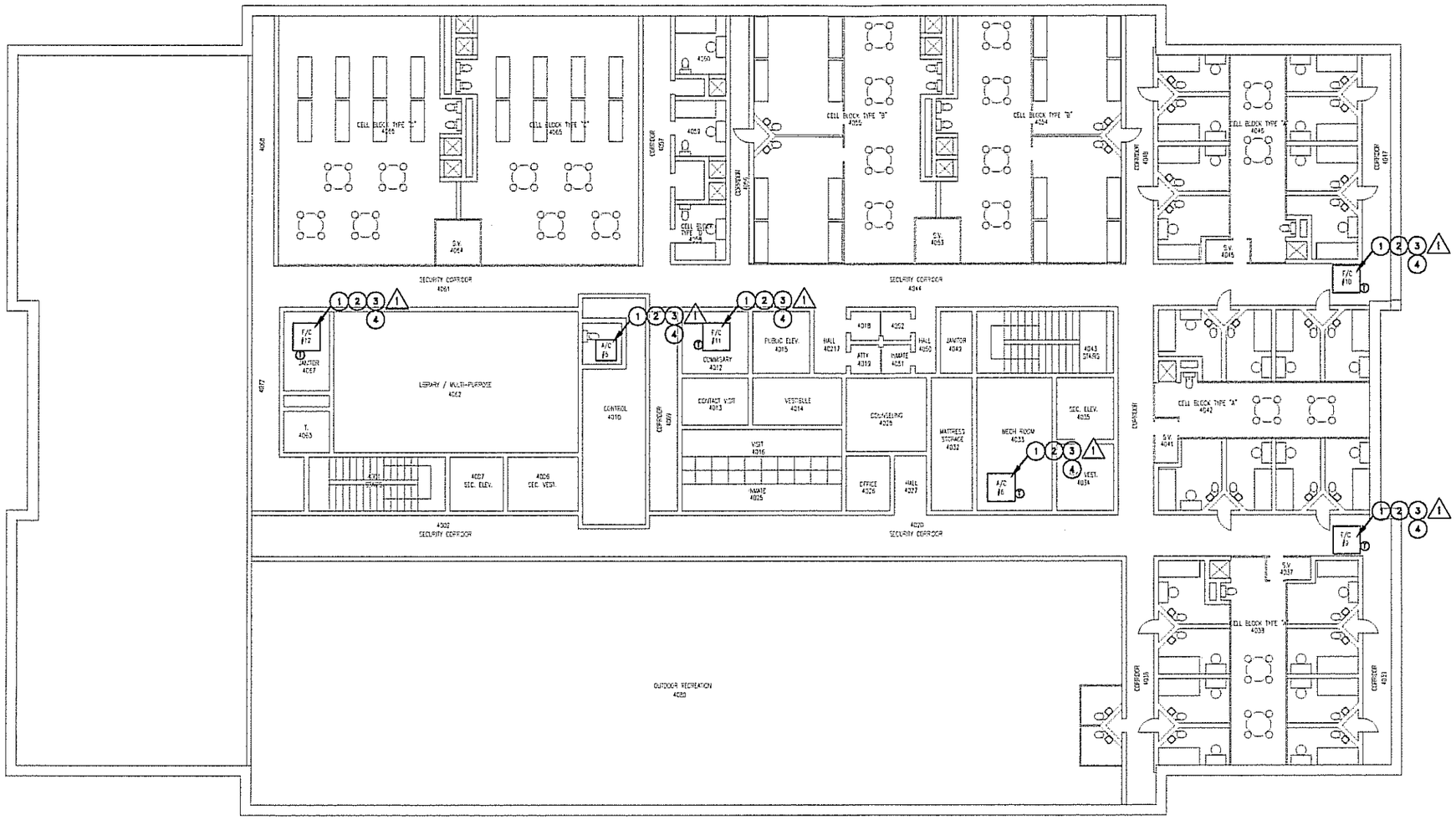
WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M3



PROPOSED

4TH FLOOR PLAN: H.V.A.C.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

6/6/2011

MECHANICAL KEYED NOTES:

1. INSTALL NEW FAN COIL UNIT WITH NEW HANGARS, ROD, AND SPRING ISOLATORS. PROVIDE NEW TAPS IF REQUIRED FOR ALL THREAD RODS. REFER TO DETAIL 03.
2. PROVIDE NEW DUCT HEATER.
3. PROVIDE NEW CHILLED WATER VALVE AND ACCESSORIES. REFER TO SCHEMATIC ON SHEET M-6.

KEYED NOTES: ELECTRICAL

1. PROVIDE NEW CONDUIT & WIRE. RECONNECT POWER TO EQUIPMENT. PROVIDE NEW 20AMP BREAKER, WIRE, AND CONDUIT. PROVIDE 1RUN #10, #10G, 1"C.

REVISIONS BY:

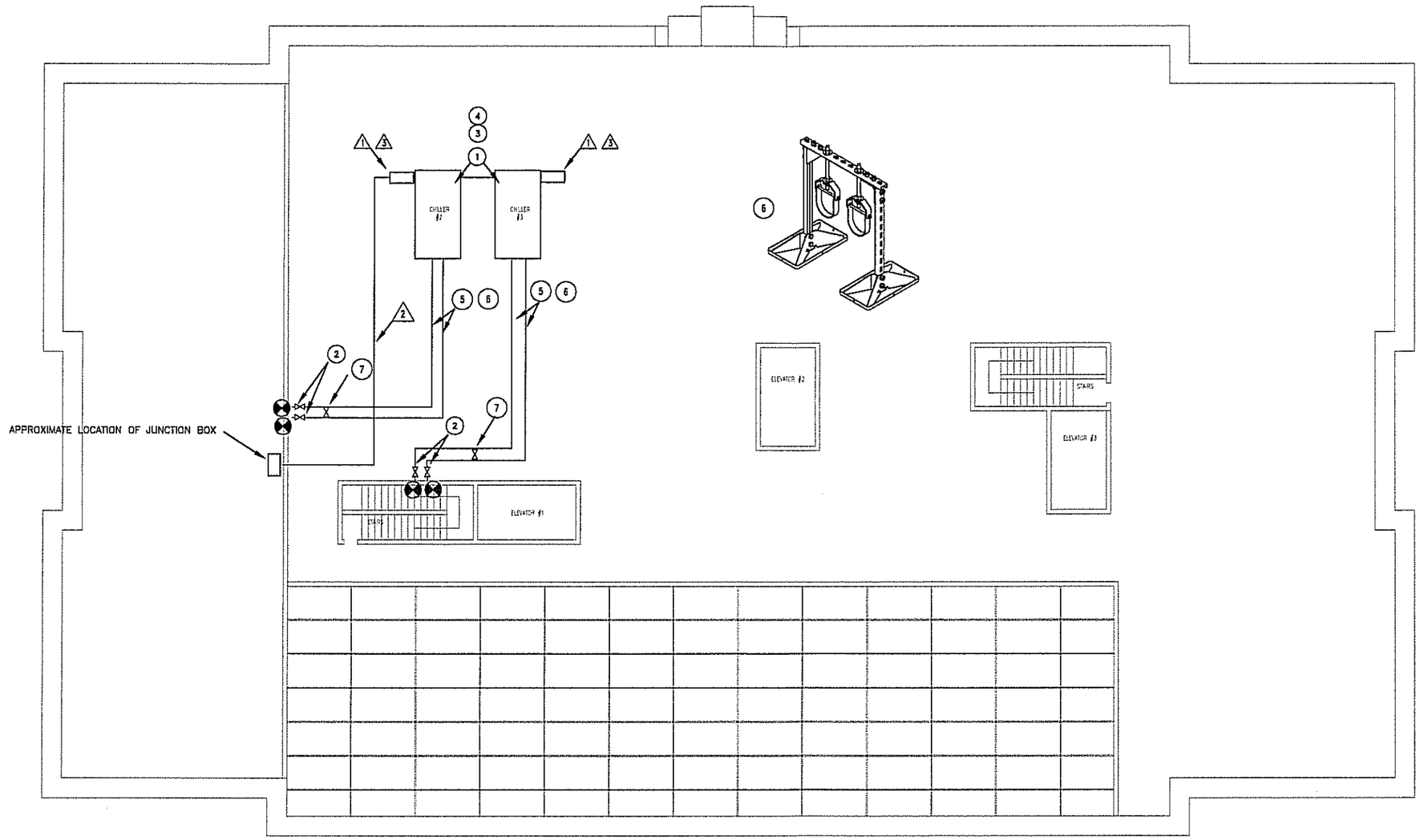
WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M4



PROPOSED

ROOF FLOOR PLAN: H.V.A.C.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

6/6/2011

ELECTRICAL KEYED NOTES:

1. PROVIDE NEW DISCONNECT. 400AMP, 3ø, 4W, N3R 208V, S/N H.D., 300 AMP FUSED DISCONNECT 2 RUNS 3/0, #3 G, 3" C. BACK TO POWER SOURCE. PROVIDE NEW 400 A BREAKER AT PANEL.
2. PROVIDE NEW CONDUIT & WIRE. RECONNECT POWER TO EQUIPMENT. PROVIDE MIRO INDUSTRIES, SUPPORTS EVERY 5 FEET. MODEL NO. 2.5-CONDUIT SUPPORT-2
3. PROVIDE NEW SUPPORTS FOR DISCONNECT INDEPENDENT OF CHILLERS.

MECHANICAL KEYED NOTES:

1. PROVIDE NEW CHILLER AND PLACE ON EXISTING SUPPORTS. MODIFY SUPPORTS AS REQUIRED TO ELEVATE CHILLERS 36" ABOVE ROOF.
2. EXISTING NEW CHILLED WATER VALVE. PROVIDED ON ROOFING CONTRACT PROJECT.
3. PROVIDE ACCESSORIES AS SHOWN ON CHILLED WATER DIAGRAM SCHEMATIC ON SHEET M-6
4. PROVIDE AUTOMATIC AIR VENTS AT SUPPLY AND RETURN PIPES.
5. PROVIDE 3 " NEW CHILLED WATER LINES. RAISE NEW PIPE 2 FEET ABOVE ROOF. PROVIDE 2 INCH INSULATION AND ALUMINUN SLEEVE.
6. PROVIDE CHILLER WATER SUPPORT EVERY FIVE FEET. MIRO INDUSTRIES MODEL NO. 6-H, STAINLESS STEEL.
7. EXISTING BY-PASS VALVE. PROVIDED ON ROOFING CONTRACT.

REVISIONS BY:

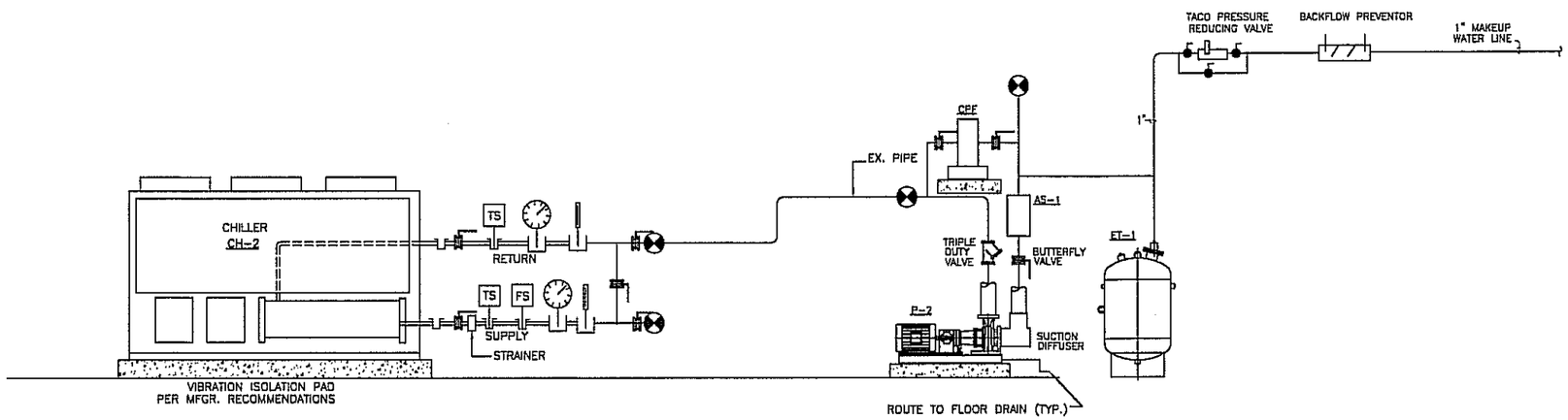
WEBB COUNTY H.V.A.C. RENOVATIONS

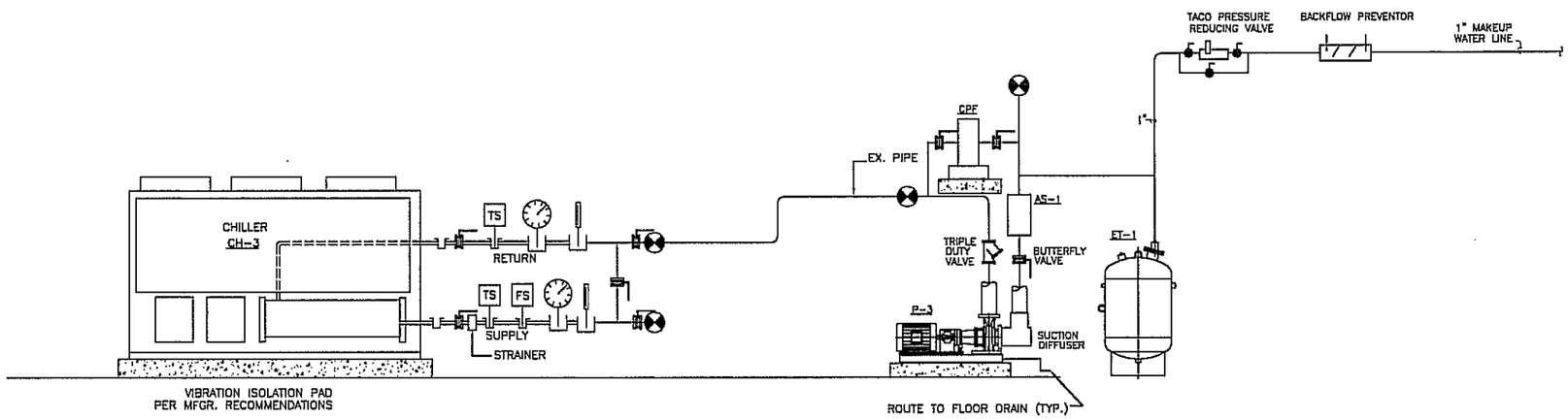
LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M5





LEGEND

- TRIPLE DUTY VALVE
- BUTTERFLY VALVE
- BALL VALVE
- AIR VENT
- TS TEMPERATURE SENSOR
- FS FLOW SENSOR
- FM FLOW METER
- PS PRESSORE SENSOR
- PRESSORE GUAGE
- TEMPERATURE GUAGE
- WALL SLEEVE
- TEST WELL
- CONNECT TO EXISTING

CHILLED WATER CHEMICAL TREATMENT SCHEDULE

TAG – CPF

SYSTEM	CHEMICAL POT FEEDER	CHEMICALS FOR LOOP	CHEMICALS FOR LOOP
DESCRIPTION	3 FILTER BAG FEEDER	NON-OXIDIZING BIOCIDE	CLOSED LOOP NITRITE CORROSION INHIBITOR
CAPACITY (GAL)	5	55	55
MANUFACTURER	HYDROSYSTEMS	NALCO	NALCO
MODEL	HS-800-3	N-2838	N-2833

1. PROVIDE CHEMICAL POT FEEDERS (CPF) FOR PUMPS 2 AND 3.

CHILLED WATER SCHEMATIC DIAGRAM

GENERAL DEMOLITION NOTES (ALL SHEETS)

1. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING ELEMENTS AND CONDITIONS PRIOR TO DEMOLITION OR MODIFICATION. NOTIFY ARCHITECT IN THE EVENT OF ANY DISCREPANCIES.
2. ALL WORK SHALL BE IN ACCORDANCE WITH ALL APPLICABLE CODES, REGULATIONS, AND ORDINANCES HAVING JURISDICTION.
3. THE GENERAL CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR COORDINATION AND SCHEDULING OF THE CONSTRUCTION WORK, PROVISION AND CONTROL OF ALL MEANS AND METHODS OF CONSTRUCTION, FIRE PREVENTION, COORDINATION, ORDERING, DELIVERY AND STORAGE OF MATERIALS, REMOVAL OF DEBRIS, AND ALL ASPECTS OF JOB SAFETY.
4. CONTRACTOR SHALL VERIFY WITH OWNER LOCATION OF DUST CONTAINMENT BARRIERS FOR DEMOLITION.
5. SWEEP DEBRIS FROM SELECTIVE DEMOLITION DAILY; NO ACCUMULATION OF TRASH AND DEBRIS MATERIALS WILL BE ALLOWED. TRASH DUMPSTERS PROVIDED BY CONTRACTOR ARE TO BE USED FOR SELECTIVE DEMOLITION WORKS. ACCUMULATION OF DUST & DEBRIS WILL BE STRICTLY CONTROLLED, AND AREA KEPT AS CLEAN AS POSSIBLE.
6. ALL ITEMS INDICATED TO BE SALVAGED, REPOSITIONED, OR REPLACED SHALL BE STORED AND DELIVERED TO OWNER IN GOOD CONDITION. REPAIR ALL SUCH ITEMS IF DAMAGED OR REPLACE TO THE SATISFACTION OF THE OWNER.
7. PROTECT ALL WALLS AND FLOOR FINISHES AS NEEDED IN ORDER TO PREVENT DAMAGE TO THOSE SURFACES FROM DEMOLITION MATERIALS AND DISPOSAL OPERATIONS.
8. CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY SHOULD UNANTICIPATED HAZARDOUS MATERIALS BE SUSPECTED OR DISCOVERED.
9. CONTRACTOR SHALL COORDINATE ALL INTERRUPTIONS OF MECHANICAL, ELECTRICAL, AND PLUMBING WITH THE OWNER DURING THE COURSE OF CONSTRUCTION.
10. REMOVE ALL ITEMS AS REQUIRED TO ACCOMPLISH THE FINAL CONSTRUCTION REQUIREMENTS EVEN IF NOT SHOWN ON THE DRAWINGS.
11. THE OWNER SHALL RETAIN THE RIGHT OF FIRST REFUSAL ON ALL REMOVED ITEMS, MATERIALS AND EQUIPMENT. IF THE OWNER DOES NOT ELECT TO KEEP ANY REMOVED ITEMS, MATERIALS OR EQUIPMENT, IT SHALL THEN BECOME THE PROPERTY AND AND RESPONSIBILITY OF THE CONTRACTOR.

GENERAL NOTES: (ALL SHEETS)

1. AFTER INSTALLING CHILLED WATER PIPING, AIR SEPARATOR, EXPANSION TANK, CHEMICAL POT FEEDER, AND ALL OTHER HYDRONIC SPECIALTIES INSULATE WITH 2" INSULATION
2. INSULATE ALL PIPING NO LESS THAT 10' FROM FAN COIL/ H.V.A.C. CONNECTIONS AFTER INSTALLING FAN COIL/AC UNITS.
3. ACCESS PANELS SHALL BE REMOVED AND MODIFIED AS REQUIRED.
4. ADJUST BEAMS SUPPORTING CHILLERS TO INSURE PROPER SUPPORT OF CHILLERS. PROVIDE NEOPRENE SUPPORT TO ABSORB VIBRATIONS.
5. ALL PIPING EXPOSED TO OUTDOORS SHALL BE INSULATED WITH 2" INSULATION AND ALUMINUM JACKETS.
6. INSULATE DUCTWORK UP TO 5 FEET FROM FAN COIL/ AC UNITS AFTER INSTALLING EQUIPMENT. PROVIDE FLEXIBLE CONNECTORS.
7. ALL WORK SHALL CONFORM TO THE CITY CODES AND ALL OTHER AUTHORITIES HAVING JURISDICTION OBTAIN PERMITS, AND PAY ALL FEES.
8. VERIFY AT JOB SITE THE EXACT LOCATION OF EXISTING STRUCTURAL MEMBERS SUCH AS BEAMS, COLUMNS ETC. TO LOCATE EQUIPMENT.
9. VERIFY AT JOB SITE ALL GENERAL WORK TO BE DONE AS SPECIFIED AS NOTED, OR AS REQUIRED FOR INSTALLATION, OF VARIOUS AIR CONDITIONING AND PLUMBING SYSTEMS PRIOR TO SUBMISSION OF BIDS.
10. MOUNT ALL THERMOSTATS 48" ABOVE FLOOR UNLESS OTHERWISE NOTED.
11. ALL AIR CONDITIONING UNITS SHALL HAVE A FIRESTAT SET AT 135' F INTERLOCKED WITH FAN MOTOR.
12. PROVIDE CLEAR PLASTIC BOXES FOR ALL THERMOSTATS.

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER

04/06/2011

REVISIONS BY:

WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M6

AIR-COOLED CHILLER SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	REFRIG.	LOAD (TONS)	AIR: AMBIENT ENTERING TEMP. DB/WB (F)	FLUID: FLOW RATE (GPM)	FLUID: ENTERING/LEAVING TEMP. (F)	FLUID: WORKING FLUID	FLUID: HEAD LOSS (FT)	ELECTRICAL: MAXIMUM KW	ELECTRICAL: TOTAL MCA	ELECTRICAL: MAXIMUM UNIT EFFICIENCY (KW/TON)	ELECTRICAL: EFFICIENCY RATING	ELECTRICAL: CHILLER AND CONTROL CIRCUIT VOLT/PH/HZ	PHYSICAL: LENGTH/WIDTH/HEIGHT (IN)	NOTES
CH-2	AGZ060-D	ROOF	SCROLL	R410a	52	105/73.4	124.4	54/44	WATER	15	61.9	264.2	1.2	10	208/3/60	94/68/100	
CH-3	AGZ060-D	ROOF	SCROLL	R410a	52	105/73.4	124.4	54/44	WATER	15	61.9	264.2	1.2	10	208/3/60	94/68/100	

PUMP SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	FLUID: FLOW RATE (GPM)	FLUID: WORKING FLUID	FLUID: HEAD LOSS (FT)	PUMP: EFFICIENCY (%)	PUMP: CONSTRUCTION	ELECTRICAL: MOTOR SIZE (HP)	ELECTRICAL: MOTOR BHP (HP)	ELECTRICAL: MOTOR SPEED (RPM)	ELECTRICAL: VOLT/PH/HZ	NOTES
P-1	TACO FI1507		HORIZ FRAME-MOUNT END-SUCTION	310	WATER	49	66.4	BRONZE FITTED	5	4.3	1760	200/3/60	PROVIDE WITH VFD
P-2	TACO FI1507		HORIZ FRAME-MOUNT END-SUCTION	100	WATER	49	66.4	BRONZE FITTED	3	1.848	1760	200/3/60	–
P-3	TACO FI1507		HORIZ FRAME-MOUNT END-SUCTION	100	WATER	40	66.4	BRONZE FITTED	3	1.848	1760	200/3/60	–

EXPANSION TANK SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	FLUID: WORKING FLUID	MIN. TANK/ACCEPTANCE (GAL)	PHYSICAL: TANK SIZE (GAL)	RELIEF VALVE (PSIG)	DIA./HEIGHT (IN)	NPT FITTING (IN)	NOTES
ET-1	TACO CA-90		HORIZ BLADDER FULL	WATER	8/5	8	50	14/22	0.5	–

AIR SEPARATOR SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	FLUID: FLOW RATE (GPM)	FLUID: WORKING FLUID	FLUID: HEAD LOSS (FT)	PHYSICAL: DIA./HEIGHT (IN)	NOTES
AS-1	TACO 436		INLINE	146	WATER	0.2	10/8	

FAN COIL UNITS WITH DUCT HEATER

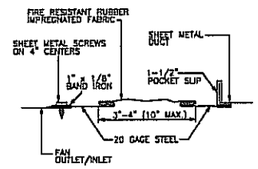
SERVES BUILDING	2,3,4,FLOORS	4 FLOORS
MARK	FC-1,2,3,4,5,6,7,8,9	FC-10,11,12
UNIT CONFIGURATION	HORIZONTAL	HORIZONTAL
SUPPLY DISCHARGE	55 F	55 F
SUPPLY CFM	2760	1740
MIN. OUTSIDE AIR (CFM)	380	380
EXT. STATIC INCHES WC	1.5	1.5
MINIMUM HP	3	2
MAXIMUM BHP	2.07	1.66
VOLTAGE/PHASE	208/3	208/3
COOLING COIL		
ENTERING AIR DB/WB	79/64	78.9/64.1
LEAVING AIR DB/WB	52/52	52/52
ENTERING/LEAVING WATER TEMP.	45/56	45/56
GPM	16.5	11
MIN. TOTAL CAPACITY (MBH)	96.2	64
MIN. SENSIBLE CAPACITY (MBH)	79.6	47
MAX. WATER PRESSURE DROP (FT)	5	10
MIN. ROWS	6	6
MAX. FINS PER INCH	12	12
INSTALLED UNIT WT.		
MANUFACTURER	MCQUAY	MCQUAY
MODEL NUMBER	LAH007A	LAH004A
NOTES:	1,2,3,4	1,2,3,4

NOTES:
1. DOUBLE WALL WITH MINUMUM R-7 INSULATION.
2. HORIZONTAL UNIT WITH FILTER SECTION, CHILLED WATER COIL AND FAN SECTION.
3. STAINLESS STEEL DRAIN PAN, STAINLESS STEEL COIL CASING AND HINGED DOORS
4. PROVIDE 20 KW OF HEAT IN DUCT

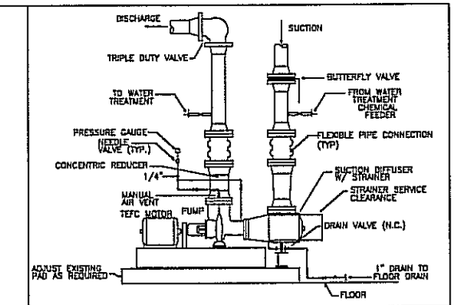
CW AIR HANDLING UNIT SCHEDULE

SERVES BUILDING	2,3,4,FLOORS	2,3,4,FLOORS	4 FLOOR
MARK	A/C-1,3,5	A/C-2,4	A/C-6
UNIT CONFIGURATION	HORIZONTAL	HORIZONTAL	HORIZONTAL
SUPPLY DISCHARGE	55 F	55 F	55 F
SUPPLY CFM	660	1290	1730
MIN. OUTSIDE AIR (CFM)	60	120	380
EXT. STATIC INCHES WC	0.25	0.3	1.5
MINIMUM HP	1	1.5	2
MAXIMUM BHP	0.81	1.1	1.55
VOLTAGE/PHASE	115/1	115/1	208/3
COOLING COIL			
ENTERING AIR DB/WB	78.9/64.1	78.9/64.1	78.9/64.1
LEAVING AIR DB/WB	55/54	55/54	55/54
ENTERING/LEAVING WATER TEMP.	45/55	45/55	45/55
GPM	3	7	11
MIN. TOTAL CAPACITY (MBH)	10	32.4	64
MIN. SENSIBLE CAPACITY (MBH)	7.2	24.3	47
MAX. WATER PRESSURE DROP (FT)	10	10	10
MIN. ROWS	6	6	6
MAX. FINS PER INCH	12	12	12
INSTALLED UNIT WT.			
MANUFACTURER	MCQUAY	MCQUAY	MCQUAY
MODEL NUMBER	LAH002A	LAH003A	LAH004A
NOTES:	1,2,3,4	1,2,3,4	1,2,3,5

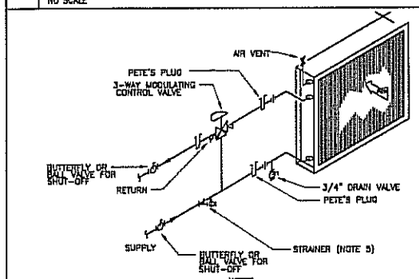
NOTES:
1. DOUBLE WALL WITH MINUMUM R-7 INSULATION.
2. HORIZONTAL UNIT WITH FILTER SECTION, CHILLED WATER COIL AND FAN SECTION.
3. STAINLESS STEEL DRAIN PAN, STAINLESS STEEL COIL CASING AND HINGED DOORS
4. PROVIDE 5 KW OF HEAT IN DUCT
5. PROVIDE 20 KW OF HEAT IN DUCT



01 FLEXIBLE CONNECTION
NO SCALE

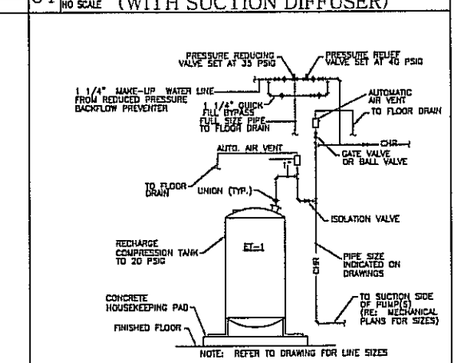


04 END SUCTION PUMP INSTALLATION (WITH SUCTION DIFFUSER)
NO SCALE

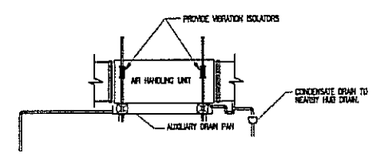


NOTES
1. WHERE PIPE SIZE IS 2 1/2" OR SMALLER, PROVIDE BALL VALVE IN LIEU OF BUTTERFLY VALVE.
2. PROVIDE THERMOMETERS AND PRESSURE GAUGES, PER SPECS.
3. INSTALL UNIONS IN PIPE LOCATION OUT OF WAY TO PULL COIL OUT
4. PROVIDE BALANCE METER IN THE SUPPLY PIPE FOR AHU COIL WITH 50 GPM OR MORE
5. PROVIDE BALL VALVE DRAIN VALVE AND DRAIN LINE TO FLOOR DRAIN.

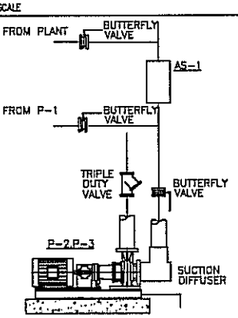
02 WATER CONTROL CONNECTION W/ 3-WAY CONTROL VALVE DETIAL
NO SCALE



05 DIAPHRAM TYPE COMP. TANK
NO SCALE



03 AHU/FAN COIL MOUNTING DETAIL
NO SCALE



BYPASS VALVES - N.C. P-1,P-2
NO SCALE

STATE OF TEXAS
ROBERTO DE LA CRUZ
85431
LICENSED
PROFESSIONAL ENGINEER
6/6/2011

REVISIONS BY:

WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M7

1ST FLOOR PLAN: H.V.A.C.

ALTERNATE 1

AIR-COOLED CHILLER SCHEDULE

	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	REFRIG.	LOAD (TONS)	AIR AMBIENT ENTERING TEMP. DB/WB (F)	FLUID FLOW RATE (GPM)	FLUID ENTERING/ LEAVING TEMP. (F)	FLUID WORKING FLUID	FLUID HEAD LOSS (FT)	ELECTRICAL MAXIMUM KW	ELECTRICAL	ELECTRICAL MAXIMUM UNIT EFFICIENCY (KW/TON)	ELECTRICAL EFFICENCY RATING	ELECTRICAL CHILLER AND CONTROL CIRCUIT VOLT/PH/HZ	PHYSICAL LENGTH/ WIDTH/ HEIGHT (IN)	
CH-1	AGZ060-D	Slab	SCROLL	R410a	52	105/73.4	124.4	54/44	WATER	15	61.9		1.2	10	208/3/60	94/88/100	

EXPANSION TANK SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	FLUID WORKING FLUID	MIN. TANK/ ACCEPTANCE (GAL)	PHYSICAL TANK SIZE (GAL)	RELIEF VALVE (PSIG)	DIA./ HEIGHT (IN)	NPT FITTING (IN)
ET-1	TACO CA-90		HORIZ BLADDER FULL	WATER	6/5	8	50	14/22	0.5

AIR SEPARATOR SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	FLUID FLOW RATE (GPM)	FLUID WORKING FLUID	FLUID HEAD LOSS (FT)	PHYSICAL DIA./ HEIGHT (IN)	NOTES
AS-1	TACO 438		INLINE	148	WATER	0.2	10/8	

DEMOLITION NOTES:

1. REMOVE AND DISPOSE OF EXISTING CHILLER. REMOVE AND REPLACE PIPING, CONDUITS, AND STRUCTURE REQUIRED TO ACCOMODATE THE REMOVAL AND INSTALLATION OF CHILLERS
2. REFER TO SHEET M-6 FOR GENERAL DEMOLITION NOTES.
3. REMOVE PIPING TO ACCOMODATE NEW CHILLED WATER LINES. PROVIDE TWO (2) 4 INCH BUTTERFLY VALVES TO EXISTING PLANT SUPPLY AND RETURN TO ALLOW FLOW WHEN DESIRED.

GENERAL NOTES:

1. PROVIDE CHEMICALS AND CHEMICAL POT FEEDER. PROVIDE MAKEUP WATER LINE WITH BACKFLOW PREVENTER. ALL PROJECT SPECIFICATIONS WILL APPLY TO THIS ALTERNATE.

MECHANICAL KEYED NOTES:

1. PROVIDE NEW CHILLER WITH ACCESSORIES. REFER TO SCHEDULE AND M6 FOR PIPING OF ACCESSORIES.
2. PROVIDE 3 IN INSULATED PIPING FROM CHILLER TO PUMP 1. PROVIDE STEEL SUPPORTS EVERY 5 FEET.

ELECTRICAL KEYED NOTES:

1. PROVIDE NEW DISCONNECT. 400AMP, 3ø, 4W, N3R 208V, S/N H.D., 300 AMP FUSED DISCONNECT 2 RUNS 3/0, #3 G, 3" C. BACK TO POWER SOURCE. PROVIDE NEW 400 A BREAKER AT PANEL.
2. PROVIDE NEW CONDUIT & WIRE. RECONNECT POWER TO EQUIPMENT. PROVIDE MIRO INDUSTRIES, SUPPORTS EVERY 5 FEET. MODEL NO. 2.5-CONDUIT SUPPORT-2
3. PROVIDE NEW SUPPORTS FOR DISCONNECT INDEPENDENT OF CHILLERS.

REVISIONS BY:

WEBB COUNTY H.V.A.C. RENOVATIONS

LAREDO, TEXAS

DATE: 4/05/2011
DRAWN BY: UEDT
JOB #: 11-003

COPYRIGHT 2011
UNITECH ENGINEERING, INC.
733 N. WARE RD. SUITE D
MCALLEN, TEXAS

SHEET: M1ALT