

**THE  
UNIVERSITY  
OF RHODE ISLAND**

**DIVISION OF  
ADMINISTRATION  
AND FINANCE**

THINK BIG  WE DO

**PURCHASING DEPARTMENT**

10 Tootell Road, Suite 3, Kingston, RI 02881 USA

p: 401.874.2171

f: 401.874.2306

uri.edu/purchasing



DATE: 2/1/16

ADDENDUM #2

BID NO.: 100185  
OPENING: 2/11/16-3:00 PM  
COMMODITY: URI DORM PLUMBING AND HEATING RENOVATIONS

Attached please find the changes to the specifications of the above mentioned bid. The attached also includes a revised Bid Form. Please replace the Bid Form included in the original solicitation with the attached.



Tracey A. Angell, Assistant Director  
URI Purchasing Department

Rev. 9-1-15

**DOCUMENT 00900 – ADDENDA AND MODIFICATIONS**

**ADDENDUM NO. 2 – Date: January 27, 2016**

From: Tecton Architects, PC

*17 Railroad Avenue  
Westerly, RI 02891  
Tel. 401-5967555*

To: Prospective Bidders

Re: Bid #100185 – URI Fayerweather and Gorham Halls Plumbing and Heating Replacement, Kingston, RI.  
OCP URI Project # KC.R.MISC.2014.003

This Addendum forms part of the Contract Documents and modifies the Bidding Documents dated 1/30/2015 with amendments and additions noted below.

Acknowledge receipt of this Addendum in the space provided in the Bid Form. Failure to do so may disqualify the Bidder.

This Addendum includes the following documents:

1. Plumbing Drawing GO.P2.101 - Basement Plumbing - Gorham
2. Plumbing Drawing FA.P2.102 – Basement Plumbing - Fayerweather
3. Plumbing Drawing GO.P2.103 – Typical Floor Plans First Thru Fourth Plumbing - Gorham
4. Plumbing Drawing GO.P2.104 – Typical Floor Plans First Thru Fourth Plumbing - Fayerweather
5. Plumbing Drawing P2.401 – Plumbing Details and risers - Gorham & Fayerweather
6. Bid Form, revised 1/27/16 – Addendum 1
7. Section 012010, Attachment A, revised 1/27/16 - Addendum 1
8. Section 220000 with the 1-23-16 revision.
9. Section 230500 with the 1-23-16 revision.
10. Section 230523 with the 1-23-16 revision.
11. Section 230529 with the 1-23-16 revision.
12. Section 230548 with the 1-23-16 revision.
13. Section 230900 with the 1-23-16 revision.
14. Section 238236 with the 1-23-16 revision.
15. Section 230548 with the 1-23-16 revision.
16. Photograph of solid surface countertop with integral lavs, to facilitate replacement unit price estimate.

## ANSWERS TO QUESTIONS

1. QUESTION 1: The mechanical plans for this project indicate the ATC system should be an extension of the existing Andover Control system already in the building however the specification indicates that there are a number of acceptable vendors. Can you please confirm that the control system is to be Andover Controls and an extension of the existing system?  
ANSWER 1: AS INDICATED ON DRAWING GO.M2.201 AND FA.M2.202 THE NEW BMS IS AN EXTENSION OF THE EXISTING ANDOVER CONTROLS IN FAYERWEATHER DORM. THE SPECIFICATION SECTION 230900 HAS BEEN REVISED TO INDICATE ANDOVER CONTROLS AS THE ONLY MANUFACTURER.
2. QUESTION 2: Section 230900-page 2 of the specifications under Instrumentation and Control for HVAC – “the Operator Workstation includes specifications for a 1.44 MB Floppy Disk Drive...” Should this be revised?  
ANSWER 2: THE ORIGINAL SPECIFICATION SECTION 230900 WAS NOT FORMATTED TO REFLECT URI STANDARDS. THE REPLACEMENT SPEC SECTION PROVIDED IN THIS ADDENDUM DOES NOT INCLUDE A DESKTOP COMPUTER FOR THIS LOCATION AND THE PROGRAM BACKUP IS TO BE PROVIDED “IN DIGITAL MEDIA FORMAT”.
3. QUESTION 3: Can GPR be used instead of x-rays to locate the sewer line?  
ANSWER 3: YES.
4. QUESTION 4: Are contractor’s and construction manager’s personnel background checks required?  
ANSWER 4: NO.

## CHANGES TO DRAWINGS

1. Architectural Drawings A2.103 to A2.106 – Demolition note 12 – Add the following sentence: “Remove wire shelves and store for re-installation”.
2. Architectural Drawings A2.203 to A2.206 – Construction note 9 – Add the following sentence: “Re-install stored wire shelves”.
3. Mechanical Drawing GO.M2.101 - Basement Storage Rm 006 – Revise Baseboard “C/6” to shift left and indicate “RIC” (return pipe run within cover).
4. Mechanical Drawing FA.M2.102 - Basement Storage Rm 017 – Revise Baseboard “C/6” to shift left and indicate “RIC” (return pipe run within cover).
5. Mechanical Drawing M2.301 – Fin-Tube Radiation Schedule – Revise BTU/FT of type A from 775 to 820, type B from 880 to 900, and Type C from 690 to 730; revise type D Tube Size from 3/4” to 1”.
6. Plumbing Drawing GO.P2.101 - Basement Plumbing Gorham – Replace sheet with revisions.
7. Plumbing Drawing FA.P2.102 – Basement Plumbing Fayerweather – Replace sheet with revisions.
8. Plumbing Drawing GO.P2.103 – Typical Floor Plans First Thru Fourth Plumbing - Gorham – Replace sheet with revisions.
9. Plumbing Drawing GO.P2.104 – Typical Floor Plans First Thru Fourth Plumbing - Fayerweather – Replace sheet with revisions.
10. Plumbing Drawing P2.401 – Plumbing Details and risers Gorham & Fayerweather – Replace sheet with revisions.

## **CHANGES TO PROJECT MANUAL**

1. Replace original Specification Section 220000 with the 1-23-16 revision attached.
2. Replace original Specification Section 230500 with the 1-23-16 revision attached.
3. Replace original Specification Section 230523 with the 1-23-16 revision attached.
4. Replace original Specification Section 230529 with the 1-23-16 revision attached.
5. Replace original Specification Section 230548 with the 1-23-16 revision attached.
6. Replace original Specification Section 230900 with the 1-23-16 revision attached.
7. Replace original Specification Section 238236 with the 1-23-16 revision attached.
8. Add missing Specification Section 230548 1-23-16 revision attached.

**END OF ADDENDUM # 2**

**Solicitation # :** 100185  
**Solicitation Title:** URI DORM PLUMBING AND HEATING RENOVATIONS

**BID FORM**

To: The University of Rhode Island, Purchasing Office  
10 Tootell Road, Kingston, RI 02881

Project: Fayerweather and Gorham Halls  
Plumbing and Heating Replacement  
The University of Rhode Island  
Kingston Campus, Kingston RI 02881

Bidder:

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Legal name of entity

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Address

---

Contact name Contact email

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Contact telephone Contact fax

**1. BASE BID PRICE**

The Bidder submits this bid proposal to perform all of the work (including labor and materials) as described in the solicitation for this Base Bid Price, (including the costs for all Allowances, Bonds, and Addenda):

\$

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(Base Bid Price *in figures* printed electronically, typed, or handwritten legibly in ink)

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(Base Bid Price *in words* electronically, typed, or handwritten legibly in ink)

- **ALLOWANCES**

The Base Bid Price ***includes*** the costs for the following Allowances:

1. Haz Mat Removal and Disposal at concealed existing locations:	\$40,000.00
2. Structural repairs at concealed existing locations:	\$60,000.00
3. Replacement of damaged existing bathroom fixtures:	\$20,000.00
4. Fire stopping at concealed existing locations:	\$40,000.00
5. Masonry repairs and patching at concealed existing locations:	\$20,000.00
Total Allowances:	<u>\$180,000.00</u>

- **BONDS**

The Base Bid Price ***includes*** the costs for all Bid and Payment and Performance Bonds required by the solicitation.

- **ADDENDA**

The Bidder has examined the entire solicitation (including the following Addenda), and the Base Bid Price ***includes*** the costs of any modifications required by the Addenda.

All Addenda must be acknowledged.

Addendum No. 1, dated \_\_\_\_\_

Addendum No. 2, dated \_\_\_\_\_

2. **ALTERNATES - Not Applicable**

3. **UNIT PRICES –**

Provide unit prices for the following fixtures and products to be replaced if damaged:

Unit Price 1- Toilet Bowl: American Standard 3451.160 w/elongated open front seat  
\$ \_\_\_\_\_

Unit Price 2 – Flush Valve: Sloane Flushometer Royal Model 111, 1.6 gal  
\$ \_\_\_\_\_

Unit Price 3 – Solid Surface Countertop with Integral Lavs., Backsplash and Shelf  
\$ \_\_\_\_\_

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Unit Price 4 – Faucet: re-build faucet if damaged  
\$ \_\_\_\_\_

**4. CONTRACT TIME**

The Bidder offers to perform the work in accordance with the timeline specified below:

- Start of Construction..... May 23, 2016
- Substantial Completion..... August 12, 2016
- Final Completion..... August 22, 2016

**5. LIQUIDATED DAMAGES**

The successful bidder awarded a contract pursuant to this solicitation shall be liable for and pay the State, as liquidated damages and not as a penalty, the following amount for **each** calendar day of delay beyond the date for substantial completion, as determined in the sole discretion of the State: **One Thousand Five Hundred Dollars (\$1500.00) per day.**

**BID FORM SIGNATURE(S)**

**This bid proposal is irrevocable for 60 days from the bid proposal submission deadline.**

**If the Bidder is determined to be the successful bidder pursuant to this solicitation, the bidder will promptly: (i) comply with each of the requirements of the Tentative Letter of Award; and (ii) commence and diligently pursue the work upon issuance and receipt of the purchase order from the State and authorization from the user agency.**

**The person signing below certifies that he or she has been duly authorized to execute and submit this bid proposal on behalf of the Bidder.**

**BIDDER** \_\_\_\_\_

Date: \_\_\_\_\_

\_\_\_\_\_  
Name of Bidder

\_\_\_\_\_  
Signature in ink

\_\_\_\_\_  
Printed name and title of person signing on behalf of Bidder

# \_\_\_\_\_  
Bidder's Contractor Registration Number

**01 2010 PRICE AND PAYMENT PROCEDURES - Attachment A**

## A. Allowances

1. Haz Mat Removal and Disposal at concealed existing locations:	\$40,000.00
2. Structural repairs at concealed existing locations:	\$60,000.00
3. Replacement of damaged existing bathroom fixtures:	\$20,000.00
4. Fire stopping at concealed existing locations:	\$40,000.00
5. Masonry repairs and patching at concealed existing locations:	\$20,000.00
Total Allowances:	<u>\$180,000.00</u>

## B. Testing Allowance

1. None.

## C. Unit Prices

Unit Price 1 –	Toilet Bowl: American Standard 3451.160 w/ elongated open front seat	\$ _____
Unit Price 2 –	Flush Valve: Sloane Flushometer Royal Model 111, 1.6 gpf	\$ _____
Unit Price 3 –	Solid Surface Countertop with Integral Lavs., Backsplash and Shelf	\$ _____
Unit Price 4 -	Faucet: Re-build faucet if damaged	\$ _____

## D. Alternates

1. None.

## E. Payroll Reporting

1. Forms for the submission of Certified Payroll Records may be found from the Rhode Island [Prevailing Wage Website](#) in either PDF or Excel formats. These forms must be used on monthly submittals.

2. Identify Apprenticeship hours required under RIGL 37-13-3.1 for all contracts over \$1million in value.



3. A Minority Utilization Report for minority subcontractors must be included.  
Use the form provided as Attachment B.

F. Warranty Inspection Retainage

1. One-half of one percent of the cost of the Work will be retained from Final Payment for this purpose.

**END OF ATTACHMENT**

SECTION 22 00 00

INTERIOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Sanitary, waste and vent piping
2. All domestic cold water hot water and hot water return piping
3. Final connections to all fixtures and equipment
4. Disconnecting, removal, storage and reinstallation of existing plumbing fixtures
5. Removal and disposal of existing piping, fixtures, trim, etc.
6. Roding and cleaning of existing sanitary lines to remain to new connections and main lines to manhole or main line connection outside the building
7. Insulation
8. Stainless Steel Hangers and accessories
9. Valves
10. Plumbing Fixtures
11. New fixture trim and accessories
12. Connections to existing piping

B. Other items in the work covered in other sections of the specifications, as shown and specified herein.

C. Removal and disposal of all existing lavatory traps, supplies and stops for new wall installation and replacement with new.

D. Examine all sections of specification and drawings for requirements affecting the work of this section, as shown and specified herein.

E. Provide all manufactured items and equipment in accordance with manufacturer's recommendations. Provide all necessary specialties and accessories, including anchors and supports.

1.2 DEFINITIONS

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

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

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

D. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
  2. CPVC: Chlorinated polyvinyl chloride plastic.
  3. RE: Polyethylene plastic.
  4. PVC: Polyvinyl chloride plastic
- E. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  2. NBR: Acrylonitrile-butadiene rubber.
- F. "Furnish and install" and "Provide" means to supply, erect, install and connect in readiness for regular operation, the particular work referred to, unless otherwise specified.
- G. Piping shall mean and include pipe, fittings, hangers, and valves.
- H. The term "capped flush" on existing piping means cap existing lines, concealed, beyond finish wall, ceiling or floor line, so proper finish can be applied.

### 1.3 SHUTDOWNS

- A. Coordinate all shutdowns with University and do all work, etc., under University's approved schedule, including requirements for overtime.
- B. Coordinate all phases of the work with Owner and do all work with the least inconvenience to the Owner.

### 1.4 EXISTING CONDITIONS

- A. Bidders are advised to visit the site and inform themselves as to conditions under which this work will be performed prior to submitting prices. Failure to do so, will, in no way relieve the successful bidder from the responsibility of furnishing any materials or performing any work in accordance with the true intent and meaning of the drawings and specifications.
- B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of the site conditions and contract documents prior to executing the contract would have revealed.
- C. This Contractor shall be responsible for ordering and furnishing the correct quantity of material required. Routing and equipment arrangements shown on the drawings are approximate only and are not warranted to be accurate.
- D. Arrangements shall be made with the University prior to the visit for inspection of the existing buildings.
- E. Field verify all inverts, pipe sizes, locations, etc. at each location, prior to starting work.
- F. Do not reuse piping, unless otherwise noted.

- G. Examine building before commencing work and make known any damaged fixtures and/or piping which exists.
- H. Remove and dispose of all piping (sanitary, vent and water), etc. and verify with owner as to which items are to be turned over to owner and which items are to be disposed of. Cap all lines in existing walls, floors, or ceilings not to be removed, flush with floors, walls, or ceilings as specified.
- I. Provide temporary lines required during construction to keep existing system) in proper working order all at no additional cost.
- J. Disconnect existing plumbing fixtures protect and store on site in a safe area. After new wall work is completed reinstall existing fixtures and trim. Provide all necessary backing, supports, valves, fittings, supplies and stops, etc., as required.
- K. Correct and repair any damage to existing plumbing fixtures and piping at no additional cost.
- L. Test all water lines being reused and repair all leaks that develop at no additional cost.
- M. Clean and rod existing sanitary lines each floor to new stacks and main sanitary lines to the nearest manhole or main line connection outside the building being reused.

#### 1.5 RELATED SECTIONS

- A. Cutting and patching - Division 1.
- B. Coring of holes and saw cutting in concrete - Division 1.
- C. Concrete work - Division 3.
- D. Masonry work - Division 4.
- E. Access panels - Division 8.
- F. Field painting of piping, hangers, etc. - Division 9.
- G. Toilet accessories - Division 10.
- H. Fire protection systems - Section 211000.
- I. Heating hot Water supply and return piping - Division 23.
- J. Condensate piping - Division 23.
- K. Heating connections, thermostats - Division 23.

- L. Electrical connections - Division 26.

## 1.6 CODES, ORDINANCES AND PERMITS

- A. All work performed under this section of the specifications shall be done in accordance with the applicable National, State and local codes, laws and ordinances and State of Rhode Island Plumbing Codes.
- B. All materials and work provided shall be in accordance with, but not limited to, the following:
  - 1. American National Standards Institute (ANSI).
  - 2. American Society for Testing and Materials (ASTM)
  - 3. Building Officials and Code Administrators (BOCA)
  - 4. National and State Electrical Code (NEC)
  - 5. National Electrical Manufacturer's Association (NEMA)
  - 6. National Fire Protection Association Codes and Standards (NFPA)
  - 7. Occupational Safety and Health Act (OSHA)
  - 8. State Building Code
  - 9. Standards of Underwriters Laboratories (UL)
- C. Where code references are given, the latest issue of that code in effect at the time of bidding shall be used. Code references given to indicate the minimum quality and performance acceptable. Where specifications and/or drawings indicate more stringent requirements, the specification shall govern.
- D. Permits: Be responsible for filing all documents, payment of all fees and securing of all inspections and approvals necessary for the installation and operation of all systems furnished under this section.

## 1.7 PROTECTION

- A. Protect materials, fixtures and fittings. Temporarily close all pipe openings to prevent obstruction and damage. Board over, water closets, lavatories and sinks and protect other fixtures with pasted-on paper.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- C. Post notices prohibiting the use of the fixtures prior to completion.

## 1.8 CUTTING AND FITTING

- A. Do the cutting and fitting necessary for the installation of the plumbing work and maintain fire integrity of floor to floor construction.
- B. Take care to prevent injury, discoloration or defacement of other finish materials; and do no cutting or fitting of finish material.

## 1.9 CLEANING

- A. Upon completion of the installation, clean and remove all oil and debris. Clean and polish and leave bright all fixtures and metal work intended to be exposed. Clean out the piping systems and all fixtures, traps and cleanouts. Leave all work in perfect operating condition.
- B. Should any pipe, duct or any part of the apparatus be stopped by refuse after the apparatus has been accepted, pay for the disconnecting, cleaning and reconnection, wherever necessary, for the purpose of location and removing the obstruction. Pay for repairs to adjoining work required thereby.

#### 1.10 DRAWINGS

- A. The drawings are diagrammatic, and not intended to show every detail of construction or arbitrary location of piping. Where building construction makes it advisable or necessary to change location of piping or fixtures, without increasing the scope of work, perform such work without additional cost, on written order or consent of the Engineer.
- B. Install the work as shown. In case of conflict with building parts, or the work of other trades, immediately request a decision be rendered so that there may be no delay in the building construction.
- C. Submit for written approval, single line diagrams of any proposed changes or modification to the drawings, at least one week before prices are due.

#### 1.11 QUALITY ASSURANCE

- A. Submit catalog cuts and brochures for approval of all proposed materials.
- B. Where items of equipment and/or materials are specified or materials are specified or identified herein by manufacturer's names, model or catalog numbers, only such specified items may be used.
- C. Submit, in booklet form, all plumbing piping, valves, hangers, insulation and related accessories for any piping and/or equipment different than the manufacturers listed. Submit catalog cuts of both manufacturers.
- D. Submit complete maintenance and operational charts and manuals for all equipment and piping specified, indicated or required for this work.
- E. On completion of the work, attach 1-1/2" diameter brass or embossed plastic as manufactured by Seton Nameplate Company consecutively numbered tags to all valves, also furnish two (2) typewritten charts (framed and glazed) showing all valve numbers with their location and riser controls. Identify all equipment with laminated plastic (lamicoid) nameplates fastened to the equipment as approved. These numbered valves to be shown on As-Built Drawings.
- F. Keep on file, at job site, a clean set of prints to clearly and accurately note all changes, wherever work is installed other than shown. After completion of work, provide a correct set of mylars (3 mil) for "As-Built Drawings".
- G. Unless otherwise specified, apply and pay for all necessary permits, fees, and inspections required by any public authority having jurisdiction.

- H. All plumbing products used within the domestic water system are to meet or exceed NSF/ANSI 61 Standard requirements for lead-free products.
- I. If conflicts occur within these specifications or on the drawings, or either between the items of greater quality or higher cost shall be bid and provided.

#### 1.12 ACCESSIBILITY

- A. Be responsible for sufficiency of shafts and chases, with adequate clearances for the proper installation of the work. Cooperate with all other contractors, whose work is in the same space, and advise the Contractor of all requirements. Keep such spaces and clearances to the minimum size required.
- B. Locate all equipment, which must be operated, serviced or maintained, in fully accessible locations. Equipment includes, but is not limited to: valves, traps, cleanouts and drain points. If required for better accessibility, provide access doors. Make minor deviations to allow for better accessibility, however, review such changes with the Architect/Engineer.

#### 1.13 COORDINATION

- A. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Specification Section "Access Doors and Frames."

#### 1.14 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- A. Refer to General Conditions (and Supplementary Conditions), Shop Drawings, Product Data and Samples and add the following:
  - 1. Within thirty (30) days after the date of notice to proceed and before purchasing any materials or equipment, submit to the Architect for review, a complete list, in six (6) copies, of all materials to be incorporated in the work. This listing shall be arranged by the order of occurrence in the specifications, followed by the items on the drawings not specifically included in the specifications.
  - 2. After the list has been processed by the Architect, submit complete shop drawings and product data of all equipment. These submittals shall be submitted within thirty (30) days after the processing date of the original submittal list.
  - 3. All submittals shall be complete and shall be in three-ring loose-leaf binders. No consideration will be given to partial submittals, except with prior approval of the Architect. Each item shall have a cover page stating project, specification and paragraph reference number, of drawing reference number, and scheduled equipment identification number, if applicable.
  - 4. The review of submittals does not relieve this Contractor from the responsibility of shop drawing errors in details, sizes, quantities, wiring diagram arrangements and dimensions

- which deviate from the specifications, contract drawings, and/or job conditions as they exist.
5. Changes to work already performed made necessary by delays in shop drawing review are the responsibility of this Contractor.
  6. Copies of equipment and system guarantees shall be submitted with shop drawing package.
- B. Refer to General Conditions (and Supplementary Conditions) for substitution of equipment.
- C. If apparatus or materials are substituted for those specified under this section, and such substitutions necessitate changes in or additional connects, supports or construction, same shall be provided at no additional cost to the Owner. This Contractor shall assume cost and entire responsibility thereof. Architect's permission to make such substitution shall not relieve this Contractor from full responsibility for work.
- D. If submitted product is different from the manufacturer specified provide in booklet form, all plumbing fixtures, etc. and related accessories and/or equipment different than the manufacturers listed. Submit catalog cuts of both manufacturers addressing point by point that the submitted product is equal to the specified models, etc.
- E. Provide catalog cuts for both manufacturer's product if the product submitted is not the specified product. Submittal is to provide point by point comparison addressing each of the specified manufacturer's specific requirements vs the submitted manufacturer.

#### 1.15 RECORD DRAWING

- A. The General Contractor shall provide two (2) sets of black-line on white record drawings to this Contractor, one set of which shall be maintained at the site and one set of which shall, at all times, be accurate, clear and complete, showing the actual location of all equipment and piping. The record drawings shall be available to the Architect's/Engineer's field representative at all times.
- B. Any addenda sketches, supplementary drawings and change orders issued during the course of construction shall be transferred to the record drawings.
- C. At the completion of this contract, this Contractor shall submit through the General Contractor an accurate checked set of record drawings.
- D. Non-availability of record drawings or inaccuracies therein shall postpone the final inspection until they are available.
- E. After approval of these record drawings, photo reproductions of the original tracings shall be revised to incorporate all the changes on the record drawings. These photo reproductions shall be certified by this Contractor as correct and delivered to the Architect together with two (2) sets of black-line prints.
- F. All costs related to the foregoing requirements shall be paid for this Contractor.
- G. All valves shown on these drawings shall be numbered with numbers corresponding to those on the valve charts.



1.16 WARRANTY

- A. Refer to General Conditions and add the following:
  - 1. Standard equipment guarantees offered by the manufacturer for on (1) year or greater shall be in addition to that as required by this contract.
  - 2. Copy of manufacturer's equipment guarantees shall be submitted with this Contractor's written guarantee.

PART 2 - PRODUCTS

2.1 SOIL, WASTE, AND VENT PIPING:

- A. Aboveground Piping: (unless otherwise indicated)
  - 1. Solid plastic pipe and fittings, PVC Schedule 40 DWV, Iron pipe Sizes (IPS) conforming to ASTM D-1785 and ASTM D-2665. PVC DWV solvent cement fittings are to conform to ASTM D-2665. Pipe and fittings are to be manufactured to the nominal dimensions cited in the applicable ASTM standard, and to be manufactured by one manufacturer.
  - 2. Foam core PVC piping is not allowed on this project. All foam core piping installed on project is to be removed and replace at no additional cost to owner.
- B. Provide all necessary adaptors and fittings necessary to connect to different piping systems.
- C. Provide No-hub couplings Husky SD Series 4000 couplings, or Mission Heavyweight (HW), 4-band couplings where connecting to the existing piping systems to remain.

2.2 CLEANOUTS

- A. Provide raised square head cleanouts, where possible.

2.3 TRAPS

- A. Provide standard chrome N.Y. Reg. "P" traps.

2.4 SLEEVES, INSERTS AND ESCUTCHEONS

- A. For all openings required in concrete floors, concrete walls and masonry walls; install sleeves of proper size, when the forms are erected and before concrete is poured or masonry is set. Provide wrought iron and steel pipe sleeves for all sleeves through floors or walls, sizes as approved, and packed as required. Extend sleeves one inch above floor for exposed piping passing through the floor.
- B. Seal all sleeves, core holes, etc. through floors, walls and ceilings with Nelson "Flame-Seal" Fire Stop Putty, 3-M Systems, Hilti Systems, or Metacaulk Fire stopping. Install in accordance with manufacturer's printed instructions.

- C. Fire stopping is to meet UL ratings for each penetration type and material for floors, walls and ceilings. Coordinate with Architectural Drawings for exact requirements and hourly ratings at various conditions.
- D. Provide catalog cuts, in a three ring binder, of various systems, materials, etc. to be used.
- E. Watertight Silicone Fire Stopping sealants are to be used at all floor penetrations.
- F. Fit all exposed uncovered pipes passing through walls, in cabinets, floors and ceilings with chromium plated spun or split type escutcheons with clamping device for holding in position.
- G. Typical for all piping.

## 2.5 HANGERS AND ANCHORS

- A. Support all piping from the building structure by means of oversized stainless steel hangers, stainless steel rods and stainless steel inserts or lag bolts. Support piping to maintain required grading and pitching of lines, to prevent vibration and to secure piping in place, and arrange so as to provide for expansion and contraction. Provide approved stainless steel anchors. Hangers shall be large enough to accept water piping with layer of insulation as specified. Provide stainless steel pipe shields.
- B. Provide all soil, waste, vent stacks and other pipe risers with friction clamp at each floor level and where required.
- C. Provide stainless steel clevis ring type hangers for piping with adjustable device, and machine stainless steel threaded hanger rods. Provide copperized hangers for water piping where piping is in contact with hangers.
- D. Size of rods shall follow schedule in NFPA Bulletin No. 13.
  - a. Up to 4" - 3/8" rod
  - b. 5" to 8" - 1/2" rod
  - c. 10" to 12" - 5/8" rod
- E. Provide hangers with double nutted with stainless steel nuts.
  - 1. Submit physical samples for approval.
- F. Provide insulation protection shields: stainless steel 20 gauge by 10" long for all insulated piping where hanger is installed outside the insulation sized to suit pipe size and insulation thickness.
- G. For plastic piping, tape all metal hangers, clamps, etc., prior to attachment (for plastic protection).
  - 1. Option: Provide plastic coated hangers.
- H. Provide Grinnell stainless steel expansion case concrete fasteners #117 for piping 3" and over where drilling of concrete is required. Submit expansion fasteners.

## 2.6 ABOVEGROUND WATER PIPING

- A. Install all piping in accordance with manufacturer's published recommendations and requirements and governing water department.
- B. Provide fittings, bends, offsets, flanges, etc. of approved pattern. Make branch connections from hot water risers to fixtures with appropriate joints to receive expansion stresses.
- C. Provide Hard Copper Tube, ASTM B88, Type L water tube, drawn temper for all domestic water piping; cold, hot and hot water returns.
  - 1. No bent tubing will be accepted.
  - 2. Coordinate with drawings and this section for additional locations of water hammer arrestors.
- D. Use SilvaBrite 100 Lead-Free solder on cold water and hot water piping. Provide non-corrosive, lead-free type flux conforming to ASTM B813 washable.
- E. COPPER PRESS TYPE FITTINGS:

- 1. Manufactures, Copper Press Fittings:

Viega North America, 3 Alfred Circle, Bedford, MA 10730, 877- 843-4262 or Ridge Tool Co.,  
400 Clark Street, Elyria, OH 44036, 800-519-3456

- 2. Material:

ASTM B88 and ANSI/ASME B16.22. O-rings for copper press fittings shall be EPDM.

Press connections for domestic water copper piping ½" to 2":

Copper press fittings and installation are to be made in strict accordance with the manufacturers installation instructions. All tubing is to be reamed and de-burred prior to the installation of the fitting. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

All valves used within a copper press-fit piping system are to be sweat type as specified under the valve section of this specification. Provide all adaptors necessary to provide sweat ball valves all sizes.

Provide copper press fit type system on domestic water piping only for pipe sizes ½" to 2".

## 2.8 WATER HAMMER ARRESTORS

- A. Provide Zurn Shoktrol #Z-1700, stainless steel, J.R. Smith or Watts #15; with adaptors, sizes as required to suit manufacturer's recommendations, PDI and ASSE Standards and job conditions. Submit drawings with detailed locations and types to be used.
- B. Provide water hammer arrestors at all fixture batteries with more than three (3) fixtures, unless noted otherwise.
- C. Provide stainless steel access panels at all water hammer arrestors, for ease of maintenance.

2.9 DIELECTRIC FITTINGS

- A. Provide approved dielectric fittings when changing from ferrous to non-ferrous piping, fittings, valves, etc.; as manufactured by Watts, 3000 Series.
- B. Where copper or brass contact ferrous material, provide sheet lead wrapped around either to avoid electrolysis.

2.10 VALVES (By domestic manufacturer)

- A. Ball Valves:
  - 1. 1/2" to 2" - Watts No. LF-B-6080, lead-free, full port.
  - 2. 2 1/2" to 4" - Watts No LF- B 6000 Series.
- B. Provide holes drilled in valve handles for valve tags.
- C. Drain Cocks: Watts LF-B-6000-CC, with chain and cap, 1/2 inch draw-off type with Watts #8A Vacuum Breaker.
  - 1. Provide draw-offs at low points.

2.11 INSULATION

- A. Cold Water: 1 inch fiberglass or approved equal, low pressure pipe insulation, fire retarded with Universal (white) vapor barrier finish. Provide material by Owens-Corning, Johns-Manville or Certainteed.
  - 1. Provide insulation on all new and existing piping as indicated and all exposed piping.
- B. Hot Water and Hot Water Return: Insulation similar to cold water.
  - 1. Provide 1" thick insulation on hot water and hot water return piping TO 1 1/2" pipe sizes.
  - 2. Provide 1 1/2" thick insulation on all pipe sizes 2" and over on all hot water and hot water return piping only.
- C. Fittings and Valve Insulation:
  - 1. Hydraulic setting combination insulating and finishing cement.
  - 2. Molded or fabricated fitting covers of equal thickness and identical in composition to adjacent pipe insulation.
    - a. Zeston Premolded Fittings.
  - 3. All materials, including vapor barrier jackets, glass cloth jackets, adhesives, etc. shall be fire-retardant.
- D. Insulate all water pipe, valves and fittings, etc.
- E. Installation shall be in strict accordance with manufacture's written instructions, as shown on the approved shop drawings.
- F. Reinstall existing pipe covering damaged, disturbed, or removed during the course of construction at no additional cost. Identically match existing insulation thickness.

- G. Provide, at all handicapped lavatories and sinks, P-trap and angle stop assemblies "Trap-Wrap Protective Kit #500R-AM" manufactured by Brocar or Truebro Lav Guard. Abrasion resistant cover shall be smooth, with white finish and a minimum 1/8" thick cushioned foam wall insert. Provide concealed fastenings. Provide units to suit offset drains at sinks.

#### 2.12 ACCESS PANELS

- A. Provide Type "A" Milcor Style "K" or "M" access panels, Karp or Acudor; sizes as required to obtain access to concealed valves, water hammer arrestors, traps and cleanouts. Provide rated panels in rated walls. Provide stainless steel panels where located in Toilet Rooms.
- B. Coordinate installation of access panels with the work of Division 9.

#### 2.13 MISCELLANEOUS

- A. Provide chrome escutcheons and exposed piping. Provide all fixtures supported from wall with 2" x 6" wood blocking concealed, built into wall, and fastened.
- B. Provide 20" x 4" x 1/4" steel back plate with thru bolts concealed and built into wall and fastened.
- C. On all brass closet flanges in addition to lead caulking, provide bronze anchors to floor. Lead caulking and cast iron must be flush with top of caulk flange.
- D. Provide at each laundry machine a new Guy Gray laundry box Model W2700 complete with arrestor and quarter turn ball valves.
- E. Provide at each lavatory to be reinstalled a new McGuire chrome 17 gauge "P" trap complete with chrome escutcheon to suit field conditions.
- F. Provide at each lavatory to be reinstalled new McGuire heavy duty supplies and stops HLF 175 chrome complete with chrome escutcheon to suit field conditions.
- G. Provide at each water closet to be reinstalled a new wax gasket, new brass closet nuts and bolts and new bolt caps.

#### 2.14 HOSE BIBBS

- A. Chicago Faucet #293 or Woodford Model 24, loose key lock shield with handle attached, hose end; chrome finish with Watts #8 backflow preventer.

### PART 3 – EXECUTION

#### 3.1 SOIL, WASTE AND VENT PIPING:

- A. Install no-hub couplings in drainage and vent system in accordance with CISPI Standard 310 and all local requirements where PVC piping is connection to cast iron or other types of piping.

- B. Install PVC waste and vent piping in accordance with the latest published Manufacturers installation instructions and requirements.
- C. Provide adequate waste from fixtures, evenly pitched and properly secured with adjustable iron hangers. Install all pipes as specified, below grade, and pitch at the rate of 1/4 inch per foot or as approved.
- D. Extend all soil and waste pipes out full size to existing vent piping through roof connect all new piping to existing lines below existing roof.
- E. Bends and Branches:
  - 1. Provide all necessary bends, branches, etc. Make all changes in direction, fixture connections, etc. with Y branches and 45 degree elbows; offsets on vertical lines at an angle not less than 45 degrees with the vertical, being at a less angle wherever practicable. Use long sweep bends at bottom of stacks. Use certain combination and re-vent fittings only upon approval, after a specific one or type is submitted for approval.
- F. Cleanouts:
  - 1. Provide with brass caps and screws, same size as pipe and screwed gas tight, where indicated and at the ends of all branches, and at each change in direction of horizontal building drain greater than 45 degrees, on soil and waste traps, and in such other portions where cleanouts are required. Provide cleanouts on drain lines at a maximum of 80 feet, unless otherwise indicated.
    - a. Where waste stacks enter drains near walls or piers causing difficult access to end cleanouts, provide a horizontal cleanout on stack just above floor, with a long 1/4 inch sweep end at foot of stack. Where such conditions occur in walls or partitions, the cleanout cover shall be accessible through an opening left in wall and covered with a flush type access panel, or as indicated.
    - b. Grease and work all cleanouts for ease of maintenance.

### 3.2 TRAPS AND VENTS

- A. Separately trap every fixture, vent all traps.
- B. Install all trap screws (brass) below water line.
- C. Run the main stacks of back ventilation parallel and as close as possible to the soil pipe stack, and connect to the vent continuation of soil stack at least 1'-0" above rim of the highest plumbing fixture on the stack. Make offsets in vent piping with 45 degree fittings where possible. Pitch horizontal vent lines toward a waste line.

### 3.3 JOINTS

- A. Provide stainless steel couplings, Husky Series 4000 or Mission Heavyweight (HW), with neoprene gaskets for use with no-hub soil pipe. Install in accordance with manufacturer's recommendations including hangers and sway braces.
- B. Threaded Joints:

1. American National taper screw threads, with graphite and oil compound applied to the male threads or Teflon tape.
  2. Provide Select Whyte for all other piping; as manufactured by Whitlaw.
- C. Ream ends of pipes and tubes and remove burrs. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Alternate copper piping joints according to the following:
1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
- E. Plastic Piping:
1. Clean fittings and joints with solvent cleaner (purple primer) to receive PVC solvent weld (or cement) joint materials.
  2. Install all PVC piping and fittings in complete accordance with manufacturers recommendations. Do not allow masonry and/or concrete to be against PVC piping.
  3. Threading of P.V.C. piping is not allowed.
  4. Joint all PVC piping by socket type man off adaptor fittings where connected to threaded fittings.
  5. Where connected to bell of cast iron soil appropriate spigot man off connector socket type adaptor must be used.
- F. Where connected to no-hub cast iron soil pipe, use appropriate spigot man off connector socket type adapter with no-hub couplings, Husky Series 400
- 3.4 HANGERS AND ANCHORS:
- A. Horizontal Piping: Support the following materials at the following maximum distance intervals:
1. Cast Iron Soil Pipe: 5 feet.
  2. Threaded Pipe: 10 feet.
  3. Copper Tubing (1-1/2 inch or less): 6 feet.
  4. Copper Tubing (1-1/2 inch or over): 10 feet.
  5. Plastic Piping: Per manufacturer's recommendations.

### 3.5 WATER PIPING

- A. Pay all charges incurred and obtain all necessary applications, permits and approvals.
- B. Do all work in accordance with and under the supervision of the municipality, pay all inspection fees established by municipality for inspection as required.
- C. Ream all cut tube to full inside diameter of pipe. Install all piping in accordance with manufacturer's recommendations and requirements, and local water company standards.

### 3.6 VALVES

- A. Provide valves located as follows and as indicated:
  - 1. Provide each fixture supply with a separate angle or straight stop, finished like the pipe it serves.
  - 2. At the foot of each riser on the upper side of the control valve, provide a ½" Tee and drain cock in addition to valve.

### 3.7 INSULATION

- A. Submit samples of each type of material specified herein for approval.
- B. Apply insulation in strict accordance with manufacturer's recommendations.
- C. Provide insulating material with a maximum thermal conductance (C Value) of 0.50, low pressure pipe.
- D. Cold Water: Seal all joints and seams with white or colorless vapor adhesive.
- E. Hot Water: Except fastening agent shall be outward clench staples as manufactured by Bostitch.
- F. Insulate fittings, valves, etc., with Fiberglas Aerocors or approved equal, to the same thickness as the adjacent pipe insulation, and finished with the same finish.

### 3.8 FIXTURES

- A. Provide sealant at walls and floors for fixtures as required.

### 3.9 TESTING

- A. Pressure test new piping and existing piping to remain in wall before new wall systems are reinstalled. Do not test any other existing piping. All system leaks which occur due to testing are to be repaired at no additional cost to the Owner.
- B. Test all piping and make water-or-gas-tight before insulation is applied, or before concealment.
  - 1. Sanitary Piping: Before the installation of any fixtures, cap the ends of the system and fill all lines with water to the roof, 10 LF head will be acceptable, and let stand until a thorough inspection has been made by Local Inspector and the Engineer.
  - 2. Test hot and cold water piping to a hydrostatic pressure of 125 pounds per square inch for a period of 24 hours.
  - 3. Sterilization of water distribution system; as soon as the water distribution system has been flushed out, sterilize the system in accordance with the requirements of the Health Department having jurisdiction or, in the absence of such, by any other method satisfactory to the Owner.
  - 4. Peppermint and/or Smoke Test as required by BOCA Code.

### 3.10 INSTRUCTION OF OWNER'S PERSONNEL

- A. Fully instruct the Owner's representative in the complete operation, adjustment and maintenance of the entire installation as directed. Arrange with the suppliers of installed



equipment and/or systems to provide the services of expert technicians to instruct owner's operating personnel in the use, care and emergency repair of equipment and/or systems. The period of instruction will be as to satisfy the Architect and/or Engineer that such instructions have accomplished their purpose.

### 3.11 COLOR CODING AND IDENTIFICATION

- A. Conformance: American National Standards Institute Standard A13.1, "Scheme for the Identification of Piping Systems".
- B. Requirements: Paint on each pipe its contents and flow direction (if flow is in both directions, use double headed arrow).
- C. Locations:
  - 1. Apply stencil adjacent to each valve.
  - 2. Apply stencil and arrow on each branch and riser take-off.
  - 3. Apply stencil and arrow a minimum of 25 feet apart in long continuous lines.
  - 4. Apply stencil and arrow on lower quarters on pipes or where unobstructed from view.
  - 5. Apply stencil and arrow at every point of entry or exit thru wall, ceiling or floor.

### 3.12 INSTRUCTION MANUAL

- A. One month prior to the completion of all work and the final inspection of the installation by the Owner, submit for approval two copies of a complete Instruction Manual, bound in a three-ring binder, typewritten and suitably indexed, containing the following minimum data:
  - 1. List of all equipment with manufacturer's name and model number of each item.
  - 2. Manufacturer's literature describing each item of equipment.
  - 3. Copy of each valve chart.

END OF SECTION

+SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Drawings and General Provisions of Contract, including General and Modifications to General Conditions and Division 1 Specification Sections, apply to work specified in this Section.
- B. Equality of materials, articles, assembly or systems, other than those named or described in this Section, will be determined in accordance with the provisions given to Substitutions.
- C. All work in this Section is subject to the codes and standards of this Section unless otherwise listed-in Section 230548, which will take precedence.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Sleeves.
  - 5. Escutcheons.
  - 6. Inserts.
  - 7. HVAC demolition.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Supports and anchorages.
  - 10. Openings in walls.
  - 11. Cutting and patching
  - 12. Electrical wiring.

1.3 DEFINITIONS

- A. Finished Spaces: **Interior** Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, 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 chases.

- 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. "Contractor" means specifically sub-contractor working under his respective Section of the Specifications.
- G. "Furnish" and "Provide" mean to supply, erect, install and connect up complete in readiness for regular operation, particular work referred to, unless otherwise specified.
- H. "Piping" includes, in addition to pipe, all fittings, valves, hangers and other accessories relating to such piping.
- I. "Ductwork" includes, in addition to ducts, all fittings, hangers, dampers, elbows, transitions, access panels, breaker strips, flexible connections and other accessories relating to ductwork.
- J. "Supply" means purchase and delivery of material to the site.
- K. "Install" means to erect in place the supplied item.

#### 1.4 SUBMITTALS

- A. Submit color samples for pipe coding system.
- B. Submit copies for approval and record of:
  - 1. All Tests.
  - 2. Balancing Report.
  - 3. Valve Chart.
  - 4. Pipe Color Code Chart.
  - 5. Maintenance Manuals.
  - 6. All products and materials supplied under Division 23.
- C. Any additional cost or loss, or damage arising from the substitution of any material or method for those originally specified shall be borne by the Contractor, notwithstanding review or acceptance of such substitution by the owner or the Architect, unless the substitution was made at the written request of the Owner. Any cost for re-design of any components of the contract documents shall be borne by the Contractor, unless the substitution was made at the written request of the Owner.
- D. Submittals shall be used by the contractor to coordinate location and size of access requirements, and location of piping, duct, drain, and electrical connections. Where the submittal is lacking proper information, the contractor shall obtain certified drawings or manufacturer's installation brochures and instructions for the equipment before proceeding with the work.

#### 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
  
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics **than what was indicated on the drawings** may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 SCOPE OF WORK

- A. Provide all labor, materials, equipment, controls and accessories necessary to complete the work shown on the Drawings or herein specified.
  
- B. The work to be done under this Division includes all related work shown on the Drawings and or included in these Specifications.
  
- C. Drawings are diagrammatic and all required duct and pipe fittings required to complete the installation in the actual space are not necessarily shown.

#### 1.7 MATERIALS

- A. Any device, material or construction required to complete the job that is not specifically covered by description herein shall be of commercial-grade material normally used for the purpose and installed in a manner consistent with the conditions of use. Items exposed to the elements shall be weatherproofed or protected. All such items shall be submitted for review before being purchased or installed.

#### 1.8 CODES AND STANDARDS

- A. Materials and equipment shall be designed, constructed, installed and tested in accordance with this Specification and the latest editions of the following applicable standards in addition to state and local codes applying. All products shall bear the label of approval from the appropriate agency.

Agencies:

National Environmental System Contractors Assoc.	NESCA
Air Moving and Conditioning Association	AMCA
American Society of Heating, Refrigerating and Air Conditioning Engineers	ASHRAE
American Society of Mechanical Engineers	ASME
Federal Construction Safety Standards (U.S. Dept. of Labor)	FCSS
American Society of Testing Materials	ASTM
National Electric Code	NEC

National Electrical Manufacturers Association	NEMA
National Fire Code	NFC
Occupational Safety and Health Act of '70	OSHA
International Building Code (Latest Edition)	IBC
National Sanitation Foundation	NSF
Air Conditioning and Refrigeration Inst.	ARI
Underwriters Laboratories, Inc.	UL
Building Officials & Code Administrators International, Inc.	BOCA
International Code Council	ICC
National Fire Protection Association	NFPA
Sheet Metal and Air Conditioning Contractors National Association	SMACNA
American National Standards Institute	ANSI
American Welding Society	AWS
Cast Iron Soil Pipe Institute	CISPI
Clean Air Act Amendment of 1990 (Title VI. Section 608)	CAA
Cooling Tower Institute	CTI
International Mechanical Code	IMC

- B. Any materials or workmanship called for in the above-mentioned requirements which are not specified or shown on the Drawings, shall be furnished and installed by the Contractors as though same had been specifically mentioned or indicated.
- C. If these Contractors fail to notify the A/E at this time, and install work in variance with the above-mentioned codes and regulations, they shall assume responsibility and expense to rectify the installation to the satisfaction of the A/E and Owner.
- D. Secure all local, state and federal permits necessary in connection with the installation of the equipment, including licenses and approvals and pay fees required for same.
- E. All work shall be performed in strict accordance with the above-mentioned standards, local and state codes.
- F. File all necessary Plans and Documents with Local Authorities and obtain the necessary Certificates of Inspection for work. Deliver same to A/E prior to request for acceptance and final payment.
- G. Notify A/E of any deviation from codes of work indicated or herein specified before installation of work is affected.

#### 1.9 WORK PROCEDURE

- A. The Contractor shall, in good workmanlike manner, perform all work and furnish all supplies and materials, machinery, equipment and means, herein and otherwise specified, necessary or proper to perform and complete all work required by the Plans and Specifications in order to have a complete and satisfactory installation acceptable to the A/E.

1.10 COOPERATION WITH OTHER TRADES / COORDINATION DRAWINGS

- A. Cooperate to fullest extent with all other trades to best expedite the entire work.
- B. Furnish all information pertaining to materials, sizes, locations, means of support, etc., to all other trades requiring such information.
- C. Where work of Contractor will be installed in close proximity to work of other trades, or where there is evidence that work of Contractor will interfere with work of other trades, he shall assist in working out space conditions to make satisfactory adjustment.
- D. Contractor shall prepare composite working “COORDINATION” drawings and sections at suitable scale not less than  $\frac{1}{4}'' = 1'-0''$  clearly showing how his work is to be installed in relation to work of other trades, and existing conditions remaining. The contractor shall identify any conflicts, investigate and suggest possible resolutions, and request assistance from the Architect / Engineer for assistance in resolving a field condition in order to complete the work required. No additional compensation will be granted or awarded for resolving coordination issues since this is considered part of this contractor’s duties. Coordination drawings for suggested resolution of coordination issues shall be produced by this contractor and approved by the Engineer.

1.11 ELECTRICAL ROOM REQUIREMENTS

- A. Do not install any piping, ductwork or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping or ductwork of equipment is intended to serve these rooms. Additionally, no ductwork or piping will be installed above electric panels. If the Contractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.
- B. The contractor shall, regardless of voltage, furnish and install all temperature control wiring, all interlock wiring, and equipment control wiring for the equipment that the contractor furnishes unless otherwise noted. Division 26 will furnish and install power wiring to the mechanical equipment and make electrical connections unless otherwise noted on the drawings.
- C. All electrical wiring furnished under the mechanical contract shall conform with **the requirements of** Division 26.

1.12 DOWNTIME

- A. Requirements for utility outage scheduling and approval, preferably off shift; request & notifications made through the utilities engineer and/or URI NETS. Include in bid documents a minimum estimated number of shut downs. Furnish form.
- B. The contractor shall submit written requests to disconnect any existing utility services and to obtain equipment downtime. Only after receiving Owner approval of these requests shall work be allowed to proceed. This contractor shall be responsible for restoring the existing utilities.

### 1.13 GUARANTEE

- A. The system specified herein and shown on the drawings shall be guaranteed to be free from original defects in both material and workmanship and shall perform to manufacturer specification for a period of ~~one (1) year~~ **two (2) years** of normal use and service, excepting damages from other causes. Systems which are manufactured ISO-9001 certification are preferred. This guarantee shall become effective starting the date the Contract work is accepted as complete by the Architect on behalf of the Owner and in accordance with the General Provisions/Conditions.
- B. Upon completion of the installation, the ATC Subcontractor shall submit to the Owner an agreement to provide the necessary programmed maintenance, to keep the various control systems in proper working condition beyond the guarantee period. Additionally, this contractor shall submit to the owner its standard agreement to support the system operation. This service must include operator support, application support, remote diagnostic support as well as database management support. This service shall be available 365 days/year, 24 hours a day.
- C. This programmed maintenance agreement shall fully describe the maintenance work to be performed and shall advise as to the cost of this work prior to awarding of Contract.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All products shall be new and without defects.
- B. Products required by construction but not specifically described herein shall be as selected by the Contractor subject to the approval of the A/E.
- C. All products of Section 230548 shall take preference over the products of this Section.

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. CPVC Piping: ASTM F 493.
  - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

#### 2.4 UNIONS / DIELECTRIC FITTINGS

- A. Use dielectric unions, flanges, or waterways to connect dissimilar metal parts.
- B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 F (82 C).
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 F (107 C).
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 F (107 C).

#### 2.5 SLEEVES

- A. Through outside masonry walls and below grade masonry walls, use schedule 40 ductile iron, caulked watertight.
- B. Through masonry floors or interior masonry walls and fire rated assemblies, use Schedule 40 galvanized steel pipe.
- C. Through interior non-fire rated stud partitions, use 22-gauge galvanized sheet metal.
- D. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- E. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.



- F. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- H. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- I. PVC Pipe: ASTM D 1785, Schedule 40.
- J. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.6 ESCUTCHEONS

- A. Escutcheons for pipes passing through outside walls shall be solid cast brass, flat type, secured to pipe with a set screw, Ritter Pattern & Casting Co., #1.
- B. Escutcheons for pipes passing through floors shall be split hinged, cast brass type designed to fit pipe on one end and cover sleeve projection through floor on other end, Ritter Pattern & Casting Company, #36A.
- C. Escutcheons for pipes passing through interior walls, partitions and ceilings shall be split-hinged, cast brass, chromium plated type, Ritter Pattern & Casting Co., #3A.
- D. Beaton & Corbin and/or Caldwell products will be acceptable.

## 2.7 INSERTS

- A. Inserts shall be individual or strip type, of pressed steel construction galvanized only with accommodation for removable nuts and threaded rods up to  $\frac{3}{4}$ " diameter, permitting lateral adjustment. Individual inserts shall have an opening at top to allow reinforcing rods up to  $\frac{1}{2}$ " diameter to be passed through insert body and shall be Fee & Mason Manufacturing Company, Figure 178. Strip inserts shall have attached rods with hooked ends to allow fastening to reinforcing rods and shall be Fee & Mason Manufacturing Company, Figure 190. Grinnell or Carpenter Patterson materials will be acceptable.
- B. At Contractor's option, inserts may be galvanized, malleable iron, Universal type, Grinnell, Figure 279, for pipe sized up to  $3\frac{1}{2}$ ", Figure 282, for all sizes up to 8".
- C. Where subject to corrosive atmospheres use stainless steel products.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. All installation methods of Section 230548 shall take precedence over the methods of this Section.

### 3.2 INTERPRETATION OF THE DRAWINGS

- A. Mechanical equipment and such other apparatus as may require maintenance and operation from time to time shall be made easily accessible. Although the equipment may be shown on the Drawings in certain locations, the construction may disclose that such locations do not make its position readily accessible. In such cases, the Owner or his Representative shall be notified before advancing the construction to a stage where a change will reflect additional expense.
- B. Compare actual site conditions with the Drawings and Specifications and include additional work which careful examination would disclose. Before the bidding period, advise the A/E of any omission, error or conflict in the Plans and Specifications.
- C. Equipment, ductwork and piping locations, as shown, are diagrammatic and approximate only unless fixed by dimensions. Actual field conditions and physical characteristics of the product govern exact locations. Where possible, adhere to locations on Drawing consistent with building construction and equipment installed by others.
- D. Contractor shall not scale measurements from the Drawings but check with General Contractor's latest Drawings, shop drawings, and equipment manufacturer's installation guides before proceeding with any work.
- E. Work layouts shall be the responsibility of the Contractor, following minimum requirements as set forth in these Specifications and accompanying Drawings.
- F. Where head room or space conditions appear inadequate, A/E shall be notified before proceeding with installation. If directed by A/E, Contractor shall, without extra charge, make reasonable modifications in layout as needed to prevent conflicts with work of other trades or for proper execution of work.
- G. If, in Contractor's opinion, work is shown or specified in manner or amount as to make it impossible to install a first-class piece of work or fulfilling intent of a perfectly efficient job when complete, refer same to A/E in writing before submitting proposals.
- H. Should Contractor fail to refer such instances to A/E as required above, no excuse for poor, defective or incomplete work will be accepted.

### 3.3 SHOP DRAWINGS

- A. All equipment shall be submitted for approval under these Sections to the A/E.

- B. Do not place orders for any equipment until final approval is received. Allow at least two weeks for submittal review.
- C. If material or equipment is installed before it is approved, Contractor shall be liable for removal and replacement at no extra charge to the Owner.
- D. Contractor shall consult manufacturers' installation brochures and instructions to determine exact location of connection points. Take special care to allow for proper space for maintenance, removal of coils, filters and equipment. Provide offset pipe and union arrangements for ease of removal of coils and equipment. Provide accessories required or recommended by the manufacturer. Locate drains for proper pitch and trapping for coils, space for control valves, and other components. Coordinate with electrical contractor by advising of proper location of attachment of electrical devices to be clear of areas of maintenance or access.

### 3.4 WARRANTY

- A. Refer to General Conditions. The warranty period for the work under this Section is for **one-year two years** from date of acceptance. These contractors shall provide free day-and-night service, parts and labor for the complete installation of the entire system for this period.

### 3.5 CONTRACTOR'S RESPONSIBILITY

- A. Contractor shall be held responsible for any injuries to people, employees or damage done to building premises or adjoining areas or to other work resulting from execution on his part of work, in any manner whatsoever.
- B. Contractor shall be responsible for proper protection of his work, materials, people or employees from injury or loss done by others and shall make good such injury at his own expense.
- C. The Engineer shall not be responsible for the safety of Contractor's employees.

### 3.6 CUTTING AND PATCHING

- A. All rough cutting and patching required for installation of the mechanical system shall be the responsibility of this contractor. All finish patching relative to this contractor's work shall be the responsibility of other trades in accordance with other sections of this specification. Coordinate all work for a complete and finished installation.

### 3.7 TESTING

- A. Contractor shall submit to the A/E for record and approval a written report for each test conducted. Report shall indicate date of test, system tested, method of testing, name of person or agency witnessing test, and results of tests. If test records are not kept and submitted, it will be assumed that the test was not completed and Contractor will be required to perform the test at A/E's direction.

- B. All piping, ducts and equipment shall be tested. Contractor shall furnish Labor, materials, instruments and power required for testing unless otherwise indicated under particular section of Specifications.
- C. Tests shall be performed in presence of and to satisfaction of A/E and/or such other parties as may have jurisdiction.
- D. Pressure test shall be applied to piping only before connection of equipment. In no case shall piping, equipment or accessories be subjected to pressures exceeding their ratings.
- E. Defective work shall be promptly repaired or replaced and tests shall be repeated until particular system and/or component parts receive approval of the A/E.
- F. Any damages resulting from tests shall be repaired and damaged materials replaced.
- G. Duration and style of tests shall be as determined by authorities having jurisdiction but in no case less than time prescribed in each Section of Specifications. In general, pressure for tests shall be 1.5 times working pressure unless prescribed otherwise by code, specific specification section or ASTM Guidelines.
- H. Equipment and systems which normally operate during certain seasons of year shall be tested during appropriate season. Test shall be performed on individual equipment, systems and their controls for proper operation, functioning and performance. Latter shall be operated simultaneously with equipment of system being tested.
- I. During testing procedure, remove accessories liable to damage during tests.
- J. Notice shall be furnished to A/E at least two days prior to any testing. Contractor shall be solely responsible for any delays, damages, etc., resulting from failure to notify.
- K. Instruments required under this Contract for permanent installation may be used for testing if re-adjusted and recalibrated for the service for which intended.

### 3.8 CLEANING OF SYSTEM

- A. All piping, ducts and equipment shall be thoroughly cleaned of foreign matter after being placed in operation. System shall be disconnected, cleaned and reconnected wherever necessary to locate and remove obstructions. Any work damaged in course of removing obstructions shall be repaired or replaced when system is reconnected at no additional cost to the Owner.

### 3.9 SLEEVES, INSERTS, ANCHOR BOLTS

- A. Sleeves shall be located by this Contractor and set by the General Contractor, subject to A/E approval. Provide General Contractor with such information in ample time to prevent unnecessary cutting and patching. Mechanical Contractor shall be responsible for and subsequent cutting and patching of openings if sleeves have been omitted due to failure of setting them properly or in time. Fasten sleeves securely to avoid dislocation during concrete pouring.

- B. In placing sleeves, inserts, anchor bolts or any other material to be embedded in masonry and concrete or built into structure, Contractor shall cooperate with all other trades and shall consult with A/E in regard to their exact locations wherever there is any interference with structural members.
- C. Contractor will be held responsible for location of and maintaining in proper positions, sleeves, inserts and anchor bolts supplied and/or set in place by him. In event that failure to do so requires cutting and patching of finished work, it shall be done at Contractor's expense.
- D. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves having an internal diameter two inches larger than outside diameter of pipe.
- E. Sleeves through outside walls shall be painted with one coat of bitumastic paint inside and outside. Sleeves shall extend ½" beyond each side of wall. Space between sleeve and pipe shall be packed with oakum to within two inches of each face of wall. Remaining space shall be packed and made watertight with a waterproof compound.
- F. Sleeves through masonry floors or interior masonry walls shall be set flush with finished wall or ceiling surfaces.
- G. Sleeves through interior stud partitions shall be set flush with finished surfaces of partitions.

### 3.10 ESCUTCHEONS

- A. Escutcheons shall be installed on pipes wherever they pass through floors, ceilings, wall partitions and outside walls where exposed to view.

### 3.11 OPERATING INSTRUCTIONS

- A. Operation of system:
  - 1. Contractor is responsible for construction and installation of all mechanical systems and shall supply the services of competent personnel for a period of three days to instruct owner's personal. As such, Contractor may be required during the first year to review every phase of all mechanical systems with Owner's personnel and also to instruct and supervise Owner's personnel in the proper operation and maintenance of said system. Time shall be recorded by Contractor and signed by Owner or Representative.
  - 2. Contractor shall also provide three sets of complete operating instructions of all systems installed, bound in a manual. Manual shall contain one approved copy of each shop drawing and submitted data, printed instructions as to care and maintenance of system, and bound in a hard cover and arranged in the following sequence:
    - a. Table of Contents
    - b. Description of Installation
    - c. Care and Maintenance: Including a check and follow-up chart for greasing and oiling of all mechanical equipment and a copy of instructions as to upkeep of motors.

- d. Manufacturer's Listing: In alphabetical order, of all equipment installed on job, together with a listing of material supplied, manufacturer's address, name and address of local manufacturer's agent.
- e. Copy of Valve Charts
- f. Copy of Pipe System complete with color samples.

### 3.12 PROJECT CLOSEOUT AND TROUBLE SHOOTING

- A. Each trade shall designate one person to methodically test, adjust, trouble shoot and effect repairs to all equipment, devices and systems. The person shall be available on one hour's notice to answer trouble calls and to fully investigate and repair the cause of the problem. Each trade shall submit the name and phone number of the designated person to the Owner, Engineer and Architect. After final acceptance, this same person shall be available on eight hour's notice for free day-and-night service during the guarantee period.
- B. Contractor shall demonstrate all sequences of control to the Engineer. The temperature control and balancing sub-contractors shall accompany the Engineer during check-out procedure and shall demonstrate proper balancing positions of minimum fresh-air settings. Personnel shall be equipped with tools and spare parts to make minor repairs and adjustments.
- C. Contractor shall demonstrate compliance with balancing of systems in the presence of the Engineer by actual measurement of water and air flows at a minimum of three locations randomly selected by the Engineer. If requested by the Engineer, re-balancing shall be done at no additional charge.

### 3.13 FIRE STOPPING

- A. Each trade is responsible for fire stopping of it's own work.
- B. Fire stopping material shall be typical of HILTI Fire Barrier.
- C. Each trade must submit intended fire stopping material and methods for each application with UL listed approved designs.

### 3.14 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect ~~and cap~~ services and **remove back to mains and cap**, and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
8. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.15 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. 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 in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install exposed piping to allow maximum possible headroom.**
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install escutcheons for penetrations of walls, ceilings, and floors.

- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  2. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  3. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
  4. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
  5. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  6. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.16 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.



- F. 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:
- G. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
- H. 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.
- I. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- J. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- K. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.CPVC Piping:
  - 2. Join according to ASTM D 2846/D 2846M Appendix.
- L. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
- M. PVC Nonpressure Piping: Join according to ASTM D 2855.
- N. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- O. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- P. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
- Q. Plain-End Pipe and Fittings: Use butt fusion.
- R. Plain-End Pipe and Socket Fittings: Use socket fusion.
- S. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.17 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.18 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC 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.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.19 CONCRETE BASES

- C. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  7. Use 28-day compressive-strength concrete and reinforcement as specified in Division 03.

END OF SECTION 230500

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Butterfly valves.
2. Ball valves.
3. Globe valves
4. Check valves.
5. Relief valves.
6. Gate valves.
7. Strainers
8. Vacuum breakers.
9. Automatic flow valves.
10. Combination balancing / flow measurement / shut off valves.
11. Suction Diffusers
12. Chainwheels.

##### B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

#### 1.2 SUBMITTALS

- ##### A. Product Data: For each type of valve indicated.

#### 1.3 QUALITY ASSURANCE

- ##### A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- ##### B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR VALVES

- ##### A. Refer to HVAC valve schedule articles for applications of valves.
- ##### B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller (except plug valves).
  - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Gate Valves: With rising stem.
  - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Solder Joint: With sockets according to ASME B16.18.
  - 3. Threaded: With threads according to ASME B1.20.1.

## 2.2 VALVES AND SPECIALTIES

- A. Valves on condenser water, chilled water, hot water and fuel oil services shall be 125 psi unless noted otherwise.
- B. Pressure ratings of valves for steam and condensate services shall be as specified.
- C. Provide balancing valves where shown on Drawings.
- D. Valves shall have name of manufacturer and guaranteed working pressure cast or stamped on bodies.
- E. Valves of similar type shall be by single manufacturer. Provide chain operators for valves 7 feet and higher above floor.
- F. Butterfly Valves
  - 1. Provide butterfly valves for shutoff on chilled, hot and condenser water services 2½" and larger. Do not use butterfly valves for balancing service.
  - 2. Valves shall be rated 175 psi maximum working pressure, iron body, threaded lug with resilient EPDM seats, bronze disc and 416 stainless stem, by Centerline, DeZurik, Keystone, or Bray.
  - 3. Valves 6" and larger shall have gear or chain operators.
  - 4. Valves smaller than 6" shall have seven-position lever or chain operators.
  - 5. Test valves at 110% of rated pressure.
- G. Ball Valves

1. Provide bronze body ball valves with reinforced teflon seats, seals, bearings and packing.
2. Ball valves shall be used for chilled, hot and condenser water services in sizes 2" and smaller.
3. Do not use ball valves for balancing service.
4. Valves on insulated piping shall have 2" extended stems.
5. Valves shall be by Apollo, Cannon, Nibco, Milwaukee, or Watts.
6. Valves shall be rated 600 psi.

H. Globe Valves

1. Provide globe valves for throttling steam and medium pressure condensate services by Crane, Jenkins, Milwaukee, Stockham or Walworth.
2. Valves 2" and larger shall be iron body, flanged ends, bronze mounted, outside screw and yoke, renewable seat.
3. Valves 2" and smaller shall be bronze body, screwed ends, bronze trim.
4. Valves shall be ANSI B16.5 rated for 300 PSI service.

I. Check Valves

1. Check valves sized 2" and larger shall be iron body, flanged ends, bronze mounted, swing pattern.
2. Check valves 2" and smaller shall be bronze, screwed ends, swing pattern.
3. Check valves for hot water, chilled water and condenser water pump discharge shall be spring loaded, silent check, by APCO, Milwaukee, Mueller or Stockham.

J. Relief Valves

1. Relief valves shall be brass with external lever, ASME approved.
2. Pipe discharge to floor drain with open connection at floor.
3. Pipe chiller refrigerant relief devices through roof to atmosphere.

K. Gate Valves

1. Provide gate valves for shut off on steam and steam condensate services by Crane, Jenkins, Milwaukee, Stockham or Walworth.
2. Valve shall be rated for 125 psi steam working pressure valves shall have iron bodies, and silicon brass stems.
4. Valves 3" and smaller shall have solid bronze wedges, Valves larger than 3" shall have solid iron wedges with bronze face rings.
5. Valves 2" and under shall be threaded, valves 2-1/2" and over shall be flanged.
6. Valves having 250 PSI steam working pressure valves 2" and under shall be bronze body with silicon brass stems and solid bronze wedges. Valves shall have threaded connections.
7. Valves having 250 PSI steam working pressure valves 2-1/2" and over shall be iron body, iron wedges with bronze face rings and have flanged connections.
8. Packing materials shall be non-asbestos.

L. Strainers

1. Strainers 2" and smaller shall be 250 lb. bronze body, stainless steel, screen with 20 mesh screen opening, Y pattern, screwed ends, Sarco Type BT, Mueller, Watts or Armstrong.
2. Strainers 2 1/2" and larger shall be 125 lb., cast iron body, stainless steel screen with manufacturer's recommended screen openings, Y pattern, flanged, Sarco Type AF 125 or equivalent by Mueller, Watts or Armstrong.
3. Provide blow off valve on each strainer.
4. Pump suction strainers 2" and smaller shall have 0.062 screen openings. Pump suction strainers 2 1/2" and larger shall have 0.125 screen openings.
5. Strainer gaskets shall not contain asbestos.

M. Vacuum Breakers

1. Provide threaded vacuum breakers with ball, spring, O-ring flexible seat, and screen.
2. Ball shall be 440 stainless steel; seat shall be EPR.
3. Spring shall be 316 stainless steel; screen and cap shall be 304 stainless steel and threaded collar shall be 416 stainless steel.
4. Body shall be brass.
5. Vacuum breakers shall be Johnson Series VB8 size 1-1/4 IPS, or equivalent by Watts or ITT Hoffman.
6. Provide unions for threaded end valves to facilitate removal from pipe.

N. ~~Automatic Flow Control Valves~~

- ~~1. Provide automatic pressure compensating flow control valves by Griswold, or Autoflow where indicated on the drawings.~~
- ~~2. Valves shall have the capacities and pressure differential characteristics, as indicated, and conform to the following specifications.~~
- ~~3. Valves 2" and smaller shall be threaded bronze valves 2 1/2" and larger shall be flanged iron or steel body.~~
- ~~4. Valves shall be factory set and shall automatically limit the rate of flow to required engineered capacity within +5% accuracy over an operating pressure differential of at least 14 times the minimum required for control.~~
- ~~5. The control mechanism of the valve shall consist of self-contained, open-chamber cartridge assembly with unobstructed flow passages that eliminate accumulation of particles and debris. All internal working parts shall be stainless steel or nickel plated brass. Body shall be ductile iron, cast iron or bronze.~~
- ~~6. The cartridge assembly shall consist of a spring loaded cup. The cup shall utilize the full available differential pressure across the valve to actuate the cup and, thereby, reduce friction and hysteresis and eliminate binding.~~
- ~~7. Valves shall be available in minimum of three pressure differential ranges, with the minimum range requiring less than 2 psig to control flow. Valve bodies shall be provided with inlet and outlet tappings suitable for connection of instruments for verification of flow rates and temperature and shall be marked to show direction of flow. Valve bodies shall be rated for use at not less than 150% of system designed operating pressures.~~
- ~~8. Certified performance data for the flow control valve, based on independent laboratory tests, supervised and witnessed by a registered professional engineer, shall be available.~~
- ~~9. All flow control valves shall be supplied by a single source responsibility.~~

- ~~10. Each automatic flow control valve shall be furnished with a valve kit consisting of 1/4" x 2" minimum size nipples, quick disconnect valves (to be located outside of insulation), and fittings suitable for use with the measuring instruments specified, as well as temperature.~~
- ~~11. Provide a metal identification tag, with chain, for each installed valve. The tag to be marked with zone identification, valve model number and rated flow in GPM.~~
- ~~12. Flow control valve shall be warranted for period of five years from date of startup.~~
- ~~13. Provide owner with dual hose meter kit including pressure gauge with 4-1/2" dial, 3-way push button operated valve, 5' long dual connection hoses, dual shutoff and vent valves, dual special valves for connection to standard valve kit, flow conversion chart and carrying case.~~

O. Combination Balancing/Flow Measurement/Shut-off Valves

1. Valves shall be Y-pattern style with multi-turn handwheel.
2. Valves shall be capable of being installed in any direction without affecting flow measurement and shall provide the following functions:
  - a. Precise flow measurement.
  - b. Precision flow balancing.
  - c. Positive shut-off with no drip seat.
  - d. 3/4" drain port suitable for hose bib fitting. (Sizes 2" and below.)
3. Valves shall have four, 360° adjustment turns (2" and below), eight, 360° adjustment turns (2-1/2" - 6"), twelve, 360° adjustment turns (8", 10"), and sixteen, 360° adjustment turns (12"). Handwheels shall have digital indicators with hidden memory and tamper-proof setting features.
4. Valves 2" and below shall be non-ferrous, pressure die-cast, non-porous Ametal copper alloy, with soldered ends.
5. Valves 2-1/2" and over shall be ductile iron body with all other metal parts of non-ferrous copper alloy. End connections shall be flanged or grooved.
6. Pressure ratings shall be 300 psi for 2" and below and 250 psi for flanged and 300 psi for grooved ends.
7. Each valve shall have pressure/temperature readout ports with EPDM seals and attached shut-off valves.
8. One, computerized hand-held, balancing meter shall be furnished to the Owner. The Testing and Balancing Contractor shall utilize this instrument for his work. The meter shall include the following:
  - a. Flow measurement direct in GPM.
  - b. Differential pressure measurement.
  - c. Temperature measurement.
  - d. Automatic calibration.
  - e. Automatic air purging.
  - f. Extended data logging functions.
9. Balance valves 2" and under shall be Tour and Anderson Model STAS.
10. Valves 2-1/2" and over shall be Tour and Anderson Models STAF-SG or STAG.
11. The handheld meter shall be Tour and Anderson Model CBI with PCB data logging features.

12. Balance valves manufactured by Macon or Victaulic shall be considered equivalent.

P. Suction Diffusers

1. Suction diffuser/strainers shall have 200 psi cast iron body and stainless steel strainer with 5/32" perforations. Units shall include flanged connections, removable gasketed cover and straightening vanes. Diffusers shall be Taco, B&G or Mueller.
2. Provide 16 mesh start-up strainer.
3. Provide blow off tapping on bottom of unit.
4. Provide full size inlet and outlet.

2.3 CHAINWHEELS

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

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve

C. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.



### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. 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.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. 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.
- E. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for gate valves 4” and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

#### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

#### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly or gate valves.
  - 2. Throttling Service, Except Steam: Globe or ball valves.
  - 3. Throttling Service, Steam: Globe valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  2. For Copper Tubing, NPS 2-1/2 to NPS 4 : Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
  4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  5. For Steel Piping, NPS 2-1/2 to NPS 4 : Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  6. For Steel Piping, NPS 5 and Larger: Flanged ends.

### ~~3.5 CHILLED WATER VALVE SCHEDULE~~

#### ~~A. Pipe NPS 2 and Smaller:~~

- ~~1. Bronze and Brass Valves: May be provided with solder joint ends instead of threaded ends.~~
- ~~2. Bronze Angle Valves: Class 125 and Class 150 bronze disc.~~
- ~~3. Ball Valves: One piece, full port, brass or bronze.~~
- ~~4. Bronze Swing Check Valves: Class 125 and Class 150 bronze disc~~
- ~~5. Bronze Gate Valves: Class 125 and Class 150 bronze disc.~~
- ~~6. Bronze Globe Valves: Class 125 and Class 150 bronze disc~~

#### ~~B. Pipe NPS 2-1/2 and Larger:~~

- ~~1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.~~
- ~~2. Iron, Single Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.~~
- ~~3. Iron, Single Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.~~
- ~~4. High Performance Butterfly Valves: Class 150 and Class 300, single flange.~~
- ~~5. Iron Swing Check Valves: Class 125 and Class 250, metal seats.~~
- ~~6. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.~~
- ~~7. Iron Gate Valves: Class 125 and Class 250, OS&Y.~~
- ~~8. Iron Globe Valves: Class 125 and Class 250.~~

### ~~3.6 CONDENSER WATER VALVE SCHEDULE~~

#### ~~A. Pipe NPS 2 and Smaller:~~

- ~~1. Bronze and Brass Valves: May be provided with solder joint ends instead of threaded ends.~~
- ~~2. Ball Valves: One piece, full port, brass or bronze.~~
- ~~3. Bronze Swing Check Valves: Class 125 and Class 150 bronze disc~~
- ~~4. Bronze Gate Valves: Class 125 and Class 150 bronze disc.~~
- ~~5. Bronze Globe Valves: Class 125 and Class 150 bronze disc~~

**B. ~~Pipe NPS 2-1/2 and Larger:~~**

- ~~1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.~~
- ~~2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.~~
- ~~3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.~~
- ~~4. High-Performance Butterfly Valves: Class 150 and Class 300, single flange.~~
- ~~5. Iron Swing Check Valves: Class 125 and Class 250, metal seats.~~
- ~~6. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.~~
- ~~7. Iron Gate Valves: Class 125 and Class 250, OS&Y.~~
- ~~8. Iron Globe Valves: Class 125 and Class 250.~~

3.7 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 and Class 150 bronze disc.
3. Ball Valves: One piece, full port, brass or bronze.
4. Bronze Swing Check Valves: Class 125 and Class 150 bronze disc
5. Bronze Gate Valves: Class 125 and Class 150 bronze disc.
4. Bronze Globe Valves: Class 125 and Class 150 bronze disc

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
4. High-Performance Butterfly Valves: Class 150 and Class 300, single flange.
5. Iron Swing Check Valves: Class 125 and Class 250, metal seats.
6. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
7. Iron Gate Valves: Class 125 and Class 250, OS&Y.
8. Iron Globe Valves: Class 125 and Class 250.

3.8 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Ball Valves: One piece, full port, brass or bronze.
2. Bronze Swing Check Valves: Class 125 and Class 150 bronze disc
3. Bronze Gate Valves: Class 125 and Class 150 disc.
4. Bronze Globe Valves: Class 125 and Class 150 bronze disc

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. High-Performance Butterfly Valves: Class 150 and Class 300, single flange.
3. Iron Swing Check Valves: Class 125 and Class 250, metal seats.
4. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
5. Iron Gate Valves: Class 125 and Class 250, OS&Y.
6. Iron Globe Valves: NPS 2-1/2 to NPS 12: Class 125 and Class 250.

3.9 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

A. Pipe NPS 2 and Smaller:

1. Ball Valves: One piece, full port, brass or bronze.
2. Bronze Swing Check Valves: Class 125 and Class 150 bronze disc
3. Bronze Gate Valves: Class 125 and Class 150 disc.
4. Bronze Globe Valves: Class 125 and Class 150 bronze disc

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. High-Performance Butterfly Valves: Class 150 and Class 300, single flange.
3. Iron Swing Check Valves: Class 125 and Class 250, metal seats.
4. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
5. Iron Gate Valves: Class 125 and Class 250, OS&Y.
6. Iron Globe Valves: NPS 2-1/2 to NPS 12: Class 125 and Class 250.

3.10 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: One piece, full port, brass or bronze.
2. Bronze Swing Check Valves: Class 125 and Class 150 bronze disc
3. Bronze Gate Valves: Class 125 and Class 150 disc.
4. Bronze Globe Valves: Class 125 and Class 150 bronze disc

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. High-Performance Butterfly Valves: Class 150 and Class 300, single flange.
3. Iron Swing Check Valves: Class 125 and Class 250, metal seats.
4. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.

5. Iron Gate Valves: Class 125 and Class 250, OS&Y.
6. Iron Globe Valves: NPS 2-1/2 to NPS 12: Class 125 and Class 250.

END OF SECTION 230523

## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Revise list below to suit Project.
  2. Trapeze pipe hangers.
  3. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- ~~D. Remaining paragraph is defined in Division 01 Section "Submittal Procedures" as an "Informational Submittal." Retain paragraph if retaining procedures for welder certification in "Quality Assurance" Article.~~

E. Welding certificates.

#### 1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

### PART 2 - PRODUCTS

#### 2.1 METAL PIPE HANGERS AND SUPPORTS

~~A. Carbon Steel Pipe Hangers and Supports:~~

- ~~1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.~~
- ~~2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.~~
- ~~3. Nonmetallic Coatings: Plastic coating, jacket, or liner.~~
- ~~4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.~~
- ~~5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.~~

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

#### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

#### 2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded **stainless**-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.4 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Verify suitability of fasteners in two subparagraphs below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.
  - 2. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.



3. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger 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.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
  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 allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, **stainless-steel** protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: **Stainless-steel** Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - ~~3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.~~
    - ~~a. Option: Thermal hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.~~

4. 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 or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications **and for all piping within basement, mechanical tunnel, and crawl space.**
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system 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 in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Hangers for horizontal lines, except as noted below and in Section 230500 -
1. Vibration Isolation and Seismic Restraint, shall be spaced no greater than as follows:

Pipe Size	Rod Diameter	Maximum Spacing	
		Copper	Steel
1/2"	3/8"	5' - 0"	7' - 0"
3/4"	3/8"	5' - 0"	7' - 0"
1"	3/8"	6' - 0"	7' - 0"
1 1/4"	3/8"	7' - 0"	7' - 0"
1 1/2"	3/8"	8' - 0"	9' - 0"
2"	3/8"	8' - 0"	10' - 0"
2 1/2"	1/2"	9' - 0"	11' - 0"
3"	1/2"	10' - 0"	12' - 0"
4" - 5"	5/8"	12' - 0"	14' - 0"
6" - 8"	3/4"	14' - 0"	17' - 0"

2. Copper tubing shall be supported with split ring hangers, copperized with supporting rod.
  3. Cast iron soil pipe shall be hung one hanger for each pipe length, close to hub.
  4. PVC pipe shall be supported no more than 4'-0" on center.
  5. Use insulation protection saddles or shields for all insulated cold piping and where hanger is outside the insulation. Secure all saddles and shields to the insulation to prevent slippage or shifting that may cause the shield to fall to the ground. Saddles shall be spot welded to hangers.
- R. Hangers for vertical pipes shall be spaced no greater than as follows:

<b>PIPING MATERIAL</b>	<b>MAX. VERTICAL SPACING</b>
Cast Iron Pipe	15'-0"
Copper Pipe/Tubing	10'-0"
Galvanized Steel Pipe	15'-0"
PVC Pipe	4'-0"
CPVC Pipe/Tubing	3'-0"

END OF SECTION 230529

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

PART 1 - GENERAL

1.01 DESCRIPTION

A. Intent

1. All mechanical equipment, piping and ductwork shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
2. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
3. It is the intent of the seismic portion of this Specification to keep all mechanical building system components in place during a seismic event.
4. All such systems must be installed in strict accordance with seismic codes, component manufacturers' and building construction standards. Whenever a conflict occurs between the manufacturers' or construction standards, the most stringent shall apply.
5. This Specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements (i.e., California Title 24; California OSHPD; Canadian Building Codes; or, other requirements).
6. The Contractor shall correct any variance or non-compliance with these Specification requirements in an approved manner.
7. Seismic restraints shall be designed in accordance with seismic force levels as detailed in the State Building Codes.
8. All in-line equipment will be braced independently of the ducts or pipes and in conformance with all applicable building codes.

B. The work in this Section includes, but is not limited to, the following:

1. Vibration isolation for piping, ductwork and equipment.
2. Seismic restraints for all new gas piping and sprinkler piping.
3. Equipment isolation bases.
4. Flexible piping connections.
5. Seismic restraints for isolated equipment.
6. Seismic restraints for non-isolated equipment.
7. Certification of seismic restraint designs and installation supervision.
8. Certification of seismic attachment of housekeeping pads.
9. All mechanical systems - equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical (equipment not listed is still included in this Specification):

AC Units  
Air Distrib. Boxes  
Air Handling Units

Air Separators  
Boilers  
Cabinet Heaters

Chillers  
Comp. Room Units  
Condensers

**VIBRATION AND SEISMIC CONTROLS  
FOR HVAC PIPING AND EQUIPMENT**

Condensing Units  
Cooling Towers  
Ductwork  
Fans (All Types)

Heat Exchangers  
Life Safety Systems  
Motor Control Ctrs.  
Piping

Pumps (All Types)  
Rooftop Units  
Tanks (All Types)  
Units Heaters

## C. Definitions

1. Life Safety Systems:
  - a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.
  - b. All systems involved with and/or connected to emergency power supply.
  - c. All medical and life-support systems.
  - d. Fresh-air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.
  - e. All life-safety equipment.
2. Positive Attachment:
  - a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.
3. Transverse Bracing:
  - a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.
4. Longitudinal Bracing:
  - a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

## 1.02 SUBMITTAL DATA REQUIREMENTS

- A. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
  1. Descriptive Data:
    - a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the Specification.
    - b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive Drawings.
  2. Shop Drawings:
    - a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
    - b. Provide all details of suspension and support for ceiling hung equipment.
    - c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installa-



- tion. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
- d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
3. Seismic Certification and Analysis:
    - a. Calculations shall be based on “G” forces appropriate for the zone in which the building is located.
    - b. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a Registered Professional Engineer with at least five years of seismic design experience, licensed in the State of the job location.
    - c. All restraining devices shall have a pre-approval number from California’s OSHPD or some other recognized government agency showing maximum restraint ratings. Pre-approvals based on independent testing are preferred to pre-approvals based on calculations. Where pre-approved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a Registered Professional Engineer with at least five years of seismic design experience and licensed in the State of the job location. Testing and calculations must include shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
    - d. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in the State Building Code acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

### 1.03 CODE AND STANDARDS REQUIREMENTS

#### A. Typical Applicable Codes and Standards

1. Applicable State Building Code.
2. Applicable State Mechanical Code.
3. Applicable State Plumbing and Gas Codes.
4. SMACNA
5. NFPA

### 1.04 MANUFACTURERS’ RESPONSIBILITIES

- #### A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
1. Determine vibration isolation and seismic restraint sizes and locations.
  2. Provide vibration isolation and seismic restraints as scheduled or specified.
  3. Provide calculations and materials if required for restraint of un-isolated equipment.
  4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.05 RELATED WORK

A. Housekeeping Pads:

1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor, if not already indicated on the Drawings.
2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

B. Supplementary Support Steel:

1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc., including roof mounted equipment, as required or specified.

C. Attachments:

1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc., in accordance with the requirements of the vibration vendor's calculations.

PART 2 - PRODUCTS

2.01 INTENT

- A. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer. Mason Industry's products are the basis of these Specifications; products of other manufacturers are acceptable provided their systems strictly comply with the Specifications and have the approval of the specifying engineer. Submittals and certification sheets shall be in accordance with Section 230500.
- B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" and/or horizontal permanent deformation greater than 1/4".

2.02 PRODUCT DESCRIPTIONS

A. Vibration Isolators and Seismic Restraints:

SPECIFICATION:

1. Two layers of 3/4" thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 16 gauge galvanized shim. Load distribution plates shall be used as required. Pads shall be Type Super "W" as manufactured by Mason Industries, Inc. or equal.

2. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron casting containing two separated-and-opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be Type BR as manufactured by Mason Industries, Inc. or equal.
3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between two steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in three planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge-bearing quality. Bushing assemblies shall be Type PB as manufactured by Mason Industries, Inc. or equal.
4. A one-piece molded bridge bearing neoprene washer/ bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal-to-metal contact. Neoprene bushings shall be Type HG as manufactured by Mason Industries, Inc. or equal.
5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be Type SLF as manufactured by Mason Industries, Inc. or equal.
6. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage pre-approval "R" number from OSHPD in the State of California certifying the maximum certified horizontal and vertical load ratings. Mountings shall be SLR as manufactured by Mason Industries, Inc. or equal.
7. Spring mountings, as in Specification 5, built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of 1/4" travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be SSLFH as manufactured by Mason Industries, Inc. or equal.

8. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8". Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician. Air springs shall be Type MT and leveling valves Type LV, as manufactured by Mason Industries, Inc. or equal.
9. Restrained air spring mountings shall have an MT air spring, as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist all seismic forces. Mountings shall be SLR-MT as manufactured by Mason Industries, Inc. or equal.
10. Hangers shall consist of rigid steel frames containing minimum 1 1/4" thick neoprene elements at the top and a steel spring with general characteristics, as in Specification 5, seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side-to-side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be Type 30N, as manufactured by Mason Industries, Inc. or equal.
11. Hangers shall be as described in paragraph 10 above, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Hangers shall be Type PC30N, as manufactured by Mason Industries, Inc. or equal.
12. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be Type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc. or equal.
  - a. Cables will be wire-core with a minimum breaking strength as shown in the table below. The cable size is for reference only. The actual cable size should be chosen to provide the breaking strength indicated in the table. Use FS = 2.0 when

pre-stretched cable is used with end connections that develop the breaking strength of the cables; otherwise, use FS = 5.0.

**Minimum Breaking Strength for Cable Braces**

<b>Size inches</b>	<b>Breaking Strength FS = 2.0 pounds</b>	<b>Breaking Strength FS = 5.0 pounds</b>
1/4	4,940	12,350
3/8	10,980	27,450
1/2	19,260	48,150

- b. Cable will be zinc-coated to a minimum of 0.4 ounces per square foot or stainless steel per ASTM A304. Tighten cable only to remove slack.
  - c. Use either cable or solid bracing for all situations. Do not mix bracing types.
13. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Seismic solid, brace-end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified load ratings. Solid seismic brace assemblies shall be Type SSB, as manufactured by Mason Industries, Inc. or equal.
- a. Cold-formed angles will conform to the material and identification requirements of the latest Specifications for the Design of Cold-Formed Steel Structural Members of the American Iron and Steel Institute with a minimum Fy = 33 ksi and a minimum Fu = 38 ksi.
  - b. The uncoated minimum steel thickness of the cold-formed product as delivered to the job site will not, at any location, be less than 95% of the thickness indicated in the table below. The thickness may be less at bends after cold-forming.

**Standard Sheet Metal Gages**

<b>Gage</b>	<b>Standard Uncoated Thickness inches</b>	<b>Galvanized Thickness inches</b>
12	0.1046	0.1084
14	0.0747	0.0785
16	0.0598	0.0635

- c. Hot-rolled shapes and plates will conform to ASTM A36. Pipes used as braces will be standard steel pipes (ASTM A120 or A53).

**Note:** Specifications 12 through 14 apply to trapeze as well as clevis hanger locations. At trapeze anchor locations, piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

14. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage pre-approval "R" number from OSHPD in the State of California. Rod clamp assemblies shall be Type SRC, as manufactured by Mason Industries, Inc. or equal.
15. Pipe clevis cross-bolt braces are required in all restraint locations. They shall be special purpose, pre-formed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage pre-approval "R" number from OSHPD in the State of California. Clevis cross braces shall be type CCB, as manufactured by Mason Industries, Inc. or equal.
16. All-directional seismic snubbers shall consist of inter-locking steel members restrained by a one-piece-molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of ¼" thick. Rated loadings shall not exceed 1,000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be Type Z-1225, as manufactured by Mason Industries, Inc. or equal.
17. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of ¾" thick. Rated loadings shall not exceed 1,000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" nor more than ¼". Snubbers shall be installed with factory-set clearances. The capacity of the seismic snubber at 3/8" deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to ½" deflection in the X, Y and Z planes. Snubbers shall have an anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be series Z-1011, as manufactured by Mason Industries, Inc. or equal.
18. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder, which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS, as manufactured by Mason Industries, Inc. or equal.
19. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an Evaluation Report Number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in female wedge anchors shall be Type SAB, as manufactured by Mason Industries, Inc. or equal.

20. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type WF, as manufactured by Mason Industries, Inc. or equal.
21. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of ½" bars welded in place on 6" centers running both ways in a layer 1½" above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts' sleeves and anchors while concrete is being poured. Height-saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Wooden-formed bases leaving concrete rather than a steel finish are not acceptable. Base shall be type BMK or K, as manufactured by Mason Industries, Inc. or equal.
22. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be a minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs' waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs' waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2" of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail and the lower Z section anchored to the roof structure. Curb shall have anchorage pre-approval "R" from OSHPD in the State of California attesting to the maximum certified horizontal and vertical load ratings. Curb shall be type RSC, as manufactured by Mason Industries, Inc. or equal.
23. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Dacron tire cord frictioning. Solid steel rings shall be used within the raised face, rubber ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes ¾" to 1½" may have threaded bolted flange assemblies, one sphere and cable retention. 14" and smaller connectors shall be rated at 250 psi up to 190°F with a uniform drop in allowable pressure to 190 psi at 250°F. 16" and larger connectors are rated 180 psi at 190°F and 135 psi at 250°F. Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent

markings verifying a five-minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal-ended expansion joints.

Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have ½" thick Neoprene washer bushings large enough in area to take the thrust at 1,000 psi maximum on the washer area. Expansion joints shall be installed on the equipment side of the shut-off valves.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut-off valves. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR, as manufactured by Mason Industries, Inc. or equal.

24. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

<b>Flanged</b>	<b>Male Nipples</b>
3 x 14	½ x 9
4 x 15	¾ x 10
5 x 19	1 x 11
6 x 20	1¼ x 12
8 x 22	1½ x 13
10 x 26	2 x 14
12 x 28	2½ x 18
14 x 30	
16 x 32	

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS, as manufactured by Mason Industries, Inc. or equal.

25. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum ½" thick, 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA, as manufactured by Mason Industries, Inc. or equal.
26. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum ½" thickness of 60-durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of + 1-5/8" motion or to meet location requirements. Pipe guides shall be type VSG, as manufactured by Mason Industries, Inc. or equal.



27. Split wall seals consist of two bolted pipe halves with minimum 3/4" thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240° F, 10# density fiberglass may be used in lieu of the ponge. Seals shall be type SWS, as manufactured by Mason Industries, Inc. or equal.
28. The horizontal thrust restraint shall consist of a spring element in series with a neoprene-molded cup as described in Specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" movement at start and stop. The assembly shall be furnished with one rod, and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI/WBD, as manufactured by Mason Industries, Inc. or equal.
29. Bolts will conform to ASTM A307. Bolt holes will be a maximum of 1/16" (1.6 mm) larger than the bolt diameter unless noted otherwise.
30. Expansion anchors will have local-governing-jurisdiction-approved values equal to, or greater than, both the shear and tension capacities listed in the table below. Cast-in-place concrete inserts may replace expansion anchors where the approved loads are equal to, or greater than, the values for the specified expansion anchors.

**Minimum Approved Values for Expansion Anchors**

<b>Size inches</b>	<b>Shear Capacity pounds</b>	<b>Tension Capacity pounds</b>
3/8	675	615
1/2	1,130	1,040
5/8	1,580	1,535
3/4	2,270	2,020
7/8	5,060	3,705

31. Welding will conform to AWS D1.1 and use either the shielded or submerged arc methods. Attachments to building components may be subject to review by the design professional.

**PART 3 - EXECUTION**

**3.01 GENERAL**

- A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.

- B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The Contractor shall not install any equipment, piping, duct or conduit that makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the A/E's attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible Contractor's expense.
- G. Bring to the A/E's attention any discrepancies between the Specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible Contractor's expense.
- H. At no additional cost, correct all installations that are deemed defective in workmanship and materials, at the Contractor's expense.
- I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the Structural Engineer of record for approval. Generally, bracing may occur from:
  - 1. Flanges of structural beams.
  - 2. Upper truss cords in bar joist construction.
  - 3. Cast-in-place inserts or wedge-type, drill-in concrete anchors.
- J. All attachments to structural elements will be reviewed with the appropriate design professional.
- K. Specification 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- L. Specification 12 cable assemblies are installed taut on non-isolated systems. Specification 13 seismic solid braces may be used in place of cables on rigidly attached systems only.
- M. At locations where Specifications 12 or 13 restraints are located, the support rods must be braced where necessary to accept compressive loads with Specification 14 braces.
- N. At all locations where Specifications 12 or 13 restraints are attached to pipe clevis', the clevis cross bolt must be reinforced with Specification Type 15 braces.
- O. Drill-in concrete anchors for ceiling and wall installation shall be Specification Type 18 and Specification Type 19 female wedge-type for floor mounted equipment.

- P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- Q. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed Specification 23 capabilities.
- R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide Specification 27 wall seals.
- S. Air handling equipment and centrifugal fans shall be protected against excessive displacement that results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be Specification Type 28.
- T. Locate isolation hangers as near to the overhead support structure as possible.
- U. When conduit is required to be braced, it may be braced the same as the equivalent weight pipe.
- V. All runs will have a minimum of two transverse braces and one longitudinal brace.
  - 1. A run is defined as a length of duct or pipe without any change in direction except as allowed by offsets

### 3.02 VIBRATION ISOLATION OF PIPING

- A. Horizontal Pipe Isolation: The first three pipe hangers in the main lines near the mechanical equipment shall be as described in Specification 11. Specification 11 hangers must also be used in all transverse braced isolated locations. Brace hanger rods with SRC clamps' Specification 14. Hangers as described in Specification 10 shall isolate horizontal runs in all other locations throughout the building. Floor-supported piping shall rest on isolators as described in Specification 6. Heat exchangers and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3"; 1½" deflection for pipe sizes up to and including 6"; and, 2½" deflection thereafter. Hangers shall be located as close to the overhead structure as practical. Where piping connects to mechanical equipment, install Specification 23 expansion joints or Specification 24 stainless hoses if 23 is not suitable for the service.
- B. Riser Isolation: Risers shall be suspended from Specification 10 hangers or supported by Specification 5 mountings, anchored with Specification 25 anchors and guided with Specification 26 sliding guides. Steel springs shall be a minimum of 0.75" except in those expansion locations where additional deflection is required to limit load changes to  $\pm 25\%$  of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.

### 3.03 SEISMIC RESTRAINT OF PIPING

- A. Seismically restrain all piping listed as 1, 2 or 3 below. If isolated, use Specification 12 cables. Specifications 12 or 13 restraints may be used on un-isolated piping.
  - 1. Fuel oil piping, gas piping, medical gas piping and compressed air piping.
  - 2. Piping located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1¼" I.D. and larger.
  - 3. All other piping, 2½" diameter and larger.
- B. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads or is otherwise noted in this Specification.
- C. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads or is otherwise noted in this Specification.
- D. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
- E. For fuel oil and all gas piping up to 5", transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
- F. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE, or combined stresses are within allowable limits at longer distances.
- G. Hold-down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
- H. Branch lines may not be used to restrain main lines.
- I. Cast iron pipe of all types, glass pipe and any other pipe joined with a shield-and-clamp assembly where the top of the pipe is 12" or more from the supporting structure, will be braced on each side of a change in direction of 90° or more. Riser joints will be braced or stabilized between floors.
- J. Provide joints capable of accommodating seismic displacements where pipes pass through building seismic or expansion joints or where rigidly supported pipes connect to equipment with vibration isolators. The joints must be allowed motion in all directions.
- K. A rigid piping system will not be braced to dissimilar parts of the building or to two dissimilar building systems that may respond differently during an earthquake.
- L. Vertical risers not specifically engineered will be laterally supported with a riser clamp at each floor. For buildings greater than six stories high, all risers will be engineered individually. For risers in hubless piping systems where the riser joints are unsupported between floors, brace in accordance with provisions of this Section.

### 3.04 VIBRATION ISOLATION OF DUCTWORK

- A. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Specification 10 hangers or Specification 5 floor isolators. Spring deflection shall be a minimum of 0.75".
- B. All duct runs having air velocity of 1,000 fpm or more, shall be isolated from the building structure by Specification 11 hangers or five floor supports. Spring deflection shall be a minimum of 0.75".

### 3.05 SEISMIC RESTRAINT OF DUCTWORK

- A. Seismically restrain all ductwork with Specification 12 or 13 restraints as listed below:
  - 1. Restrain rectangular ducts with cross sectional area of 6 sq. ft. or larger.
  - 2. Restrain round ducts with diameters of 33" or larger.
  - 3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
- B. Transverse restraints shall occur at 30' intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
- C. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within four feet of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
- D. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
- E. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
- F. Unbraced ducts will be installed with a 6" minimum clearance to vertical ceiling hanger wires.
- G. Walls, including gypsum board non-bearing partitions, that have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame at all stud wall construction.

### 3.06 SEISMIC RESTRAINT OF FIRE PROTECTION EQUIPMENT

- A. All fire protection piping shall be braced in accordance with NFPA 13 and 14.
- B. All fire protection equipment is considered life safety equipment and shall be seismically restrained using the seismic force levels for life safety equipment detailed in the State Building Code if higher levels are shown.

3.07. SEISMIC RESTRAINT OF MECHANICAL EQUIPMENT

- A. All mechanical equipment shall be vibration isolated and seismically restrained as per Section 2.02 of this Specification.

3.08 SEISMIC RESTRAINT EXCLUSIONS

A. Piping:

1. All piping less than 2½" in diameter except those listed in Section 3.03, paragraph A.
2. All piping in boiler and mechanical equipment rooms less than 1¼" I.D except where noted otherwise in this Specification and in Section 3.03, paragraph A.1.
3. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than the 12" in length from the structure to top of pipe, except those listed in Section 3.03, paragraph A.1.

B. Ductwork:

1. Rectangular, square or oval ducts less than six square feet in cross sectional area.
2. Round duct less than 33" in diameter.
3. No bracing is required if the duct is suspended by hangers 12" or less in length, as measured from the top of the duct to the bottom of the support where the hanger is attached. Hangers must be positively attached to the duct with 2" of the top of the duct with a minimum of two #10 sheet metal screws.

C. Suspended Equipment:

1. VAV boxes and fan-powered equipment weighing less than 50 lbs. and rigidly connected to the supply side of the duct system and supported with a minimum of four hanger rods.

END OF SECTION 230548

## SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. See drawings GO.M2.201 and FA.M2.202 "Temperature Control Notes" for requirements that relate to this Section.**
- C. The following specification describes components of the control system required for this project. Provide all components necessary for a complete automatic control system that will accomplish all of the "Sequences of Operations" ~~described in Section 230993 of these specifications.~~

#### 1.2 SCOPE

- A. Furnish and install, as hereinafter specified, an extension to the existing electric/electronic temperature control system and Facilities Management Control System. The system extension shall be comprised of a network of various independent stand-alone Digital Controllers (SDC's), Programmable Unit Controllers (PUC's), Air Terminal Control Units (ATCU's), electric/electronic control equipment, thermostats, sensors, controllers, valves, panels, and related hardware and other accessory equipment, along with a complete system of electrical control wiring to fill the intent of the specifications and provide for a complete and operable system. Systems and components manufactured under ISO-9001 certification are preferred. Controls system shall interface seamlessly with the University's existing building management system located in the Sherman Building.**
- B. Provide a graphic display for each NEW AND EXISTING major piece of HVAC equipment (i.e. pumps, steam valves, fans, etc.). Equipment shall be represented by a two or three-dimensional drawing. Where multiple pieces of equipment combine to form a system, such as air handling units and return air fan provide one graphic to depict the entire system. Indicate the equipment, piping, ductwork, dampers, and control valves in the installed location. Include labels for equipment, piping, ductwork, dampers, and control valves. Show the direction of air and water flow. Include dynamic display of applicable object data with clear names in appropriate locations. Show the position of the fresh air return and outdoor air dampers, space/discharge/return air temperature, supply, return and outdoor air flow. Show all related alarm points. Provide communication jack at the main panel in the building for field connection of a portable trouble shooting and programming device.**
- C. Alarms, where applicable and all interlocking wiring required shall be provided by the ATC Subcontractor.**
- D. The ATC Subcontractor shall review and study all HVAC, Electrical and Plumbing drawings and entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc., he has to provide. Numerous references to the ATC Subcontractor are made throughout this**

**specification identifying work to be performed under this Section in addition to work specifically indicated under this paragraph.**

- E. All interlocking wiring and installation of control devices, both powered and non-electric, shall be provided by the ATC Subcontractor. Close coordination shall be exercised between the ATC Subcontractor and the HVAC Subcontractor and equipment manufacturers so that installation will be provided in a manner to result in fully operable systems, as intended in these specifications.**
- F. Provide incidental 110V power wiring to panels and control transformers where not shown on electrical drawings.**
- G. The controls systems shall be installed by competent control mechanics and electricians regularly trained by the manufacturer of the control equipment. All control equipment shall be the product of one (1) manufacturer and all ATC components shall be capable of interfacing with the HVAC equipment. The factory trained control contractor must maintain adequate staff and offer standard services to fully support the owner in the timely maintenance, repair, and operation of the control system. Contractors who do not maintain such staff and offer services or must develop some for this project are not acceptable. Bids from franchised dealers or others whose principal business is not the installation and service of temperature control systems will not be acceptable.**

### 1.3 SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
  - 1. Schematic flow diagrams.
  - 2. Power, signal, and control wiring diagrams.
  - 3. Details of control panel faces.
  - 4. Damper schedule.
  - 5. Valve schedule.
  - 6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
  - 7. Control System Software: Schematic diagrams, written descriptions, and points list.
- C. Software and firmware operational documentation.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

### 1.4 GUARANTEE AND SERVICE

- A. This contractor shall provide two full years of on-site service as required to readjust controls, answer trouble calls and resolve them and to repair or replace any broken or malfunctioning part or system. The contractor may provide off site monitoring for verification of trouble calls.**



- B. The system specified herein and shown on the drawings shall be guaranteed to be free from original defects in both material and workmanship and shall perform to manufacturer specification for a period of two (2) years of normal use and service, excepting damages from other causes. Systems which are manufactured ISO-9001 certification are preferred. This guarantee shall become effective starting the date the Contract work is accepted as complete by the Architect/Owner in accordance with the General Provisions/Conditions.**
- C. Upon completion of the installation, the ATC Subcontractor shall submit to the owner an agreement to provide the necessary programmed maintenance, to keep the various control systems in proper working condition beyond the guarantee period. Additionally, this contractor shall submit to the Owner a standard agreement to support the system operation. This service must include operator support, application support, remote diagnostic support as well as database management support. This service shall be available 365 days/year, 24 hours a day.**
- D. This programmed maintenance agreement shall fully describe the maintenance work to be performed and shall advise as to the cost of this work prior to awarding of Contract.**

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.**

#### 1.6 ELECTRIC WIRING

- A. All electric wiring, connections and all interlocking control wiring required for the installation of the temperature control system regardless of voltage, as herein specified, shall be provided by the ATC Subcontractor, unless specifically shown on the Electrical drawings or called for in the Electrical specifications. Power to valves and actuators shall be by the ATC Subcontractor, except as specifically noted in the electrical drawings and specifications.**
- B. All wiring shall comply with the requirements of the Electrical Section of the specifications.**

#### 1.7 INCIDENTAL WORK BY OTHERS

- A. The following incidental work shall be furnished by the designated Subcontractor under the supervision of the ATC Subcontractor:**
  - 1. The HVAC subcontractor shall coordinate required work with ATC and, without limiting the generality thereof, the work he is to perform for the ATC shall include the following:**
    - a. Install automatic valves (INCLUDING NON-ELECTRIC ZONE VALVES), sensor wells and other similar equipment that are specified to be supplied by the ATC Subcontractor.**
    - b. Provide, on magnetic starter furnished, all necessary auxiliary contracts, with buttons and switches in required configurations.**

- c. Provide access doors or other approved means of access through ceiling and walls for service to control equipment.

2. The Electrical Subcontractor shall:

- a. Provide all power wiring (110 VAC or greater) to motors.

## 1.8 INSTRUCTION AND ADJUSTMENT

- A. Upon completion of the project, the ATC Subcontractor shall test and troubleshoot the system including the following:
- B. Fine-tune and “de-bug” all software control loops, routines, programs and sequences of control associates with the control system supplied.
- C. Set up trends for all new and existing controlled and monitored points. Utilize the trends to confirm that systems are controlling properly.
- D. Completely adjust and make ready for use, all transmitters, relays, valves, etc., provided under this Section. This contractor shall furnish copies of complete, detailed, calibrating checkout and commissionary documentation for each controller. Documentation shall list each procedure and shall be signed by the control specialist performing the service.
- E. Furnish a complete set of system operation manuals, including standard manufacturers’ operating manuals, complete as-built installation diagrams, and complete software hardcopy documentation, as well as a digital media back-up.
- F. Provide an on-site training program for the Owner’s staff in the operation and use of the control system. Training shall include two (2) segments, as follows:
  1. Segment 1 shall include 4 hours of classroom and hands-on training. This segment shall instruct personnel in the system configuration, component characteristics, control strategy on each controlled system and all requirements for daily operation and use of the system. This segment shall give the Owner’s representative a working proficiency in the day-to-day operational requirements (i.e., system monitoring, alarm acknowledgment, HVAC system troubleshooting techniques, set point and time schedule adjustments, manual override, etc.).
  2. Segment 2 shall include 8 hours of onsite training. This segment will be geared for the Owner’s designated prime operator. An emphasis on overall software management and manipulation shall be made, to allow the prime operator(s) to make control strategy and overall facility and system management changes as required. Attendees shall have attended Segment 1.
- G. All training shall take place at the site and at times mutually agreed to between the ATC Subcontractor and the Owner. The ATC Subcontractor shall provide to the Owner’s designated representative, at least three (3) weeks before each segment, a course syllabus outline and schedule. The ATC Subcontractor shall provide all training material, reference material and training aids, as required, all as part of his Contract cost.

## PART 2 - PRODUCTS

### 2.1 CONTROL SYSTEM MANUFACTURERS

- A. **Available Manufacturers:** As indicated on the drawings, the new controls shall be an extension of the existing Andover controls located in the Fayerweather building.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An existing operator workstation in the Sherman Building permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

### 2.2 DDC EQUIPMENT

- A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
  - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
  - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
    - d. Software applications, scheduling, and alarm processing.
    - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
- B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
  - 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
  - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
  - 3. Local operator interface provides for download from or upload to operator workstation.

- C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
  2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
  5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
  6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
  7. Universal I/Os: Provide software selectable binary or analog outputs.
- D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
  2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
  3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
  2. Maximum response time of 10 nanoseconds.
  3. Minimum transverse-mode noise attenuation of 65 dB.
  4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

### 2.3 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72 hour battery backup.
  2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
  3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

## 2.4 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
  - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

## 2.5 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Temperature Sensors and Transmitters (DDC )**
  - 1. Space temperature sensors WITHOUT display and adjustment: Sensor shall provide heating control of room. Sensor indicated with an S symbol on contract documents. Sensor shall be provided with the following:**
    - a. Accuracy: Plus or minus 0.5 deg F at calibration point.**
    - b. Preferential rate control to minimize overshoot and deviation from set point.**
    - c. Sensors located on exterior walls shall be provided with insulated sub-bases.**
    - d. Color shall be white.**
- C. Temperature Sensors and Transmitters
  - 1. Accuracy: Plus or minus 0.5 deg F at calibration point.
  - 2. Wire: Twisted, shielded-pair cable.
  - 3. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
  - 4. Averaging Elements in Ducts: use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
  - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
  - 6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
  - 7. Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
  - 1. Bulbs in water lines with separate wells of same material as bulb.
  - 2. Bulbs in air ducts with flanges and shields.
  - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.

4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
  5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
  6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- E. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- F. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- G. Humidity Sensors: Bulk polymer sensor element.
1. Accuracy: 2 percent full range with linear output.
  2. Room Sensor Range: 20 to 80 percent relative humidity.
  3. Room Sensor Cover Construction: Provide sample for Owner approval.
  4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
  5. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F.
  6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- H. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
    - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    - b. Output: 4 to 20 mA.
    - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
    - d. Duct Static-Pressure Range: 0- to 5-inch wg.
  2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
  3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
  4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
  5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.
  6. Room Sensor Cover Construction: Provide sample for Owner approval

## 2.6 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- E. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- F. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
  - 1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. I.T.M. Instruments Inc.

## 2.7 THERMOSTATS (NON-DDC) (WITH NON-ELECTRIC ZONE VALVES)

- A. **Manufacturers:**
  - 1. **Danfoss Inc.; Air-Conditioning and Refrigeration Div.**
- B. **Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.**
  - 1. **Bulbs in water lines with separate wells of same material as bulb.**
  - 2. **Bulbs in air ducts with flanges and shields.**
  - 3. **Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.**
  - 4. **Scale settings and differential settings are clearly visible and adjustable from front of instrument.**
  - 5. **On-Off Thermostat: With precision snap switches and with electrical ratings required by application.**
  - 6. **Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.**
- C. Room Thermostat Cover Construction: Provide sample for Owner approval.

## 2.8 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 : Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf .
  4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf .
  5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf .
  6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf .
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc.
  2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  3. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
  4. Coupling: V-bolt and V-shaped, toothed cradle.
  5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  7. Power Requirements (Two-Position Spring Return): 24 / 120 / 230 V ac.
  8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  10. Temperature Rating: Minus 22 to plus 122 deg F.
  11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F .



## 2.9 CONTROL VALVES

### A. Manufacturers:

1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
2. Erie Controls.
3. Belimo

### B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

### C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
  - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
  - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:
  - a. Two Position: Line size.
  - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
  - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

### D. Butterfly Valves: 200-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.

### E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.

3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

- F. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.

## 2.10 DAMPERS

- A. Manufacturers:

1. Air Balance Inc.
2. TAMCO (T. A. Morrison & Co. Inc.).
3. Nailor
4. Greenheck

- B. Dampers: AMCA-rated, **opposed-blade design**; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F .
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

## 2.11 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

- B. Install guards on thermostats in the following locations:

### **INSTRUMENTATION AND CONTROL FOR HVAC**

1. Entrances.
  2. Public areas.
  3. Where indicated.
- C. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- F. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- G. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- H. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- I. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

### 3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  2. Install exposed cable in raceway.
  3. Install concealed cable in raceway.
  4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
  5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
  7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Sequences shall be tested and demonstrated to perform by input of values to demonstrate automated operation; command of operation does not demonstrate performance.**
- C. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.
  - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
  - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  - 6. Test each system for compliance with sequence of operation.
  - 7. Test software and hardware interlocks.
- D. DDC Verification:
  - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  - 2. Check instruments for proper location and accessibility.
  - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  - 4. Check instrument tubing for proper fittings, slope, material, and support.
  - 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
  - 6. Check temperature instruments and material and length of sensing elements.
  - 7. Check control valves. Verify that they are in correct direction.
  - 8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
  - 9. Check DDC system as follows:
    - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    - c. Verify that spare I/O capacity has been provided.
    - d. Verify that DDC controllers are protected from power supply surges.
- E. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 230900

## SECTION 238236 - FINNED-TUBE RADIATION HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes hydronic baseboard and finned-tube radiation heaters.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include details and dimensions of custom-fabricated enclosures.
  - 4. Indicate location and size of each field connection.
  - 5. Indicate location and arrangement of piping valves and specialties.
  - 6. Indicate location and arrangement of integral controls.
  - 7. Include enclosure joints, corner pieces, access doors, and other accessories.
- C. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.
- D. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Structural members, including wall construction, to which finned-tube radiation heaters will be attached.
  - 2. Method of attaching finned-tube radiation heaters to building structure.
  - 3. Penetrations of fire-rated wall and floor assemblies.
- E. Field quality-control reports.

PART 2 - PRODUCTS

**2.1 HOT-WATER BASEBOARD RADIATION HEATERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sterling Hydronics; a Mestek company.
  2. Embassy Industries, Inc.
  3. Slant/Fin Corporation.
- B. Performance Ratings: Rate baseboard radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Baseboard Radiation."
- C. Furnish and install where shown on all plans/drawings, Sterling Guardian Finned-Tube Assemblies as described in the specifications below or approved equal quality and capacity. Ratings shall be IBR approved and submitted as so. Material shall be installed in a workman-like manner in accordance with specifications and Sterling's recommendations.
- D. **Element:**
1. **Type "A": The Catalog Designation is C3/4 435. The Heating element shall be a 3/4" nominal diameter copper/aluminum tube. All copper/aluminum heating elements shall be manufactured with seamless copper tubing. The Tubing shall be mechanically expanded into its diameter of the equally spaced aluminum fins. The ends of the copper tube shall be of finished O.D. (male) and finished I.D. (female, swaged) as to allow the use of standard domestic copper fittings. The tube will have a guaranteed working pressure at 300 degrees F of not less than 218 PSI. The fins shall be 4-1/4" wide by 3-5/8" high and 0.020" thick. The fins shall be spaced at 50 fins per foot.**
  2. **Type "B": The Catalog Designation is C45. The Heating element shall be a 1" diameter copper/aluminum tube. All copper/aluminum heating elements shall be manufactured with seamless copper tubing. The Tubing shall be mechanically expanded into its diameter of the equally spaced aluminum fins. The ends of the copper tube shall be of finished O.D. (male) and finished I.D. (female, swaged) as to allow the use of standard domestic copper fittings. The tube will have a guaranteed working pressure at 300 degrees F of not less than 204 PSI. The fins shall be 4-1/4" SQ. and 0.020" thick. The fins shall be spaced at 50 fins per foot.**
  3. **Type "C": The Catalog Designation is C3/4 434. The Heating element shall be a 3/4" nominal diameter copper/aluminum tube. All copper/aluminum heating elements shall be manufactured with seamless copper tubing. The Tubing shall be mechanically expanded into its diameter of the equally spaced aluminum fins. The ends of the copper tube shall be of finished O.D. (male) and finished I.D. (female, swaged) as to allow the use of standard domestic copper fittings. The tube will have a guaranteed working pressure at 300 degrees F of not less than 218 PSI. The fins shall be 4-1/4" wide by 3-5/8" high and 0.020" thick. The fins shall be spaced at 40 fins per foot.**
  4. **Type "D": The Catalog Designation is C435. The Heating element shall be a 1" nominal diameter copper/aluminum tube. All copper/aluminum heating elements shall be manufactured with seamless copper tubing. The Tubing shall be**

**mechanically expanded into its diameter of the equally spaced aluminum fins. The ends of the copper tube shall be of finished O.D. (male) and finished I.D. (female, swaged) as to allow the use of standard domestic copper fittings. The tube will have a guaranteed working pressure at 300 degrees F of not less than 218 PSI. The fins shall be 4-1/4" wide by 3-5/8" high and 0.020" thick. The fins shall be spaced at 50 fins per foot.**

- E. Enclosure: Finned-tube enclosures are to be Flat Top Partially Perforated. Catalog Number: GSBF-12P, corresponding to an enclosure with a height of 12", and a Depth of B: 5-5/16", with one tier of element. The enclosure shall be mounted at a height of 16". Guardian enclosure shall be as scheduled on the plans. Enclosure will be fabricated from 14 or 12 gauge perforated cold rolled steel that has been de-greased, phosphatized, sealer coated, and painted with an electrostatically applied temperature-cured polyester based powder coated prime finish (or standard color is optional). Perforations shall be 1/8" diameter holes on staggered 3/16" center lines in either a partial (inlet & outlet) or full (entire enclosure) pattern as specified. The full wrap around design allows complete engagement at the wall so that unauthorized material cannot be inserted into them. 14ga underlapping joiner strip applied at right hand end on partial perforated enclosures. Factory punched, 11/32" mounting holes, located in the bottom rear vertical flange, are located on 12 inch centers and evenly spaced over the length of the security enclosure.
- F. Backplates: All full backplates will be one piece construction, 14 gauge galvanized steel (12 gauge optional) with a die-formed mounting channel into which the enclosure shall self-locate and secure. Self-adhesive closed cell neoprene air seal gasket to be provided on backplates when requested to prevent wall streaking. All partial backplates are to be pre-painted, 14 gauge steel (12 gauge optional) with die-formed mounting channel into which the enclosure shall self-locate and secure.
- G. Brackets/Hangers: Hangers shall be die-formed 14 gauge galvanized steel with channel type wiped edge construction for rigidity. Nickel-chromium plated ball bearings inserted into a nylon isolator insert shall be used in conjunction with an 18 gauge galvanized die-formed element support cradle to provide friction free lateral movement during expansion and contraction. Hangers are to be used to support element only, as the cover is secured to the wall at the bottom flange with tamper resistant fasteners by others.
- H. Accessories: Accessories shall be die-formed 14 gauge cold rolled steel with the same finish as the enclosure. Overlapping accessories shall provide for make-up required in runs when and where partitions and/or walls may vary from bay to bay. Accessories shall extend back to wall at bottom for securing with tamper resistant fasteners by others. Accessories may also be secured to enclosure using supplied clearance holes with optional #10 by 1/2" long type BP self tapping truss head tamper resistant sheet metal screws as determined by local or regional codes.

## **2.2 HOT-WATER FAN COIL UNIT HEATER**

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
  - 1. **Airtherm; a Mestek company.**
  - 2. **Embassy Industries, Inc.**
  - 3. **Slant/Fin Corporation.**



- B. Furnish and install where shown on all plans/drawings, Airtherm and Embassy fan coil heaters as described in the specifications and drawing schedules or approved equal quality and capacity. Material shall be installed in a workman-like manner in accordance with specifications and the manufacturer's recommendations.**

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of finned-tube radiation heaters.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 BASEBOARD RADIATION HEATER INSTALLATION

- A. Install units level and plumb.
- B. Install enclosure continuously around corners, using outside and inside corner fittings.
- C. Join sections with splice plates and filler pieces to provide continuous enclosure.
- D. Install access doors for access to valves.
- E. Install enclosure continuously from wall to wall.
- F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
- G. Install valves within reach of access door provided in enclosure.
- H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- I. Install piping within pedestals for freestanding units.

#### 3.3 FAN COIL UNIT HEATER INSTALLATION

- A. Install units level and plumb.
- B. Install enclosure continuously around corners, using outside and inside corner fittings.
- C. Join sections with splice plates and filler pieces to provide continuous enclosure.
- D. Install access doors for access to valves.

- E. Install enclosure continuously from wall to wall.
- F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
- G. Install valves within reach of access door provided in enclosure.
- H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- I. Install piping within pedestals for freestanding units.

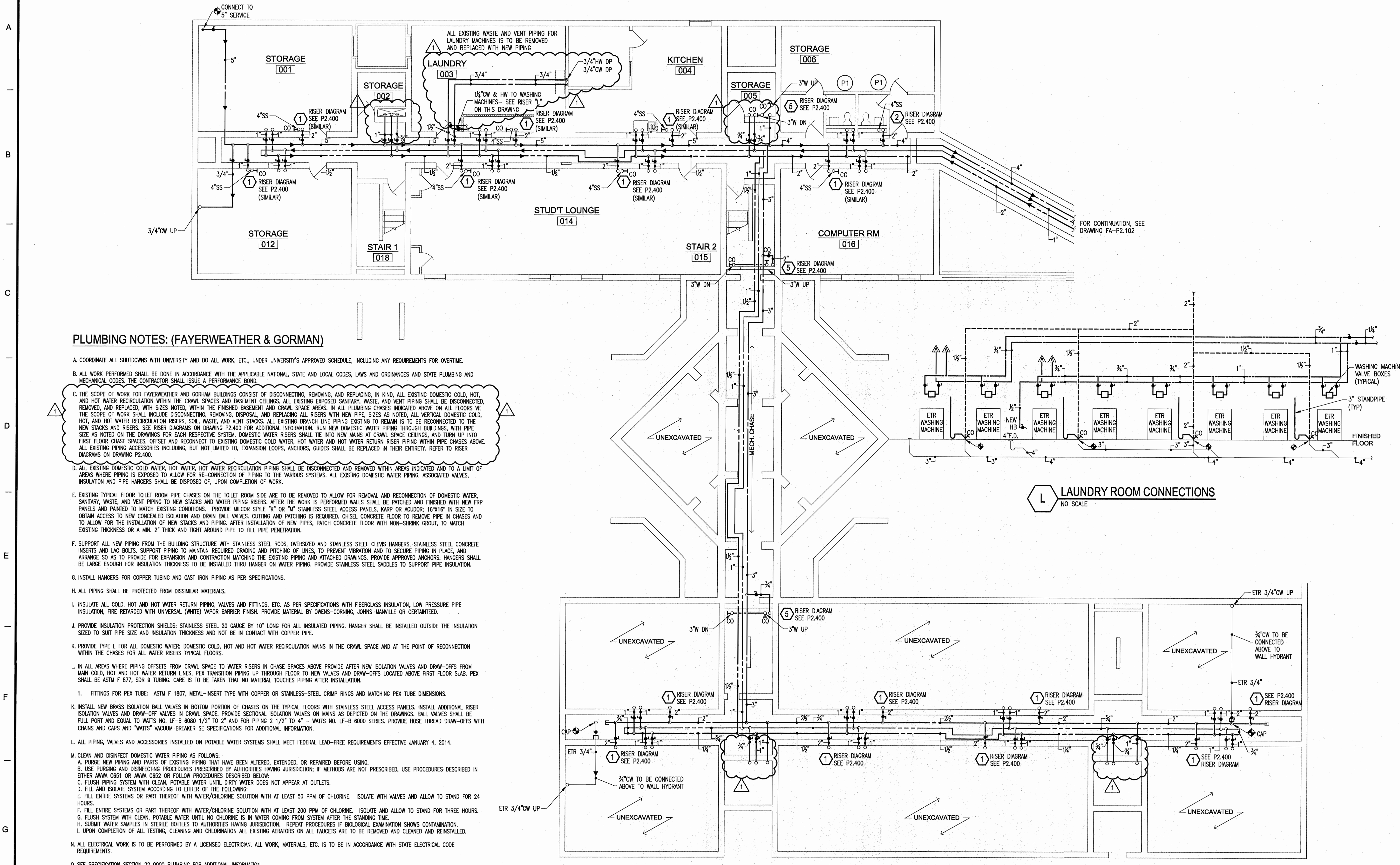
### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."
  - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Section 230900 "Instrumentation and Control for HVAC."
- D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

END OF SECTION 238236



**PLUMBING NOTES: (FAYERWEATHER & GORMAN)**

- A. COORDINATE ALL SHUTDOWNS WITH UNIVERSITY AND DO ALL WORK, ETC., UNDER UNIVERSITY'S APPROVED SCHEDULE, INCLUDING ANY REQUIREMENTS FOR OVERTIME.
- B. ALL WORK PERFORMED SHALL BE DONE IN ACCORDANCE WITH THE APPLICABLE NATIONAL, STATE AND LOCAL CODES, LAWS AND ORDINANCES AND STATE PLUMBING AND MECHANICAL CODES. THE CONTRACTOR SHALL ISSUE A PERFORMANCE BOND.
- C. THE SCOPE OF WORK FOR FAYERWEATHER AND GORMAN BUILDINGS CONSIST OF DISCONNECTING, REMOVING, AND REPLACING, IN KIND, ALL EXISTING DOMESTIC COLD, HOT, AND HOT WATER RECIRCULATION WITHIN THE CRAWL SPACES AND BASEMENT CEILING. ALL EXISTING EXPOSED SANITARY, WASTE, AND VENT PIPING SHALL BE DISCONNECTED, REMOVED, AND REPLACED, WITH SIZES NOTED, WITHIN THE FINISHED BASEMENT AND CRAWL SPACE AREAS. IN ALL PLUMBING CHASES INDICATED ABOVE ON ALL FLOORS VE THE SCOPE OF WORK SHALL INCLUDE DISCONNECTING, REMOVING, DISPOSAL, AND REPLACING ALL RISERS WITH NEW PIPE, SIZES AS NOTED. ALL VERTICAL DOMESTIC COLD, HOT, AND HOT WATER RECIRCULATION RISERS, SOIL, WASTE, AND VENT STACKS. ALL EXISTING BRANCH LINE PIPING EXISTING TO REMAIN IS TO BE RECONNECTED TO THE NEW STACKS AND RISERS. SEE RISER DIAGRAMS ON DRAWING P2.400 FOR ADDITIONAL INFORMATION. RUN NEW DOMESTIC WATER PIPING THROUGH BUILDINGS, WITH PIPE SIZE AS NOTED ON THE DRAWINGS FOR EACH RESPECTIVE SYSTEM. DOMESTIC WATER RISERS SHALL TIE INTO NEW MAINS AT CRAWL SPACE CEILING, AND TURN UP INTO FIRST FLOOR CHASE SPACES. OFFSET AND RECONNECT TO EXISTING DOMESTIC COLD WATER, HOT WATER AND HOT WATER RETURN RISER PIPING WITHIN PIPE CHASES ABOVE. ALL EXISTING PIPING ACCESSORIES INCLUDING, BUT NOT LIMITED TO, EXPANSION LOOPS, ANCHORS, GUIDES SHALL BE REPLACED IN THEIR ENTIRETY. REFER TO RISER DIAGRAMS ON DRAWING P2.400.
- D. ALL EXISTING DOMESTIC COLD WATER, HOT WATER, HOT WATER RECIRCULATION PIPING SHALL BE DISCONNECTED AND REMOVED WITHIN AREAS INDICATED AND TO A LIMIT OF AREAS WHERE PIPING IS EXPOSED TO ALLOW FOR RE-CONNECTION OF PIPING TO THE VARIOUS SYSTEMS. ALL EXISTING DOMESTIC WATER PIPING, ASSOCIATED VALVES, INSULATION AND PIPE HANGERS SHALL BE DISPOSED OF, UPON COMPLETION OF WORK.
- E. EXISTING TYPICAL TOILET ROOM PIPE CHASES ON THE TOILET ROOM SIDE ARE TO BE REMOVED TO ALLOW FOR REMOVAL AND RECONNECTION OF DOMESTIC WATER, SANITARY, WASTE, AND VENT PIPING TO NEW STACKS AND WATER PIPING RISERS. AFTER THE WORK IS PERFORMED WALLS SHALL BE PATCHED AND FINISHED WITH NEW FRP PANELS AND PAINTED TO MATCH EXISTING CONDITIONS. PROVIDE MILCOR STYLE "M" OR "W" STAINLESS STEEL ACCESS PANELS, KARP OR ALCUDOR, 16"x16" IN SIZE TO OBTAIN ACCESS TO NEW CONCEALED ISOLATION AND DRAIN BALL VALVES. CUTTING AND PATCHING IS REQUIRED. CHISEL CONCRETE FLOOR TO REMOVE PIPE IN CHASES AND TO ALLOW FOR THE INSTALLATION OF NEW STACKS AND PIPING. AFTER INSTALLATION OF NEW PIPES, PATCH CONCRETE FLOOR WITH NON-SHRINK GROUT, TO MATCH EXISTING THICKNESS OR A MIN. 2" THICK AND TIGHT AROUND PIPE TO FILL PIPE PENETRATION.
- F. SUPPORT ALL NEW PIPING FROM THE BUILDING STRUCTURE WITH STAINLESS STEEL RODS, OVERSIZED AND STAINLESS STEEL CLEVIS HANGERS, STAINLESS STEEL CONCRETE INSERTS AND LAG BOLTS. SUPPORT PIPING TO MAINTAIN REQUIRED GRADING AND PITCHING OF LINES, TO PREVENT VIBRATION AND TO SECURE PIPING IN PLACE, AND ARRANGE SO AS TO PROVIDE FOR EXPANSION AND CONTRACTION MATCHING THE EXISTING PIPING AND ATTACHED DRAWINGS. PROVIDE APPROVED ANCHORS. HANGERS SHALL BE LARGE ENOUGH FOR INSULATION THICKNESS TO BE INSTALLED THRU HANGER ON WATER PIPING. PROVIDE STAINLESS STEEL SADDLES TO SUPPORT PIPE INSULATION.
- G. INSTALL HANGERS FOR COPPER TUBING AND CAST IRON PIPING AS PER SPECIFICATIONS.
- H. ALL PIPING SHALL BE PROTECTED FROM DISSIMILAR MATERIALS.
- I. INSULATE ALL COLD, HOT AND HOT WATER RETURN PIPING, VALVES AND FITTINGS, ETC. AS PER SPECIFICATIONS WITH FIBERGLASS INSULATION, LOW PRESSURE PIPE INSULATION, FIRE RETARDED WITH UNIVERSAL (WHITE) VAPOR BARRIER FINISH. PROVIDE MATERIAL BY OWENS-CORNING, JOHNS-MANVILLE OR CERTAINTED.
- J. PROVIDE INSULATION PROTECTION SHIELDS: STAINLESS STEEL 20 GAUGE BY 10" LONG FOR ALL INSULATED PIPING. HANGER SHALL BE INSTALLED OUTSIDE THE INSULATION SIZED TO SUIT PIPE SIZE AND INSULATION THICKNESS AND NOT BE IN CONTACT WITH COPPER PIPE.
- K. PROVIDE TYPE L FOR ALL DOMESTIC WATER; DOMESTIC COLD, HOT AND HOT WATER RECIRCULATION MAINS IN THE CRAWL SPACE AND AT THE POINT OF RECONNECTION WITHIN THE CHASES FOR ALL WATER RISERS TYPICAL FLOORS.
- L. IN ALL AREAS WHERE PIPING OFFSETS FROM CRAWL SPACE TO WATER RISERS IN CHASE SPACES ABOVE PROVIDE AFTER NEW ISOLATION VALVES AND DRAW-OFFS FROM MAIN COLD, HOT AND HOT WATER RETURN LINES, PEX TRANSITION PIPING UP THROUGH FLOOR TO NEW VALVES AND DRAW-OFFS LOCATED ABOVE FIRST FLOOR SLAB. PEX SHALL BE ASTM F 877, SDR 9 TUBING. CARE IS TO BE TAKEN THAT NO MATERIAL TOUCHES PIPING AFTER INSTALLATION.
  1. FITTINGS FOR PEX TUBE: ASTM F 1807, METAL-INSERT TYPE WITH COPPER OR STAINLESS-STEEL CRIMP RINGS AND MATCHING PEX TUBE DIMENSIONS.
- K. INSTALL NEW BRASS ISOLATION BALL VALVES IN BOTTOM PORTION OF CHASES ON THE TYPICAL FLOORS WITH STAINLESS STEEL ACCESS PANELS. INSTALL ADDITIONAL RISER ISOLATION VALVES AND DRAW-OFF VALVES IN CRAWL SPACE. PROVIDE SECTIONAL ISOLATION VALVES ON MAINS AS DEPICTED ON THE DRAWINGS. BALL VALVES SHALL BE FULL PORT AND EQUAL TO WAITS NO. LF-B 6080 1/2" TO 2" AND FOR PIPING 2 1/2" TO 4" - WAITS NO. LF-B 6000 SERIES. PROVIDE HOSE THREAD DRAW-OFFS WITH CHAINS AND CAPS AND "WAITS" VACUUM BREAKER SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION.
- L. ALL PIPING, VALVES AND ACCESSORIES INSTALLED ON POTABLE WATER SYSTEMS SHALL MEET FEDERAL LEAD-FREE REQUIREMENTS EFFECTIVE JANUARY 4, 2014.
- M. CLEAN AND DISINFECT DOMESTIC WATER PIPING AS FOLLOWS:
  - A. PURGE NEW PIPING AND PARTS OF EXISTING PIPING THAT HAVE BEEN ALTERED, EXTENDED, OR REPAIRED BEFORE USING.
  - B. USE PURGING AND DISINFECTING PROCEDURES PRESCRIBED BY AUTHORITIES HAVING JURISDICTION; IF METHODS ARE NOT PRESCRIBED, USE PROCEDURES DESCRIBED IN EITHER ANWA C651 OR ANWA C652 OR FOLLOW PROCEDURES DESCRIBED BELOW.
  - C. FLUSH PIPING SYSTEM WITH CLEAN, POTABLE WATER UNTIL DIRTY WATER DOES NOT APPEAR AT OUTLETS.
  - D. FILL AND ISOLATE SYSTEM ACCORDING TO EITHER OF THE FOLLOWING:
    - E. FILL ENTIRE SYSTEMS OR PART THEREOF WITH WATER/CHLORINE SOLUTION WITH AT LEAST 50 PPM OF CHLORINE. ISOLATE WITH VALVES AND ALLOW TO STAND FOR 24 HOURS.
    - F. FILL ENTIRE SYSTEMS OR PART THEREOF WITH WATER/CHLORINE SOLUTION WITH AT LEAST 200 PPM OF CHLORINE. ISOLATE AND ALLOW TO STAND FOR THREE HOURS.
    - G. FLUSH SYSTEM WITH CLEAN, POTABLE WATER UNTIL NO CHLORINE IS IN WATER COMING FROM SYSTEM AFTER THE STANDING TIME.
    - H. SUBMIT WATER SAMPLES IN STERILE BOTTLES TO AUTHORITIES HAVING JURISDICTION. REPEAT PROCEDURES IF BIOLOGICAL EXAMINATION SHOWS CONTAMINATION.
    - I. UPON COMPLETION OF ALL TESTING, CLEANING AND CHLORINATION ALL EXISTING AERATORS ON ALL FAUCETS ARE TO BE REMOVED AND CLEANED AND REINSTALLED.
- N. ALL ELECTRICAL WORK IS TO BE PERFORMED BY A LICENSED ELECTRICIAN. ALL WORK, MATERIALS, ETC. IS TO BE IN ACCORDANCE WITH STATE ELECTRICAL CODE REQUIREMENTS.
- O. SEE SPECIFICATION SECTION 22 0000 PLUMBING FOR ADDITIONAL INFORMATION.
- P. ALL FIRE PROTECTION AND DETECTION DEVICES SHALL BE WRAPPED AND PROTECTED DURING CONSTRUCTION TO PREVENT FALSE ALARMS AND NOTIFICATIONS.
- Q. ALL EXISTING PLUMBING FIXTURES SHALL BE DISCONNECTED, REMOVED, PROTECTED AND STORED DURING CONSTRUCTION, AS REQUIRED TO PERFORM REPLACEMENT OF RISERS AND STACKS WITHIN PLUMBING CHASES. AT ALL LAVATORIES ALL EXISTING TRAPS, SUPPLIES AND STOPS ARE TO BE REMOVED AND DISPOSED.
- R. UPON COMPLETION OF PIPING AND NEW WALL CONSTRUCTION, AS PART OF PLUMBING FIXTURE REINSTALLATION PROVIDE NEW P-TRAPS, SUPPLIES, STOPS, ALONG WITH NEW WATER CLOSETS WAX GASKET, BRASS NUTS AND BOLTS AND NEW BOLT CAPS AS SPECIFIED

**1 BASEMENT PLUMBING PLAN - GORHAM**  
1/8"=1'-0"

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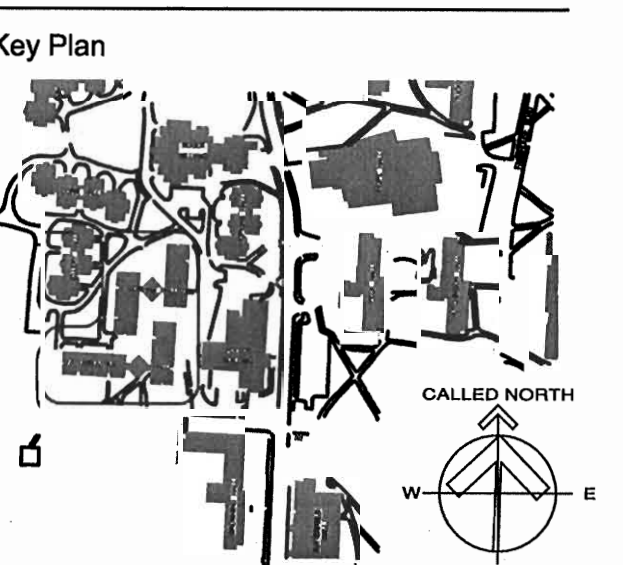
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KINGSTON, RI



Seals  
**CONSTRUCTION DOCUMENTS**

Issues	Date	Description

Revisions	No.	Date	Description

Drawing Title

**BASEMENT PLUMBING - GORHAM**

Issue Date:	01/30/2015
Project No:	UR120N Scale: AS NOTED
Project Manager:	WA Production Leader: RCN
Project Architect:	MT Peer Reviewer:

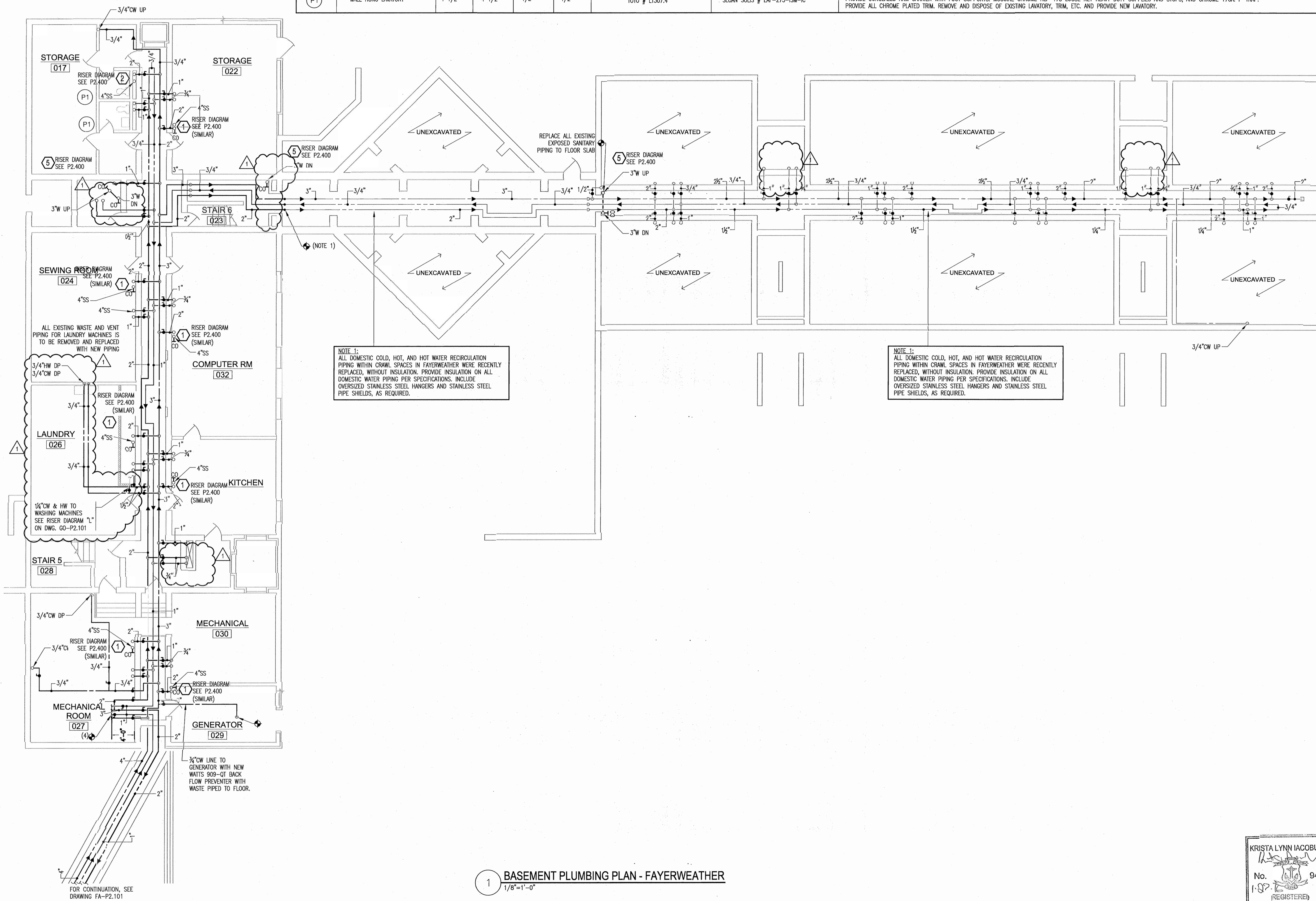
Drawing Number

**GO-P2.101**

KRISTA LYNN IACOBUCCI  
No. 9455  
REGISTERED PROFESSIONAL ENGINEER MECHANICAL

PLUMBING FIXTURE SCHEDULE

SYMBOL	DESCRIPTION	CONNECTIONS				FIXTURE	FITTINGS	REMARKS
		WASTE	VENT	HOT WATER	COLD WATER			
(P1)	WALL HUNG LAVATORY	1 1/2"	1 1/2"	1/2"	1/2"	TOTO # LT307.4	SLOAN SOLUS # EAF-275-ISM-IC	VITREOUS CHINA, 4" CENTERS. FAUCET SOLAR OPERATED FAUCET HOLES TO SUIT LAVATORY FLOWING AT .5 GPM. PROVIDE MCGUIRE GRID STRAINER WITH OVERFLOW. PROVIDE CONCEALED ARM CARRIER WITH FOOT SUPPORTS, MCGUIRE CHROME HLF-175 LOOSE KEY HEAVY DUTY SUPPLIES AND STOPS, AND CHROME 17GA. P-TRAP. PROVIDE ALL CHROME PLATED TRIM. REMOVE AND DISPOSE OF EXISTING LAVATORY, TRIM, ETC. AND PROVIDE NEW LAVATORY.



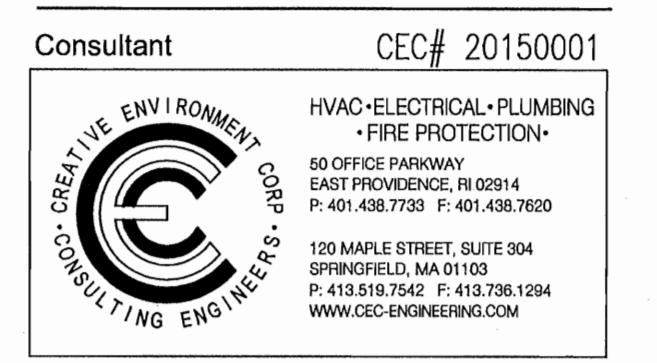
NOTE 1:  
ALL DOMESTIC COLD, HOT, AND HOT WATER RECIRCULATION PIPING WITHIN CRAWL SPACES IN FAYERWEATHER WERE RECENTLY REPLACED, WITHOUT INSULATION. PROVIDE INSULATION ON ALL DOMESTIC WATER PIPING PER SPECIFICATIONS. INCLUDE OVERSIZED STAINLESS STEEL HANGERS AND STAINLESS STEEL PIPE SHIELDS, AS REQUIRED.

NOTE 1:  
ALL DOMESTIC COLD, HOT, AND HOT WATER RECIRCULATION PIPING WITHIN CRAWL SPACES IN FAYERWEATHER WERE RECENTLY REPLACED, WITHOUT INSULATION. PROVIDE INSULATION ON ALL DOMESTIC WATER PIPING PER SPECIFICATIONS. INCLUDE OVERSIZED STAINLESS STEEL HANGERS AND STAINLESS STEEL PIPE SHIELDS, AS REQUIRED.

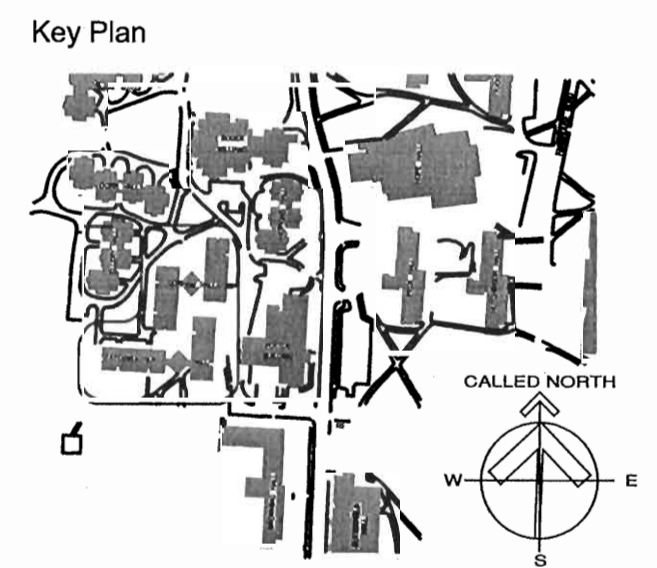
1 BASEMENT PLUMBING PLAN - FAYERWEATHER  
1/8"=1'-0"



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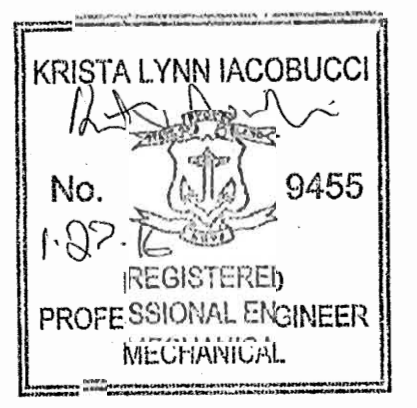
Issues	Date	Description

Revisions	No.	Date	Description

Drawing Title  
**BASEMENT PLUMBING-FAYERWEATHER**

Issue Date:	01/30/2015
Project No:	URI20IN
Scale:	AS NOTED
Project Manager:	WA
Production Leader:	RCN
Project Architect:	MT
Peer Reviewer:	

Drawing Number  
**FA-P2.102**



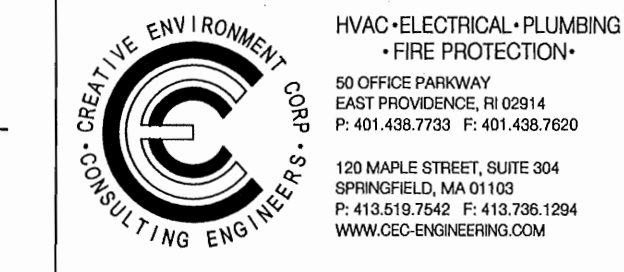


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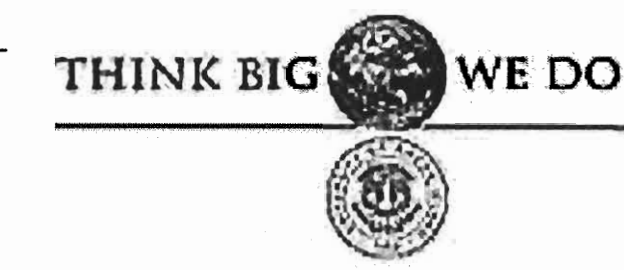
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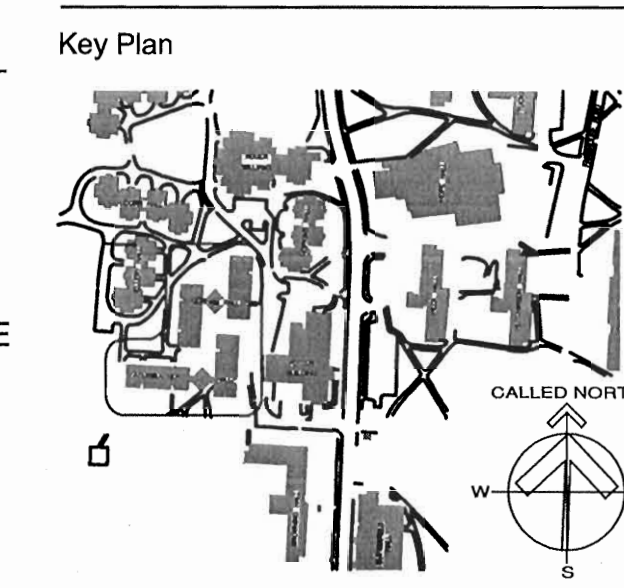
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Seals  
 CONSTRUCTION DOCUMENTS

Issues	Date	Description

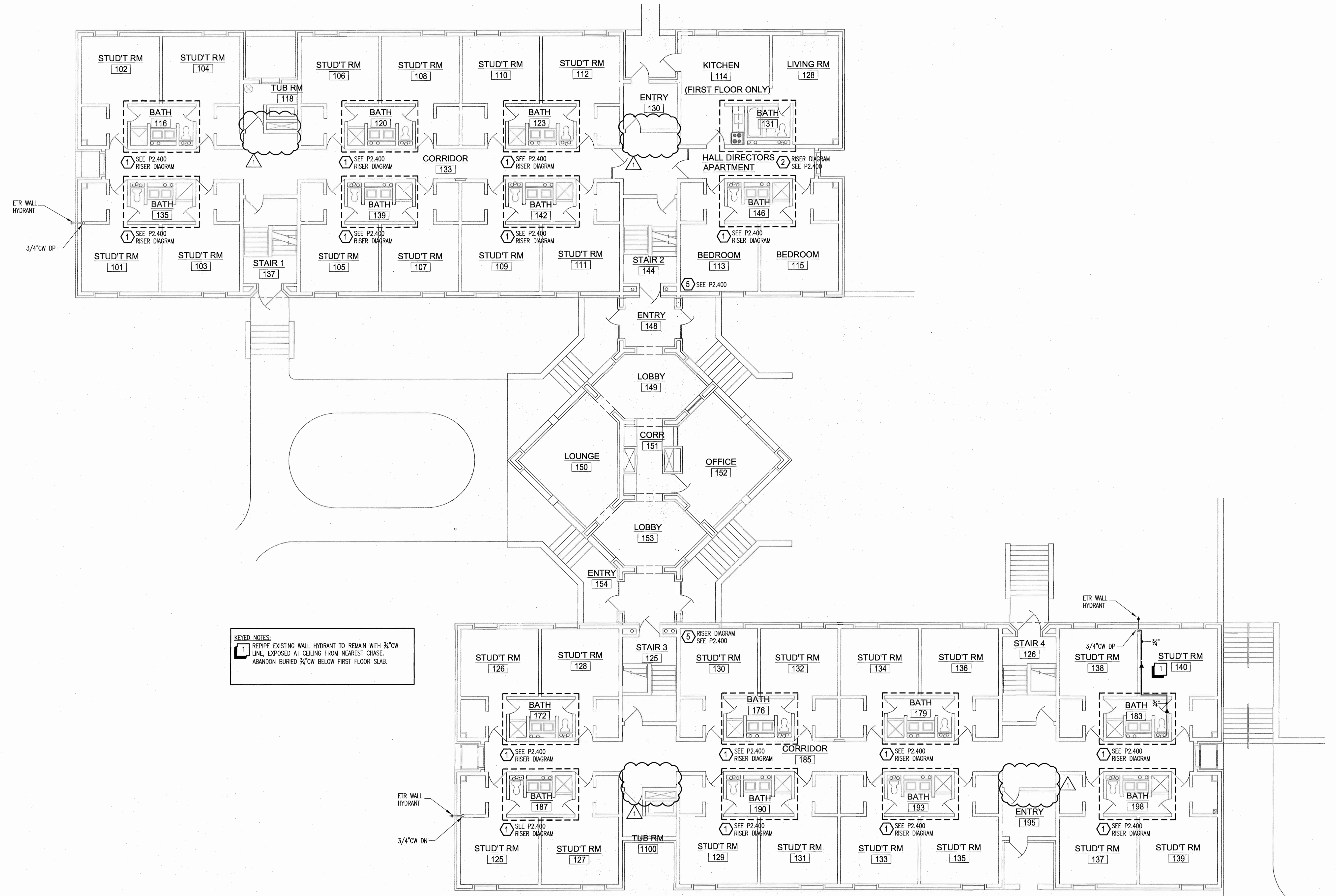
Revisions	No.	Date	Description

Drawing Title

**TYPICAL FLOOR PLANS  
 FIRST THRU FOURTH  
 PLUMBING -  
 GORHAM**

Issue Date: 01/30/2015  
 Project No: UR120N Scale: AS NOTED  
 Project Manager: WA Production Leader: PCN  
 Project Architect: MT Peer Reviewer:   
 Drawing Number

**GO-P2 103**



**KEYED NOTES:**  
 1 REPIPE EXISTING WALL HYDRANT TO REMAIN WITH 3/4" CW LINE, EXPOSED AT CEILING FROM NEAREST CHASE.  
 2 ABANDON BURIED 3/4" CW BELOW FIRST FLOOR SLAB.

1 TYPICAL FLOOR PLANS FIRST THRU FOURTH - PLUMBING - GORHAM  
 1/8" = 1'-0"

KRISTA LYNN IACOBUCCI  
 No. 9455  
 REGISTERED PROFESSIONAL ENGINEER  
 MECHANICAL



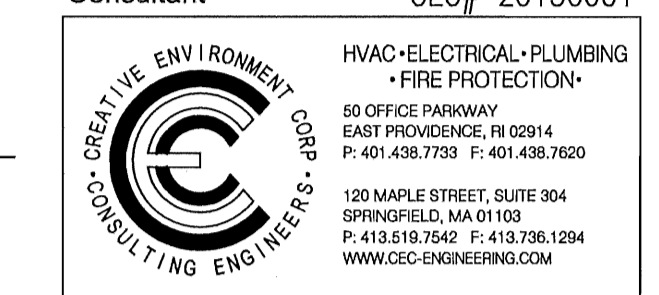
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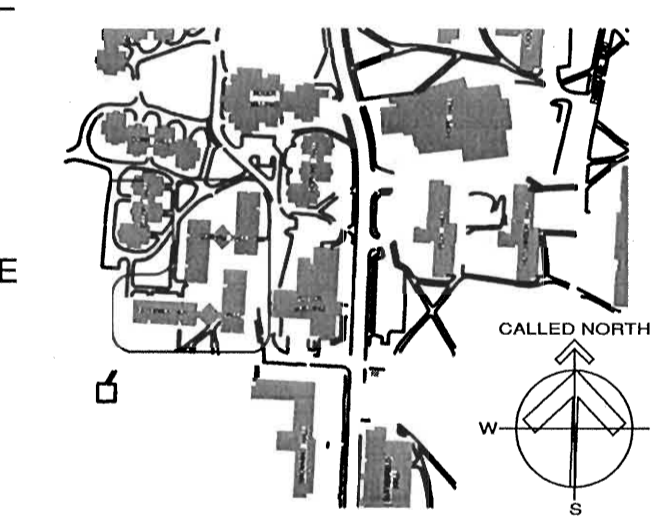
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Key Plan



Seals

CONSTRUCTION DOCUMENTS

Issues	
Date	Description

Revisions		
No.	Date	Description
1	02/25/15	REVISION
2	01/23/16	REPLACE SHEET W/ REVISIONS

Drawing Title

TYPICAL FLOOR PLANS  
FIRST THRU FOURTH  
PLUMBING -  
FAYERWEATHER

Issue Date: 01/30/2015

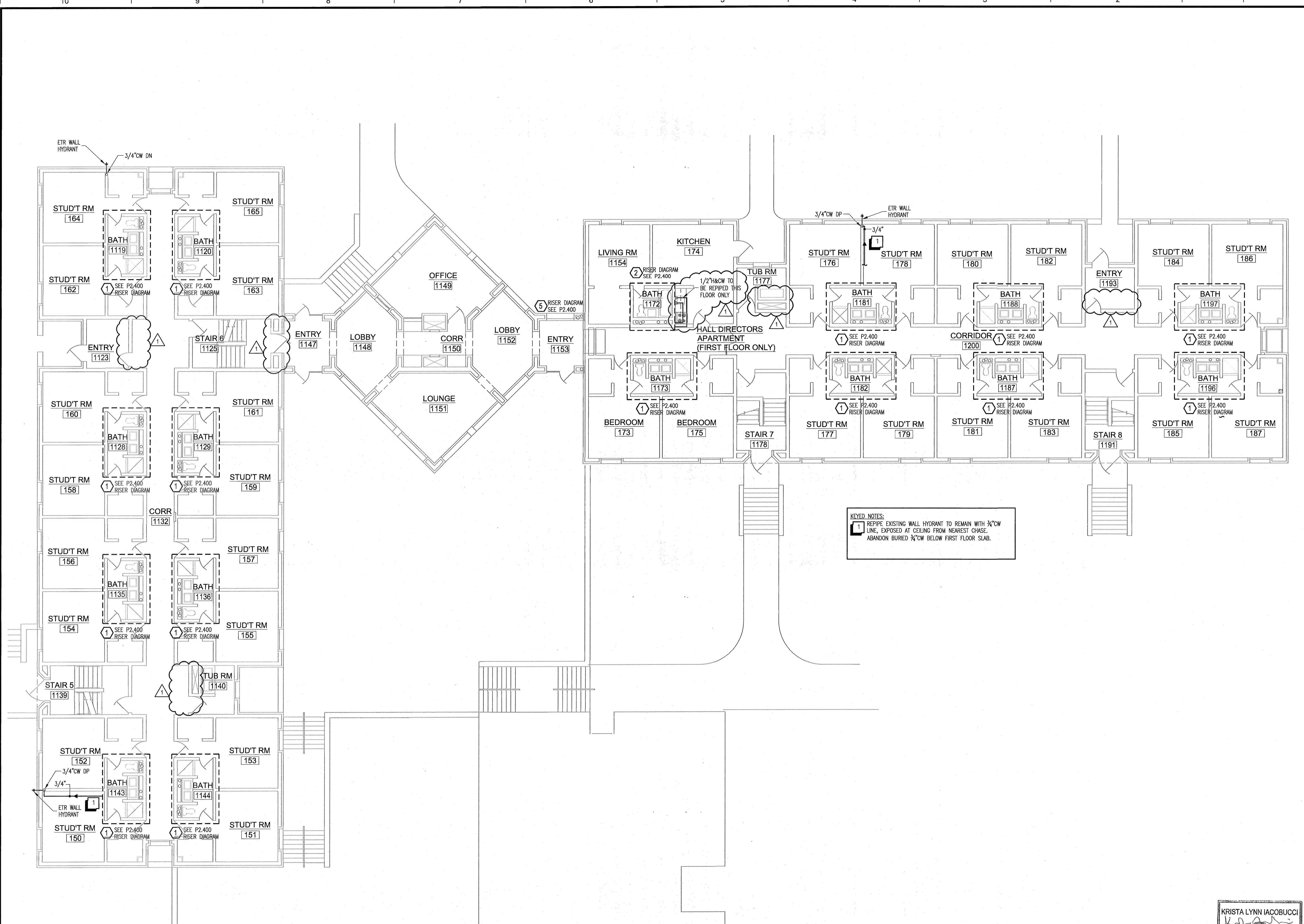
Project No: URI20IN Scale: AS NOTED

Project Manager: WA Production Leader: RCN

Project Architect: MT Peer Reviewer:

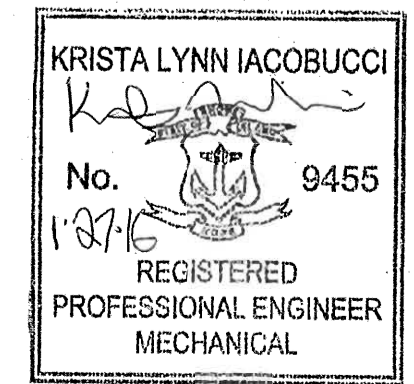
Drawing Number

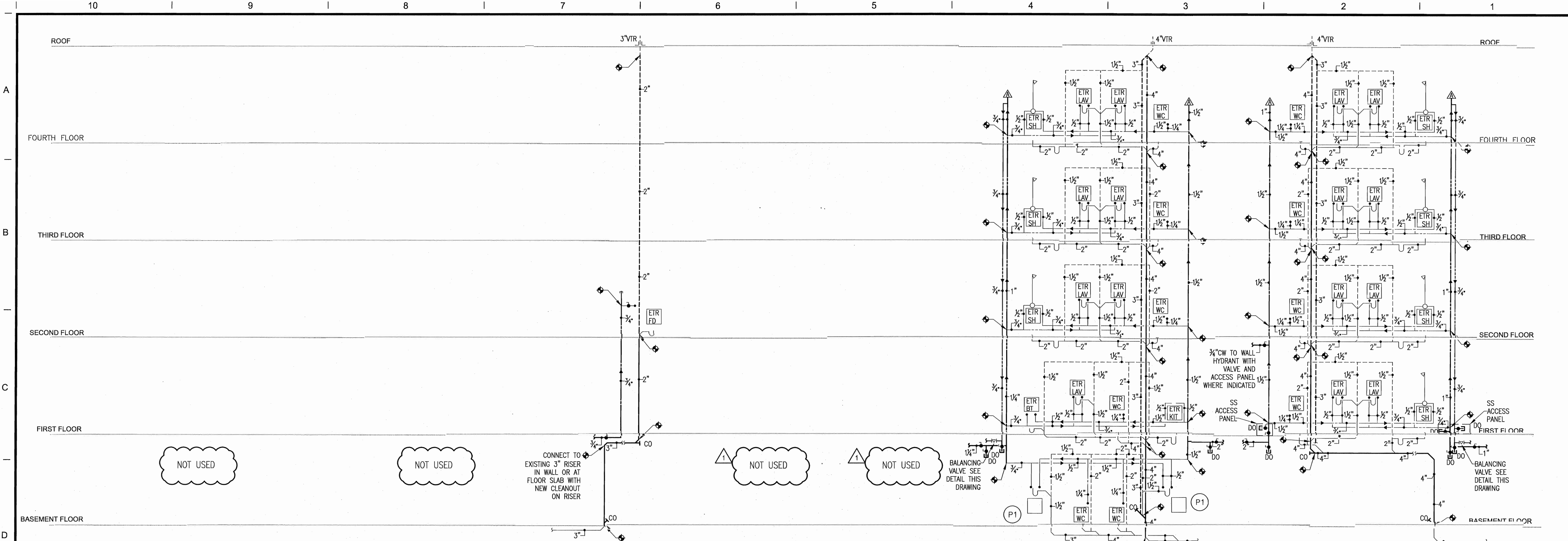
FA-P2.104



KEYED NOTES:  
1 REPIPE EXISTING WALL HYDRANT TO REMAIN WITH 3/4" CW LINE, EXPOSED AT CEILING FROM NEAREST CHASE. ABANDON BURIED 3/4" CW BELOW FIRST FLOOR SLAB.

1 TYPICAL FLOOR PLANS FIRST THRU FOURTH - PLUMBING - FAYERWEATHER  
1/8"=1'-0"





7 RISER DIAGRAM  
NO SCALE

6 RISER DIAGRAM  
NO SCALE

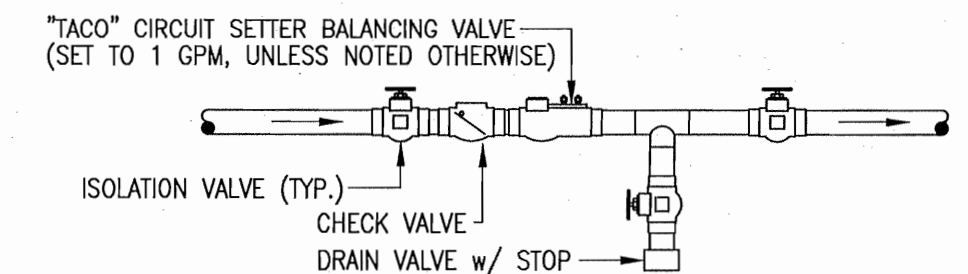
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NO SCALE

4 RISER DIAGRAM  
NO SCALE

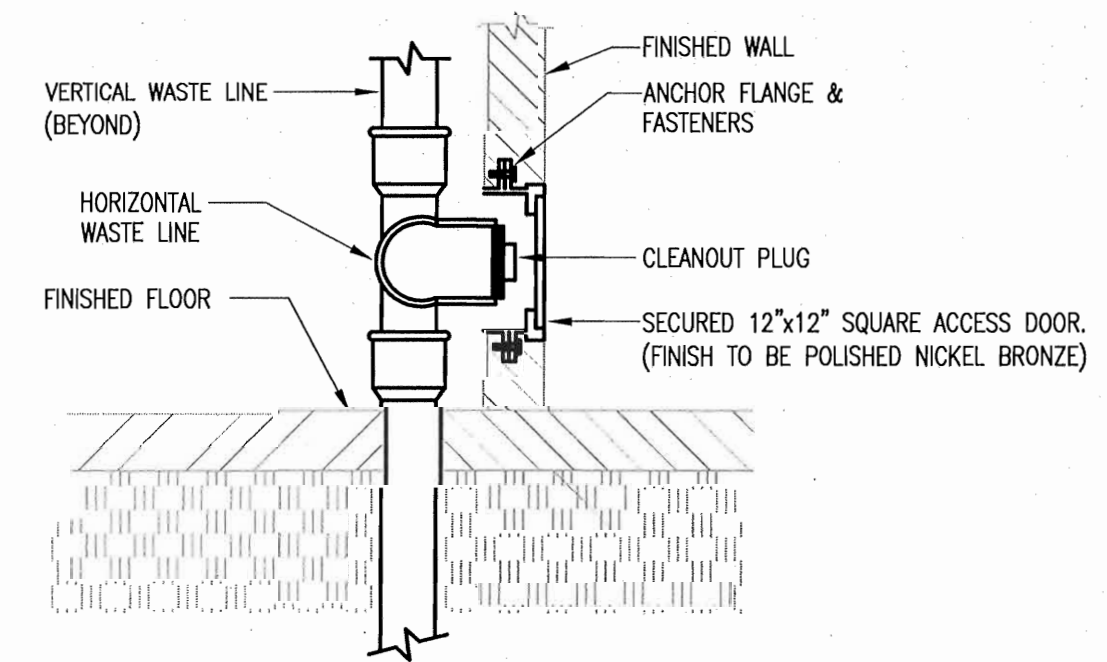
3 RISER DIAGRAM  
NO SCALE

2 RISER DIAGRAM  
NO SCALE

1 RISER DIAGRAM  
NO SCALE



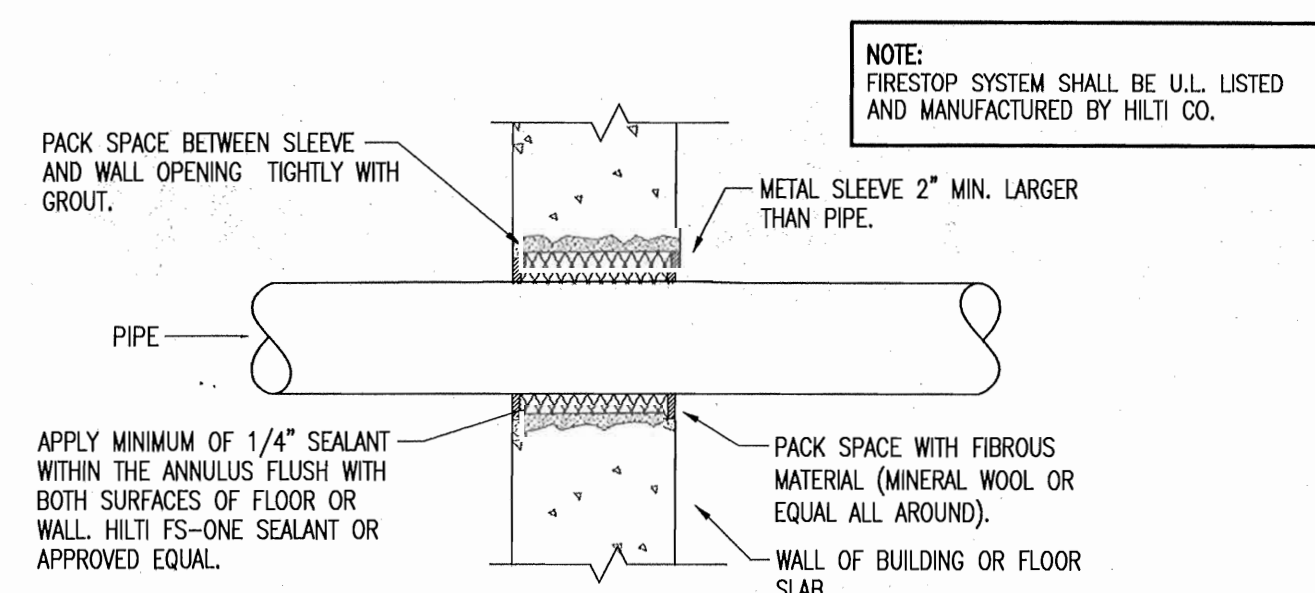
TYPICAL BALANCING VALVE STATION  
@ BASE OF EACH HWR RISER  
NTS



WALL CLEANOUT DETAIL  
NTS

WATER HAMMER ARRESTOR SCHEDULE				
SYMBOL	*J.R. SMITH #	FIXTURE UNITS	PIPE SIZE	REMARKS
△	5005	1-11	3/4"	PROVIDE ACCESS PANEL AS REQUIRED
△	5010	12-32	1"	PROVIDE ACCESS PANEL AS REQUIRED
△	5020	33-60	1"	PROVIDE ACCESS PANEL AS REQUIRED
△	5030	61-113	1"	PROVIDE ACCESS PANEL AS REQUIRED

\*OR APPROVED EQUAL BY ZURN OR JOSAM  
NOTE: PROVIDE WATER HAMMER ARRESTORS AT ALL FIXTURES OR EQUIPMENT WHICH HAVE QUICK-CLOSING VALVES SUCH AS A FLUSH VALVE OR SOLENOID VALVE. PROVIDE WATER HAMMER ARRESTORS WHERE AIR CHAMBERS ARE BEING REMOVED.



- PIPING INSTALLATION NOTES:**
- FIRESTOP SYSTEMS ARE NOT REQUIRED FOR PENETRATIONS THROUGH WALLS WHICH DO NOT HAVE A FIRE RESISTANCE RATING. REFER TO ARCHITECTURAL DRAWINGS FOR LOCATION OF WALLS WHICH HAVE A FIRE-RESISTANCE RATING. ALL VOIDS IN AND AROUND PIPE SLEEVES IN NON-RATED WALLS SHALL BE FILLED WITH MINERAL WOOL TO PREVENT THE MOVEMENT OF SMOKE.
  - THIS CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING CLEARANCE AROUND ALL PIPING FOR SEISMIC PROTECTION AND PIPE SLEEVES WITH FIRESTOP MATERIALS.
  - PIPE SLEEVES SHALL HAVE A NOMINAL DIAMETER 2" LARGER THAN THE NOMINAL DIAMETER OF THE PIPE FOR PIPE SIZES 1" THROUGH 3".
  - PIPE SLEEVES SHALL HAVE A NOMINAL DIAMETER 4" LARGER THAN THE NOMINAL DIAMETER OF THE PIPE FOR PIPE SIZES 4" AND LARGER.
  - FLEXIBLE COUPLINGS ARE ACCEPTABLE ON EACH SIDE OF WALL. THE NOMINAL DIAMETER OF THE SLEEVE SHALL BE ONE PIPE SIZE LARGER THAN THE DIAMETER OF THE PIPE WHEN FLEXIBLE COUPLINGS ARE USED.
  - REFER TO SPECIFICATIONS FOR FIRESTOP MATERIALS TO BE USED. ALL SYSTEMS SHALL BE U.L. LISTED.
  - SLEEVES THROUGH LOAD BEARING WALLS SHALL BE SCHEDULE 40 BLACK STEEL PIPE. OTHER PIPE SLEEVE MATERIALS ARE ACCEPTABLE PROVIDED THEY HAVE BEEN TESTED AS PART OF THE FIRE RATED ASSEMBLY. ALL PIPE SLEEVES THROUGH EXTERIOR WALLS SHALL BE GALVANIZED STEEL.
  - INSTALL AIR RELEASE VALVES AT ALL HIGH POINTS IN PIPING SYSTEM AND DRAIN VALVES AT ALL LOW POINTS.
  - PLUMBING CONTRACTOR SHALL CONSIDER THE ELECTRICAL, MECHANICAL, STRUCTURAL, ARCHITECTURAL AND CIVIL DRAWINGS AS AN INTEGRAL PART OF HIS BID PACKAGE AND SHALL REVIEW ALL ASSOCIATED DRAWINGS AND DETAILS DURING THE BID PROCESS.

WALL PENETRATION DETAIL  
NTS

PLUMBING LEGEND		
SYMBOL	ABV.	DESCRIPTION
---		LIGHT LINES INDICATE EXISTING PIPING
---		HEAVY LINE INDICATE NEW PIPING
---	S/W	SOIL/WASTE PIPE ABOVE FLOOR SLAB
---	V	VENT PIPE ABOVE FLOOR SLAB
---	CW	COLD WATER PIPE
---	HW	HOT WATER PIPE
---	HWR	HOT WATER RECIRCULATION PIPE
---		KEYED NOTED
1		RISER DESIGNATION
△	SV	SHUTOFF VALVE
△	WHA	BALANCING VALVE - SEE DETAIL
△	WHA	WATER HAMMER ARRESTORS - SEE SCHEDULE
□	AP	ACCESS PANEL
□	CTE	CONNECT TO EXISTING
— —		UNION
— —		TEE OFF TOP
— —		TEE OFF BOTTOM
— —		DROP AND RUN
— —		DROP AND TURN
— —		TEE UP
— —		TEE DOWN
— —		PIPE CAP/PLUG
— —	UP	PIPE UP AND / OR RISE
— —	DP/DN	PIPE DROP / DOWN
— —	W&T	WASTE & TRAP
— —		PIPE CONTINUATION
— —	VTR	VENT THRU ROOF
— —	NTS	NOT TO SCALE
— —	VIF	VERIFY LOCATION, SIZE & DIRECTIONAL FLOW IN FIELD
— —	EC	ELECTRICAL CONTRACTOR
— —	GC	GENERAL CONTRACTOR
— —	CO	CLEANOUT
— —	WCO	WALL CLEANOUT
— —	TYP	TYPICAL
— —	ETR	EXISTING TO REMAIN
— —	RE	REMOVE EXISTING
— —	AFS	ABOVE FINISHED FLOOR
— —	WS	WASTE STACK
— —	SS	SOIL STACK

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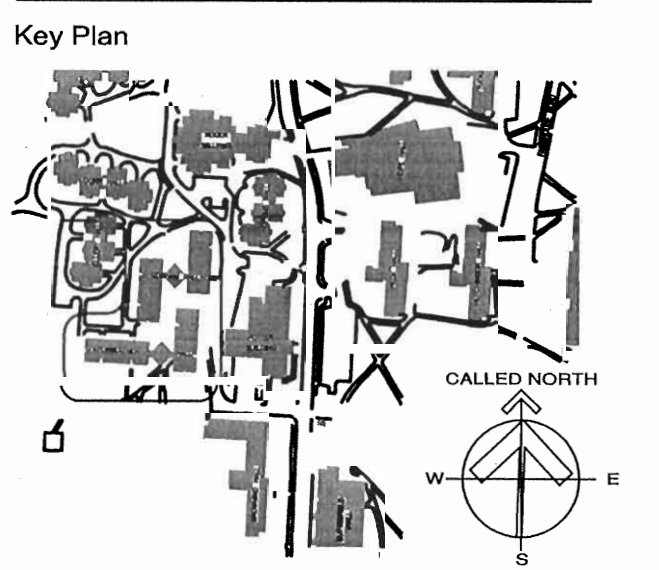
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CONSTRUCTION DOCUMENTS

Issues	
Date	Description

Revisions		
No.	Date	Description
△	02/25/15	REVISION
△	01/23/16	REPLACE SHEET W/ REVISIONS

Drawing Title  
**PLUMBING DETAILS  
AND RISERS  
GORHAM &  
FAYERWEATHER**  
Issue Date: 01/30/2015  
Project No: UR120IN Scale: AS NOTED  
Project Manager: WA Production Leader: RCN  
Project Architect: MT Peer Reviewer:   
Drawing Number

P2.400

