State of Rhode Island
Department of Administration / Division of Purchases
One Capitol Hill, Providence, Rhode Island 02908-5855
Tel: (401) 574-8100 Fax: (401) 574-8387

ADDENDUM # 2

9/18/13
RFQ #7497377

Title: Utility Modifications to Butterfield Hall - URI

Submission Deadline: Wednesday, September 25, 2013 @ 2:00 PM (ET)

Per the issuance of ADDENDUM # 2 the following are noted:

☒ Addendum #2: To the Drawings / Project Manual / Bid Documents
(see attached)

Interested Parties should monitor this website on a regular basis, for any additional information that may be posted.

Gary P. Mosca
Sr. Buyer

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University of Rhode Island
Utility Modifications to Butterfield Hall
(Bid #7497377)
Butterfield Road, Kingston, RI
Architect's Project No. 12027a
September 18, 2013

ADDENDUM No. 2: To the Drawings / Project Manual /Bid Documents for the University of Rhode Island Utility Modifications to Butterfield Hall.

ITEM(S): No. 1 – No. 21

ATTACHMENTS:

Section 000110 – Table of Contents
Section 00410 – Bid Form (Addendum #2 revised 9-18-13)
Section 01201 – Price and Payment Procedures – Attachment A (Addendum #2 revised 9-18-13)
Section 230529 (Addendum #2 revised 9-18-13)
Section 230700 (Addendum #2 revised 9-18-13)
Section 232213 (Addendum #2 revised 9-18-13)
Section 336110 (Addendum #2 revised 9-18-13)
CKS-1 (9/17/13)
Drawings C1.2 & C1.3 (Addendum #2 revised 9-18-13)

PREPARED BY: Vision 3 Architects
225 Chapman Street
Providence, RI 02905

TO: All Bidders of Record

This Addendum No. 2 forms part of the Contract Documents and shall supersede the documents dated May 31, 2013, wherein it contradicts the same.

COPIES TO: All Bidders of Record
Owner

File

QUESTIONS FROM BIDDERS:

ITEM No. 1:

Question: The length of the project is stated at 60 days, the delivery time for the underground Perma Pipe is typically six to eight weeks after release. This will exceed the 60 days for the project.
Answer: The Contract Time has been changed to 90 days from date of contract award. Refer to revised Bid Form – 00410 (attached)

ITEM No. 2:

Question: Should we assume that we will be working in winter conditions? Who would provide snow removal on roads and walkways etc?
Answer: Snow removal within the work zone will be the responsibility of the General Contractor. Snow removal outside the work zone will be the responsibility of the University. Also, some of the insulating materials require special treatment and storage/preparation in heated conditions. Follow the manufacturer's installation instructions specific to the temperature conditions at the time of installation.

ITEM No. 3:

Question: Is there any phasing or sequencing of installing the new utilities and disconnecting the existing
Answer: The University needs to remain functional for as much time as possible. Shutdowns need to be kept to a minimum and shall be coordinated with the University. The steam and condensate services to Adams Hall must remain active during the project. Careful coordination will be required to install the new steam and condensate piping beside the existing piping and at the same elevation in order to maintain the manufacturer's required minimum of 2'-0" of cover and to enter the Adams Steam Room at the correct elevation to connect to existing piping, and avoid existing electrical and storm piping."

ITEM No. 4:

Question: Whose responsibility will it be to purge and isolate pipe lines for tie-in?
Answer: The General Contractor is responsible for this work and all work shall be coordinated with the University. If the site utility installer is different than the interior system installer, the contractor with the interior work contract shall be responsible for the isolation, exterior connection to the new site utility services, purging of the new piping, and changeover of the utilities. The site utility contractor shall coordinate with the interior work contractor to expedite this work.

ITEM No. 5:

Question: The road must be excavated for the gas installation, this will disrupt traffic. Should we assume the road can be shut down? If not, what is expected for traffic control and access etc.?
Answer: Butterfield Road can be closed down to one lane, but cannot be completely shut down. The General Contractor will also be responsible for traffic control. All road work shall be coordinated with the University.

ITEM No. 6: **Question:** The road will also be excavated for the steam work crossing from Adams Hall. The nature of that type of installation will require the road to remain excavated over a period of time. Is it required that the road remain passable by providing road plates, or can the road be shut down
Answer: Butterfield Road can be closed down to one lane, but cannot be completely shut down. The General Contractor will also be responsible for traffic control and road plates as required to maintain traffic flow. All road work shall be coordinated with the University.

ITEM No. 7: **Question:** Drawing # C1.2 labels the gas pipe as "proposed 6" gas main" and at the point it enters the building it is called "proposed 2" gas service" please clarify.
Answer: The six-inch gas main is an extension to the main that is already located in Butterfield Road. The main extension will be capped with a tee at a point just south of the proposed building service. The Building service shall be 2".

ITEM No. 8: **Question:** Please supply piping specifications for the underground gas piping
Answer: Gas main and service shall be PE pipe meeting the Specifications of National Grid.

ITEM No. 9: **Question:** Are there any restrictions on the length and time that existing utilities can be taken out of service?
Answer: The University needs to remain functional for as much time as possible. Shutdowns need to be kept to a minimum and shall be coordinated with the University.

ITEM No. 10: **Question:** Typically elevation profiles are provided for prefabricated piping systems. Since this is a steam system no piping traps can be installed in the piping. Is there information that shows all the utilities with depth information in the proposed area of installation so bidders can ascertain the route of the piping?
Answer: The steam piping route from Adams Hall west to the sidewalk on the east side of the street will follow the existing piping route. There is not as built information for this area. Exploration test pits would be required to determine pipe route (10 minimum, included in the Base Bid). From the sidewalk east to the proposed connection into Butterfield Hall is the proposed new route. Maintain manufacturers cover requirements based on final grading conditions as shown in attached sketch CSK-1.

ITEM No. 11: **Question:** We do not have a specification for the above ground 8" ductile iron pipe after it enters the building. Also would it be required to be insulated to help prevent condensation?

Answer: Once inside the building the 8" ductile iron pipe ties into the existing sprinkler piping. In the Fire Protection specification, SECTION 211000 WATER-BASED FIRE-SUPPRESSION SYSTEMS, Part 3.4 SPRINKLER PIPING APPLICATIONS, Paragraph A, calls for sprinkler piping 4" to 6" shall be Schedule 10 Steel, with grooved ends and joints. The domestic water piping shall be type L copper, as specified in Plumbing specification, SECTION 221116 DOMESTIC WATER PIPING, Part 2.2 COPPER TUBE AND FITTINGS, Paragraph A. Only domestic water is required to be insulated, as specified in Plumbing specification SECTION 220700 PLUMBING INSULATION, Part 2.2 DOMESTIC WATER PIPING, Paragraphs A and B.

ITEM No. 12: **Question:** The Drawings for URI Butterfield also call out a new gas meter can you provide a specification for this meter?
Answer: The gas meter shall be American Meter Company, model AL-1000, similar to existing meter being removed.

CHANGES TO SPECIFICATIONS:

ITEM No. 13: **Section 000110 – Table of Contents**
There are no changes to this section. It may have been left out of your printed copy.

ITEM No. 14: **Section 00410 – Bid Form**
(Refer to attached revised section. Revisions shown in **Bold**)

- Change Contract Time to 90 days from contract award.
- Add $20,000 Allowance for Rock Excavation/Removal.
- Add $70,000 Allowance for the Installation of a new Grease Trap in Butterfield Road.
- Add Unit Price for Test Pits to determine location of existing utilities.

ITEM No. 15: **Section 01201 - Price and Payment Procedures – Attachment A**
(Refer to attached revised section. Revisions shown in **Bold**)
Attachment A was revised to include the following:

- $20,000 Allowance for Rock Excavation/Removal.
- $70,000 Allowance for the Installation of a new Grease Trap in Butterfield Road.

ITEM No. 16: **Section 230529 – Hangers and Supports for HVAC Piping and Equipment**
Add the following item 2.5. (Refer to attached revised section. Revisions shown in **Bold**)

ITEM No. 17: **Section 230700 – HVAC Insulation**
Revise Part 2 Items 2.1 A.3 and 2.2 E.3 (typical notes). (Refer to attached revised section. Revisions shown in **Bold**)

ITEM No. 18: **Section 232213 – Steam and Condensate**

- Revise Item 2.12. (Refer to attached revised section. Revisions shown in **Bold**)
- Add Item 2.13. (Refer to attached revised section. Revisions shown in **Bold**)
- Revise Items 3.2, A & C. (Refer to attached revised section. Revisions shown in **Bold**)
- Add Item 3.13. (Refer to attached revised section. Revisions shown in **Bold**)

ITEM No. 19: **Section 336110 – Leak Detection**
Revise section as noted. (Refer to attached revised section. Revisions shown in **Bold**)

CHANGES TO DRAWINGS:

ITEM No. 20: **Revision to MS1.2**
On plan 1/MS1.2 – Piping Renovations – Butterfield, revise pipe guide note (on left side of plan) to read: "Locate pipe guides and anchors on steam and condensate piping in accordance with spacing as required by the pipe guide and expansion fitting manufacturer. Pipe Guide/Hangers shall be type ASG as manufactured by Mason Industries, Inc"

ITEM No. 21: **Revision to C1.2 and C1.3**
Replace drawings C1.2 and C1.3 with attached revised drawings. Changes to drawings are clouded.

END OF ADDENDUM NO. 2

PROJECT MANUAL

TABLE OF CONTENTS

INTRODUCTORY INFORMATION

BIDDING AND CONTRACT REQUIREMENTS

SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

END OF TABLE OF CONTENTS

DOCUMENT 00410 - BID FORM

Date: _____

To: Dept. of Administration
Division of Purchases
One Capitol Hill
Providence, RI 02908

Project: Utility Modifications to Butterfield Hall
University of Rhode Island, Kingston Campus

Submitted by: _____
(include address,
tel. & FAX nos., _____
and license no.
if applicable) _____

1. BID
Having examined the Place of The Work and all matters referred to in the Bid Documents and in the Contract Documents prepared by Vision 3 Architects for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

_____($ _____.)
(written, and numerically)

- We have included the specified Allowances from Section 01200 in Division 1 of the Specifications in the above Bid sum as follows:

Hazardous Materials Testing/Removal Allowance	$20,000
Rock Excavation/Removal	**$20,000**
Installation of new Grease Trap in Butterfield Road	**$70,000**
Total Allowances	**$115,000**

- We have included the required Bid security in the above Bid Sum. We have included 100% Payment and Performance Bonds in the above Bid Sum.

- We have included the original Bid and required additional **"public copy"** if required by Document 00210 – Supplemental Instructions to Bidders.

2. ALTERNATES

We propose to modify the above Bid Sum by the following amount(s) as identified by (a) numbered Alternative(s) specified in Section 01200 of the Specifications, and as may be selected by the Owner:

No Alternates

3. UNIT PRICES

Per Section 01200, provide unit prices/SF or each as noted for the following items:

Ledge Removal - _____($_____/cubic foot)
Test Pits to determine the location of existing utilites - _____($____/per test pit)

4. ACCEPTANCE

This offer shall be open to acceptance and is irrevocable for sixty days from the bid closing date. If this bid is accepted by the Owner within the time period stated above, we will:

- Proceed under the Agreement, subject to compliance with required State regulatory agency approvals as described in the Bid Documents.
- Furnish the required bonds in compliance with amended provisions of the Instructions to Bidders.
- Commence work within seven days after receipt of a Purchase Order from URI Purchasing.

If this bid is accepted within the time stated, and we fail to commence the Work, or we fail to provide the required Bonds, the security deposit shall be forfeited to the Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

In the event our bid is not accepted within the time stated above, the required security deposit shall be returned to the undersigned, in accordance with the provisions of the Instructions to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for an extended period of time.

5. CONTRACT TIME

If this Bid is accepted, we will achieve Substantial Completion of the Work within 90 days of award. We have included all premium time or additional staffing required to accommodate this schedule.

6. LIQUIDATED DAMAGES

Time is of the Essence: If we fail to achieve certification of Substantial Completion at the expiration of the agreed upon Contract Time indicated above, we acknowledge that we will be

assessed Liquidated Damages for each calendar day the project continues to be in default of Substantial Completion, as follows:

$ 1,000 per calendar day.

7. REQUIREMENT FOR LICENSE NUMBER
In compliance with the requirements of Rhode Island General Law, Section 5-65-23, my Rhode Island license number for the work to be performed by this firm as prime contractor is:

LICENSE NUMBER: _____ .

8. ADDENDA
The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

Addendum No. 1, dated _____
Addendum No. 2, dated _____

9. BID FORM SIGNATURE(S)

_____
(Bidder's name)

By: _____

Title: _____

Corporate Seal:

END OF DOCUMENT

Attachment A – 01201

A. Allowances

1. Hazardous Materials Testing /Removal Allowance $20,000
2. **Rock Excavation/Removal $20,000**
3. **Installation of new Grease Trap in Butterfield Road $70,000**

B. Testing Allowance

1. N/A

C. Unit Prices

1. Provide costs for Ledge Removal per cubic foot.
2. **Provide costs for Test Pits to determine the location of existing utilites.**

D. Alternates

1. N/A

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 23 05 29

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: Pregalvanized 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. 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 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-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.

2.3 EQUIPMENT SUPPORTS

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

2.4 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.

2.5 ASG SLIDING PIPE GUIDES

A. Sliding pipe guides shall be used to control the axial motion of pipe due to thermal expansion and contraction, to protect expansion joints and vital equipment from lateral offset forces.

B. Sliding pipe guides shall be installed as recommended by the expansion joint manufacturer or in accordance with the Expansion Joint Manufacturers Association (EJMA) guidelines.

C. Sliding pipe guides shall be manufactured with stainless steel wrapping the carbon steel foot where it passes through horizontal U guides similarly lined to prevent corrosion. The base plate shall have multiple holes for bolting to beam flanges or flat surfaces. Bases may be welded in position in lieu of bolting. Height must be adjustable to accept different thicknesses of insulation. Guides shall be professionally load rated for bottom, overhead, side mounted, or riser positioning to provide both load bearing and guiding capabilities. Submittals shall include load ratings in all modes.

D. Guides shall be type ASG as manufactured by Mason Industries, Inc.

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, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: 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.

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 non-insulated 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 non-insulated, 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**
½”	3/8”	5’ - 0”	7’ - 0”
¾”	3/8”	5’ - 0”	7’ - 0”
1”	3/8”	6’ - 0”	7’ - 0”
1¼”	3/8”	7’ - 0”	7’ - 0”
1½”	3/8”	8’ - 0”	9’ - 0”
2”	3/8”	8’ - 0”	10’ - 0”
2½”	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:

PIPING MATERIAL	**MAX. VERTICAL SPACING**
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 23 05 29

SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied jackets.
10. Tapes.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.
4. Division 33 Section "Underground Hydronic Energy Distribution" for loose-fill pipe insulation in underground piping outside the building.
5. Division 33 Section "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.

C. Requirements:

1. Insulate steam and steam condensate piping.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

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

PART 2 PRODUCTS

2.1 STEAM AND STEAM CONDENSATE PIPING

A. Fiberglass pipe insulation shall be by Owens Corning type SSL-II or approved equal, with factory applied all-service jacket (ASJ) and two-component adhesive closure system, rated for a maximum service temperature of 850F. For large pipe sizes where SSL-II is not available, the single adhesive SSL closure may be substituted. Circumferential joints shall be sealed by butt strips having a two-component sealing system. Thickness as follows:

1. Piping 1-1/2" and smaller shall have a minimum insulation thickness of 1-1/2".
2. Piping larger than 1-1/2" shall have a minimum insulation thickness of 3".
3. Insulation thickness is based on a "k" value not exceeding 0.27 Btu per inch/h•ft^2•°F **at 75 degree F mean temperature.**

B. Fittings and valves shall be insulated with pre-formed fiberglass fittings. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers.

C. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.

2.2 STEAM & STEAM CONDENATE PIPING INSULATION WITHIN MANHOLES

A. This specification is general in nature and intended to be used as a guide for design purposes. Refer to the manufactures written installation instruction & product data sheet for additional information & specific installation instructions.

B. All surfaces to be insulated shall be cleaned of all scale, rust, oil, and foreign matter and shall be dry and free of frost prior to and during application of insulation.

C. All testing of piping to be insulated shall be completed prior to the application of any insulation materials.

D. All insulation and accessory materials shall be stored in an area that is dry and protected from the weather before and during insulation application.

E. Insulation: insulation shall be cellular glass insulation manufactured in accordance with ASTM C 552, “standard specification for cellular glass thermal insulation,” the insulation shall be fabricated in half sections wherever possible. For large diameter piping where half sections are not practical, curved side wall segments are preferred. Insulation shall be Foamglas as manufactured by Pittsburgh corning corporation. Thickness as follows:

1. Piping 1-1/2” and smaller shall have a minimum insulation thickness of 1-1/2”.
2. Piping larger than 1-1/2” shall have a minimum insulation thickness of 3”.
3. Insulation thickness is based on a “k” value not exceeding 0.27 Btu per inch/h•ft^2•°F **at 75 degree F mean temperature.**

F. Jacketing: provide a 125 mil thick heat-seal multi-ply laminate consisting of three layers of a polymer-modified bituminous compound separated by glass reinforcement and aluminum foil. Jacketing products shall have 1/2" aluminum, or fiberglass reinforced nylon bands applied 12” on center to the exterior of the wrap jacketing products to minimize slippage of the jacketing. Jacketing shall be Pittwrp as manufactured by Pittsburgh corning corporation. Metal jacket - metal jacket should only be used at support points so that supports such as pipe cradles can be installed on the outside of the metal jacket. The cradle must be banded on the jacket, with the banding located so as not to interfere or restrict pipe movement over the support member. This method results in a continuous membrane over the insulation, with no breaks in the wrap jacketing. Metal jacketing shall be 0.016" smooth aluminum jacket. Bands for metal jacket shall be 0.5" x 0.020" aluminum bands with matching seals.

G. Sealant: when a guide or other support member is welded directly to the pipe the break in the Foamglas insulation/pit wrap jacketing system needs to be sealed from water entry with Pittseal 444n sealant, a non-setting butyl sealant.

H. Valves & fittings: valves & fittings shall be finished using a five-layer application of the Pittcote 300 finish, asphalt cutback mastic and the pc fabric 79 open mesh polyester fabric with a 6 x 5.5 mesh/inch configuration.

PART 3 EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
    4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:

    1. Draw jacket tight and smooth.
    2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches on center.
    3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches on center.
    4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
    5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

    1. For above ambient services, do not install insulation to the following:
        a. Vibration-control devices.
        b. Testing agency labels and stamps.
        c. Nameplates and data plates.
        d. Manholes.
        e. Handholes.

f. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   a. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   b. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   c. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
   d. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   e. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   f. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   g. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

3. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
4. Install removable insulation covers at locations indicated. Installation shall conform to the following:
   a. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
   b. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange

cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

c. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
d. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
e. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches on center. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch on center. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches on center.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.
   a. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

8. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
9. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
10. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches on center. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

11. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch on center. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

12. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
13. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches on center. and at end joints.
D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch circumference limit allows for 2-inch overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.
C. Piping, Concealed:

1. PVC: 20 mils thick.
2. Aluminum, Smooth: 0.016 inch thick.

D. Piping, Exposed:

1. PVC: 20 mils thick.
2. Aluminum, Smooth: 0.016 inch thick.

3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

3.12 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 23 07 00

SECTION 23 22 13

STEAM AND CONDENSATE PIPING & ACESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following for low & high pressure steam and condensate piping:

1. Pipe and fittings.
2. Strainers.
3. Safety valves.
4. Pressure-reducing valves.
5. Steam traps.
6. Thermostatic air vents and vacuum breakers.
7. Moisture Seperator

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. LP Steam Piping: 15 psig.
2. HP Steam Piping: 100 psig
3. LP Condensate Piping: 1 psig @ 250°F
4. HP Condensate Piping: 100 psig @ 350°F
5. Makeup-Water Piping: 80 psig @ 150°F.
6. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
7. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
8. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.3 SUBMITTALS

A. Product Data: For each type of the following:

1. Pressure-reducing and safety valve.
2. Steam trap.
3. Air vent and vacuum breaker.

B. Shop Drawings: Detail, minimum 1/4 inch = 1 foot scale, fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.
C. Field quality-control test reports.
D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
C. Wrought-Copper Fittings and Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.
B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in Part 3 piping applications articles.
C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.
D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.
E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.
F. Stainless-Steel Bellows, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig .
5. Maximum Operating Temperature: 250 deg F.

2.3 JOINING MATERIALS

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

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries, International Inc.
   d. Watts Water Technologies, Inc.
   e. Zurn Plumbing Products Group.

3. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

2.5 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
B. Stop-Check Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.
   b. Jenkins Valves; a Crane Company.
   c. Lunkenheimer Valves.

3. Body and Bonnet: Malleable iron.
4. End Connections: Flanged.
5. Disc: Cylindrical with removable liner and machined seat.
6. Stem: Brass alloy.
7. Operator: Outside screw and yoke with cast-iron handwheel.
8. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
9. Pressure Class: 250.

2.6 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig working steam pressure.

2.7 SAFETY VALVES

A. Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Kunkle
    b. Armstrong International, Inc.
    c. Spirax Sarco, Inc.
    d. Watts Water Technologies, Inc.

3. Disc Material: Forged copper alloy.
4. End Connections: Threaded inlet and outlet.
5. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
6. Pressure Class: 250.
7. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
8. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Cast-Iron Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Kunkle
    b. Armstrong International, Inc.
    c. Spirax Sarco, Inc.
    d. Watts Water Technologies, Inc.

3. Disc Material: Forged copper alloy with bronze nozzle.
4. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
5. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
6. Pressure Class: 250.
7. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
8. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
9. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.8 PRESSURE-REDUCING VALVES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong International, Inc.
2. Hoffman Specialty; Division of ITT Industries.
3. Spirax Sarco, Inc.

C. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.
D. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.
E. Body: Cast iron.
F. End Connections: Threaded connections for valves NPS 2 and smaller and flanged connections for valves NPS 2-1/2 and larger.
G. Trim: Hardened stainless steel.
H. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.
I. Gaskets: Non-asbestos materials.

2.9 STEAM TRAPS

A. GENERAL

1. The condensate removal device shall remove condensate completely and continuously as it is formed in an equipment/steam header. Devices (i.e., traps) which function cyclically are not acceptable.

2. The basic device shall be constructed entirely of non-magnetic 300 series stainless steel. The internal flow path shall converge and diverge in steps to form a modified venturi nozzle. The nozzle shall be no less than 0.5 inches long and shall be inserted from the inlet end in order to prevent dislodging, tampering or unauthorized removal. The cross-sectional area of the discharge shall be no less than 9% of the total cross-sectional area of the exit face of the nozzle. This is to minimize the adherence of solids. The inlet shall be protected by a secondary wire mesh screen. An arrow stamped on the body shall indicate direction of flow.

3. In order to ensure the proper operation of the device the system shall include a strainer with a stainless steel mesh screen to capture particulates. Materials of the strainer body shall be suitable for the steam pressure and temperature in use. There must be a method available to inspect the seating of the screen at the top of the strainer body.

4. A valve to allow for the removal of particulates shall be provided for operating pressures up to 250 psig.

5. As each component, the basic device, the strainer and the blowdown device or valve, must meet the engineering guidelines and specifications for their function, they may not be combined in a simplified body. Devices combining components into one body are not acceptable.

6. The manufacturer shall assemble the three items and perform hydrostatic testing and quality control on the assembly. A test certificate shall be supplied with the assemblies,

B. REQUISITES FOR APPROPRIATE APPLICATION

1. In order to ensure that the device is properly applied at each location, it is imperative that the following data be compiled for each condensate removal point. These items will need to be reported prior to the purchase of the devices. The manufacturer of the device will supply this report after having inspected the site and performed the engineering necessary to provide the report.

2. A detailed schedule of each condensate removal point will list the following:
    - Location – a numbered tag shall be hung, if possible.
    - Description of the existing device for condensate removal.
    - Inlet steam pressure and back pressure, including vacuum or hydraulic head.
    - If the steam supply is at a constant pressure or is modulated (i.e., with a control valve).
    - Detailed information of the steam equipment being drained by the existing device. This shall be sufficient to properly apply the device This may require the following: Classification of the equipment. Profile of the condensate load of the equipment.

C. PRODUCT FABRICATION

1. Complete factory pre-assembled and hydrostatically tested assemblies.
2. Each assembly is boxed with the pipe size and model number on the box.

D. INSTALLATION

1. The installer of the device shall have a minimum of five years experience in working with steam and condensate piping systems. This experience must involve the actual installation of this device. In further discussions of the installation, “manufacturer’s installer” will be used to describe either the product manufacturer or an approved subcontractor who is to perform the installation.
2. In some cases, the end-user or a subcontractor will perform the installation. Instruction in and the inspection of the installation of the assemblies are provided by the manufacturer. Any assemblies installed in improper locations or with improper techniques will be corrected by the manufacturer’s installer.
3. Manufacturer’s field engineer shall be on site and the steam system brought to operating pressure when the installation is complete. This allows the engineer to check for leaks, open bypass valves or other conditions which must then be corrected.
4. Standard piping practice is to be used to pipe the devices in place. Detailed items are as follows:
5. The device may be installed horizontally. It may also be installed in a vertical drop or a downward pitch. It should not be installed to allow vertical flow upward through the device. If a condensate lift is required, the piping shall rise after the discharge of the device.
6. If condensate shall be lifted vertically, a check valve will be installed at the bottom of the lift.
7. For low pressure or modulated supply pressure applications, the device should be suitably below the lowest point of the equipment drained such that enough static head is available for condensate drainage, via gravity, to be possible.
8. Bypass lines to the device are not recommended, but are optional. If required, the shut off valve on the bypass line must be of the globe type so that a tight disk-to-seat-ring contact is possible under all operating conditions. The shut off valve must be inspected prior to the steam system start up in order ensure that it is closed. The bypass must not restrict the blowing down of the strainer.
9. To drain distribution lines, the hydraulic head should be maximized to increase drainage at start up.

2.10 MOISTURE SEPERATOR

A. Moisture Separator shall be of the high efficiency internal baffle type having a pressure drop that does not exceed an equivalent length of pipe. Separator shall be of steel construction in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code. ASME Code Stamped for maximum working pressures of 150, 300, or 600 psig. A screwed bottom drain connection shall be provided for the installation of a trap to discharge accumulated liquid. A Float Operated Drain Trap and "Y" Type Strainer shall be installed on the drain connection.

2.11 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Barnes & Jones, Inc.
   c. Hoffman Specialty; Division of ITT Industries.
   d. Spirax Sarco, Inc.

3. Body: Cast iron, bronze, or stainless steel.
4. End Connections: Threaded.
5. Float, Valve, and Seat: Stainless steel.
6. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
7. Pressure Rating: 125 psig.
8. Maximum Temperature Rating: 350 deg F.

B. Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Dunham-Bush, Inc.
   c. Hoffman Specialty; Division of ITT Industries.
   d. Spirax Sarco, Inc.

3. Body: Cast iron, bronze, or stainless steel.
4. End Connections: Threaded.
5. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
6. O-ring Seal: EPR.
7. Pressure Rating: 125 psig.
8. Maximum Temperature Rating: 350 deg F.

2.12 PRE-INSULATED UNDERGROUND STEAM & STEAM CONDENSATE PIPING

A. Furnish a complete **FRP** jacketed system of factory pre-insulated steel piping for the specified service. The system shall be Multi-Therm 750 as manufactured by Perma-Pipe or prior approved equal **with complete leak detection and location system**. All

pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the pre-insulated piping system manufacturer. **The pipe insulation shall have an overall system R-Value of no less than 6.0, and resulting surface temperature no greater than 75 degrees F at the anticipated operating temperatures.**

B. A complete layout of the system, showing anchors, expansion provisions, and building entrance details, shall be provided by the pre-insulated pipe manufacturer. Means for expansion must be made in pipe offsets or loops.

C. All underground distribution lines as shown on the contract drawings shall be MULTI-THERM 750 SUPREME as manufactured by PERMA-PIPE. The system supplier shall have at least ten years' experience fabricating underground high temperature distribution systems. All straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions. Each system layout shall be computer analyzed by the piping system manufacturer to determine stresses and movements of the service pipe. The system design shall be in strict conformance with ANSI B31.1, latest edition, and stamped by a Registered Professional Engineer.

D. SERVICE PIPE: Internal piping shall be standard weight carbon steel, except for condensate piping which shall be schedule 80. Pipe shall be butt welded for sizes 2.5 inches and larger and socket welded for 2 inches and below. Where possible, straight sections shall be supplied in 40 foot random lengths with 6 inches of piping exposed at each end for field joint fabrication.

E. SUB-ASSEMBLIES: End seals, gland seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the system. All subassemblies shall be designed to allow for complete draining and drying of the conduit system.

F. SERVICE PIPE INSULATION: Service pipe insulation shall be Pyrogel® XT as manufactured by Aspen Aerogels. Pyrogel® XT is a high temperature insulation blanket formed of silica aerogel and reinforced with a non-woven, glass-fiber batting. The insulation shall be held in place by stainless steel bands or staples installed not more than 18 inches apart.

G. PIPE SUPPORTS: All pipes within the outer conduit shall be supported to allow for continuous drainage of the conduit in place. Supports shall be the type where Pyrogel® XT insulation thermally isolates the service pipe from the outer conduit. No calcium silicate or other type of insulation shall be allowed. The surface of the support insulation shall be protected by a steel sleeve not less than 12 inches long.

H. OUTER CONDUIT: The steel conduit casing shall be smooth wall, welded steel conduit of the thicknesses specified below:

Conduit Size	Conduit Thickness
6"-26"	10 Gauge
28"-36"	6 Gauge
38"-42"	4 Gauge

Changes in casing size, as required at oversized casing to allow for service pipe expansion shall be accomplished by eccentric and/or concentric fittings and shall provide for continuous drainage

I. The exterior steel conduit surface shall be abrasive blast-cleaned to a minimum of a near white surface, SSPC-SP10-63T. Profile must be a minimum of 1.5 mil peak to valley range. Any areas of rust bloom or oil shall be wiped and reblasted. After blasting, the steel conduit shall be coated with Epoxy, Urethane Elastomer, or Zinc as recommended by the Manufacturer for the site conditions.

1. The epoxy coating shall be a two part coating consisting of a base material and curing agent spray applied to a minimum thickness of 8-12 mils. The coated conduit shall be holiday tested at 1,000 volts to ensure a void free coating. Areas of the conduit not passing the holiday test shall be patch coated and retested.

2. The urethane elastomer coating shall be a sprayable two component, aromatic, corrosion protection elastomeric coating applied to a minimum thickness of 20 mils. The coated conduit shall be holiday tested at 2,500 volts to ensure a void free coating. Areas of the conduit not passing the holiday test shall be patch coated and retested.
3. The zinc coating shall be a high solids inorganic zinc rich coating that protects the steel galvanically, thus eliminating sub-film corrosion. The zinc coating shall be a two part sprayable coating consisting of a liquid base portion and a dry powdered metal. The two components when mixed together can be spray applied. The dry film thickness shall be in a range of 2 to 4 mils.

J. OUTER CONDUIT INSULATION: Conduit insulation shall be spray applied polyurethane foam having a minimum density of 2 lbs/ft^3 for the straight lengths and fittings. The insulation thickness shall be 1 inch maximum. The polyurethane foam shall have a maximum initial K value of 0.18, minimum density of 2 lbs/ft^3 and a minimum closed cell content of 90%.

K. OUTER CONDUIT JACKET: The outer jacket shall be fiberglass reinforced polymer (FRP) and shall be applied directly onto the urethane foam insulation. No PVC or polyethylene jacket shall be allowed. All straights and fittings shall be factory jacketed.

L. DIFFUSION BARRIER: An aluminum diffusion barrier shall be applied on the outside of the insulation before application of the outer jacket. The barrier shall prevent the diffusion of the blowing agent out of the foam to prevent the foam from aging. The diffusion barrier shall be of composite construction with a minimum 12 micron aluminum layer sandwiched between two layers of polyethylene each a minimum of 50 microns thick. The polyethylene layers shall be corona treated to guarantee bonding between the foam insulation and the outer jacket.

M. Underground systems shall be buried in a trench not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted back fill placed over the top of the pipe will meet H-20 highway loading.

N. Trench bottom shall have a minimum of 6” of sand or rounded smooth, maximum 14” O.D. Pea gravel material as a cushion for the piping. All field-cutting of the pipe shall be performed in accordance with the manufacturer's installation instructions.

O. A hydrostatic pressure test of the service pipe and outer conduit jacket shall be performed per the engineer's specification with a factory recommendation of one and one-half times the normal system operating pressure for not less than two hours. Care shall be taken to insure all trapped air is removed from the system prior to the test. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.

P. A certified manufacturer's representative or company field service technician shall be on-site to check unloading, storing and handling of pipe, pipe installation, pressure testing, field joints, and back filling techniques.

2.13 LEAK DETECTION SYSTEM FOR PRE-INSULATED UNDERGROUND STEAM & STEAM CONDENSATE PIPING

A. Furnish complete leak detection and location system consisting of a microprocessor based monitoring unit, sensor cables, probes, system layout map and auxiliary equipment required to provide continuous monitoring of the sensing string(s) for leaks, shorts, breaks and probe activations. If any of these conditions should occur at any point along the cable, an alarm shall sound, type of condition and location shall be clearly identified. Systems that lose accuracy or alarm due to build up of dust, dirt or other dry containments shall not be acceptable.

B The system shall be the PAL-AT Leak Detection and Location System manufactured by PermAlert, Niles, Illinois, (847)-966-2190. The manufacturer shall have at least ten years experience in supplying leak detection systems.

C. The system shall be UL Listed (USA and Canada), CE certified.

D. The Leak Detection System shall locate the point of origin of the first liquid leak or fault (break/short/probe) within ± 0.25% (0.6% for hydrocarbons) of the sensor string length, or ± 5 feet, whichever is greater. The system shall identify the type of alarm leak/break/short/probe as well as the location. The system shall be able to monitor (detect and locate) with up to 100' of cable wetted without significant inaccuracy in location.

E. Sensing String Length: The system shall be capable of monitoring up to 3,000 feet of cable per sensor string from a single monitoring unit.

F. Multiple Leaks: The system shall be capable of monitoring (detecting and locating) for multiple leaks or additional liquid on the sensor cable.

G. Breaks and Shorts: The system shall be capable of identifying the location of breaks and shorts on the cable. When either of these faults occurs, an alarm shall sound and a display visible on the front of the monitoring unit shall clearly indicate the type of fault, i.e. BREAK or SHORT and display the location of the fault. Systems that cannot detect and identify shorts on the sensor cable are not acceptable.

H. Liquids Detected: The system shall be capable of detecting all liquids, including, but not limited to aqueous, hydrocarbon, conductive and nonconductive liquids.

I. Remote Annunciation: The system shall provide Modbus RTU output and dry contact relays for remote indication of an alarm condition. The relays shall provide indication that no alarm conditions exist, a power failure has occurred, an alarm condition exists but has not yet been silenced, and an alarm condition exists and has been silenced but not cleared or a second alarm has been detected after an alarm has been silenced but not cleared. Two communications ports shall be available via RS-232 and RS485/232 with Modbus RTU and/or ASCII communication protocol to allow central point monitoring and control via a remote computer.

J. Archives: The system shall record significant events in nonvolatile memory. A minimum of 900 events shall be stored. When the memory becomes full, the recorded events shall be deleted from memory on a FIFO basis. Each recorded event shall include the time and date that the event occurred. Archives shall be retrievable through the communication ports.

K. System Status: The system shall continuously provide positive indication that it is monitoring the sensing string and the status of the sensing string. The system clock shall provide the time and date on the LCD of the monitoring panel. The system clock shall be programmable by the user. A time and date indication shall be included for all events recorded in memory.

L. Security: The system shall have assignable password security to provide for varying levels of system access. A minimum of 20 passwords shall be available within the system. The system shall not permit unauthorized modifications to the sensing string to be made (i.e. shortening the cable length) without causing an alarm condition.

M. Sensor Types: The system shall be capable of monitoring sensor cables, probe sensors and switch sensors (such as float switches, pressure switches, etc.) from the same monitoring panel. Language displays (English, German, Spanish and others) shall indicate the status of the system.

N. sensitivity: the system shall not detect incidental liquid contact that is not at least equivalent to a small puddle, 3 inches in diameter. the sensitivity of the system shall be field adjustable to increase or decrease the amount of wetted cable needed to cause an alarm from several inches to several feet.

O. Monitoring Unit: The monitoring unit shall be microprocessor based and capable of monitoring up to 3,000 feet of sensing string per cable, including sensor cable, probes and jumper cable, depending on cable type. The monitoring unit shall indicate when any liquid comes in contact with the sensor cable by sounding an alarm, actuating two output relays, and displaying a message that states a leak has been detected and shows the location of that leak on the sensing string.

1. The monitoring unit shall have a green LED on the front panel to indicate the unit is powered. A 2-line by 40-character backlit LCD shall be visible from the front of the unit to provide system data. A red LED on the front panel shall indicate an alarm condition has occurred.

2. The monitoring unit power requirements shall be 120/240 VAC, 50 VA, 50/60 Hz, -phase or 24 VDC, 24VA. Monitoring units shall be equipped with an RS-232 and an RS485/232 communication ports and a minimum of one power failure relay, one common and one per cable SPDT output relay, rated for 250 VAC, 10 A. The ability to locate a leak shall not depend on battery backed up functions. In the event of power failure, system conditions and parameters shall be stored in nonvolatile memory allowing the unit to automatically resume monitoring, without resetting, upon restoration of power. An on-off switch shall be provided in the panel for servicing.

3. The monitoring unit shall be enclosed in a Type 12 (IP52) enclosure. The unit shall be UL Listed and CE certified.

P. Sensor Cable:The sensor cables shall be suitable for use with the monitoring unit. The sensor cables shall be of coaxial construction consisting of an insulated copper center conductor, a suitable spacer material, and an outer braid.

1. All coaxial sensor center conductors must not be less than 14 AWG for mechanical strength.

2. All cables must be capable of field installation of connectors by trained technicians. The cable shall be available in lengths up to 1,500 feet in bulk spools. All cables must be field repairable by trained technicians. Cable on flat surfaces shall have hold down clips every 8 feet and cable identification tags every 50 feet.

PART 3 EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

A. LP Steam Piping: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
B. LP Condensate Piping above Grade: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
C. LP Condensate Piping below Grade: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
D. All piping shall be installed so as to provide allowances for expansion and contraction and shall be thoroughly cleaned and reamed before erection. Unions or flanges shall be installed at all connections to equipment.

3.2 HP STEAM PIPING APPLICATIONS

A. HP Steam Piping: All high-pressure steam piping (150-psig maximum) shall be Schedule 80 black steel pipe, **seamless**, conforming to ASTM A53. Fitting shall be ASTM B16.3 malleable iron Class 250, or ASTM A234 forged steel welding type, Class 300. Joints shall be threaded or AWS D1.1 welded.

B. HP Condensate Piping above Grade: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints assembled same as steam piping.
C. HP Condensate Piping below Grade: Schedule 80, **seamless,** Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
D. All piping shall be installed so as to provide allowances for expansion and contraction and shall be thoroughly cleaned and reamed before erection. Unions or flanges shall be installed at all connections to equipment.

3.3 ANCILLARY PIPING APPLICATIONS

A. Makeup-water piping installed above grade shall be the following:

1. Drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

B. Makeup-Water Piping Installed below Grade and within Slabs: Annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
C. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blow down drain is installed.
D. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.

E. Vacuum-Breaker Piping: Outlet, same as service where installed.
F. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.4 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.
B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.5 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
C. 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.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping free of sags and bends.
G. Install fittings for changes in direction and branch connections.
H. Install piping to allow application of insulation.
I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
K. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe.
P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
S. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
V. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

    1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.
    2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

3.6 STEAM-TRAP INSTALLATION

A. Install steam traps in accessible locations as close as possible to connected equipment.
B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.7 PRESSURE-REDUCING VALVE INSTALLATION

A. Install pressure-reducing valves in accessible location for maintenance and inspection.
B. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.
C. Install gate valves on both sides of pressure-reducing valves.
D. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.
E. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 23 Section "Meters and Gages for HVAC Piping."
F. Install strainers upstream for pressure-reducing valve.
G. Install safety valve downstream from pressure-reducing valve station.

3.8 SAFETY VALVE INSTALLATION

A. Install safety valves according to ASME B31.9, "Building Services Piping."

B. Pipe safety-valve discharge without valves to atmosphere outside the building.
C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

3.9 HANGERS AND SUPPORTS

A. Install hangers and supports according to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing.
B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

D. Install hangers with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 9 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 9 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 13 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 14 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 15 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 17 feet; minimum rod size, 1/2 inch.

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

1. NPS 1/2: Maximum span, 4 feet; minimum rod size, 1/4 inch.
2. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.10 PIPE 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 ends. 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," Chapter "Pipe and Tube," 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:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. 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.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.11 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install traps and control valves in accessible locations close to connected equipment.
C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
D. Install vacuum breakers downstream from control valve, close to coil inlet connection.
E. Install a drip leg at coil outlet.

3.12 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Perform the following tests on steam and condensate piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

C. Prepare written report of testing.

3.13 LEAK DETECTION SYSTEM

A. The system shall be installed per the manufacturer's recommended installation procedures. All local, state and federal codes and requirements shall be followed. The system shall be installed by properly trained personnel.

B. Graphic Locator Maps: A location map shall be provided with the system by the installing contractor; indicating the "As Installed" system configuration and sensing string layout. Footage along the cable shall be provided as references to locate leaks. Footage shall be based upon Calibration Points taken per Section C.

C. Calibration Point The installing contractor shall be responsible for taking and recording calibration points along the sensing string per the manufacturer's recommended procedures. All cable not in containment piping shall have cable tags every 50 feet.

D Field Test of System: Tests shall be performed to demonstrate the ability of the system to detect and locate breaks, shorts and probes on the sensor string. The cable shall be shorted with the alarm and location verified. Leak testing shall be done per the following procedure to verify operation and ability to work with condensation pools of other static moisture.

1. **Wet the sensor cable near the start of the sensor string and silence/acknowledge the detection/location alarm.**
2. **Increase the amount of cable wet and verify the second alarm and location. Clear the alarm queue.**
3. **Wet the sensor cable near the end of the sensor string with the first location still wetted and silence/acknowledge the detection/location alarm and clear the alarm queue.**
4. **Wet the sensor cable in three additional locations between the first and second leak location with each detection/location alarm being silenced/acknowledged and the alarm queue cleared with all prior leak locations still wetted.**
5. **Prepare and submit a report verifying leak location and detection accuracy for each event. Furnish a history print out of the test results from the panel. Submit TDR traces for each test run to allow verification of wet locations.**

E. Field Technical Assistance: The contractor will provide manufacturer's technical assistance for contractor, training, installation inspection, start up and owner operating and maintenance training. Contractor is to follow the manufacturer's instructions for installation. A time domain reflectometry graph of the cable installation shall be furnished at time of owner training.

END OF SECTION 23 22 13

SECTION 336110

LEAK DETECTION

PART 1 - GENERAL

1.1 Furnish complete leak detection and location system consisting of a microprocessor based monitoring unit, sensor cables, probes, system layout map and auxiliary equipment required to provide continuous monitoring of the sensing string(s) for leaks, shorts, breaks and probe activations. If any of these conditions should occur at any point along the cable, an alarm shall sound, type of condition and location shall be clearly identified. Systems that lose accuracy or alarm due to build up of dust, dirt or other dry containments shall not be acceptable. ~~(Optional:) [The system shall be designed to monitor piping and equipment in a computer room or clean room and shall detect all liquids, which may be present using a single sensor cable.] [The system shall monitor double contained piping, tanks, generator sets, single wall piping and/or trenches.] [The system shall monitor direct buried hydrocarbon sensing cable.]~~

1.2 Manufacturer

The system shall be the PAL-AT Leak Detection and Location System manufactured by PermAlert, Niles, Illinois, (847)-966-2190. The manufacturer shall have at least ten years experience in supplying leak detection systems.

1.3 Approvals

The system shall be UL Listed (USA and Canada), CE certified.
~~When zener barriers are required for intrinsically safe sensor circuits for hazardous areas the components shall be UL Listed (USA and Canada), ATEX and IECEx approved for Class I, Division 1, Groups C & D or Zone 0, Group II B locations.~~

Part 2 Performances

2.1 The Leak Detection System shall locate the point of origin of the first liquid leak or fault (break/short/probe) within ± 0.25% (0.6% for hydrocarbons) of the sensor string length, or ± 5 feet, whichever is greater. The system shall identify the type of alarm leak/break/short/probe as well as the location. The system shall be able to monitor (detect and locate) with up to 100' of cable wetted without significant inaccuracy in location.

For applications requiring U.S. EPA Third Party Approval the system shall be evaluated by an independent third party according to the Third Party Procedures developed according to the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Liquid-Phase Out-of Tank Product Detectors." The evaluation results shall verify the system manufacturer's claim regarding sensitivity, range and other performance data.

2.2 Sensing String Length

The system shall be capable of monitoring up to ~~[7,500]~~ [3,000] feet of cable per sensor string from a single monitoring unit.

2.3 Multiple Leaks

The system shall be capable of monitoring (detecting and locating) for multiple leaks or additional liquid on the sensor cable.

2.4 Breaks and Shorts

The system shall be capable of identifying the location of breaks and shorts on the cable. When either of these faults occurs, an alarm shall sound and a display visible on the front of the monitoring unit shall clearly indicate the type of fault, i.e. BREAK or SHORT and display the location of the fault. Systems that cannot detect and identify shorts on the sensor cable are not acceptable.

2.5 Liquids Detected

The system shall be capable of detecting all liquids, including, but not limited to aqueous, hydrocarbon, conductive and nonconductive liquids~~. (Optional:) [Two cables are to be furnished to detect and differentiate between hydrocarbon/solvents and aqueous liquids.] [Only hydrocarbons are to be detected.]~~

2.6 Remote Annunciation

The system shall provide Modbus RTU output and dry contact relays for remote indication of an alarm condition. The relays shall provide indication that no alarm conditions exist, a power failure has occurred, an alarm condition exists but has not yet been silenced, and an alarm condition exists and has been silenced but not cleared or a second alarm has been detected after an alarm has been silenced but not cleared. Two communications ports shall be available via RS-232 and RS485/232 with Modbus RTU and/or ASCII communication protocol to allow central point monitoring and control via a remote computer.

2.7 Archives

The system shall record significant events in nonvolatile memory. A minimum of 900 events shall be stored. When the memory becomes full, the recorded events shall be deleted from memory on a FIFO basis. Each recorded event shall include the time and date that the event occurred. Archives shall be retrievable through the communication ports.

2.8 System Status

The system shall continuously provide positive indication that it is monitoring the sensing string and the status of the sensing string. The system clock shall provide the time and date on the LCD of the monitoring panel. The system clock shall be programmable by the user. A time and date indication shall be included for all events recorded in memory.

2.9 Security

The system shall have assignable password security to provide for varying levels of system access. A minimum of 20 passwords shall be available within the system. The system shall not permit unauthorized modifications to the sensing string to be made (i.e. shortening the cable length) without causing an alarm condition.

2.10 Sensor Types

The system shall be capable of monitoring sensor cables, probe sensors and switch sensors (such as float switches, pressure switches, etc.) from the same monitoring panel. Language displays (English, German, Spanish and others) shall indicate the status of the system.

2.11 Sensitivity

The system shall not detect incidental liquid contact that is not at least equivalent to a small puddle, 3 inches in diameter. The sensitivity of the system shall be field adjustable to increase or decrease the amount of wetted cable needed to cause an alarm from several inches to several feet.

Part 3 Products

3.1 Monitoring Unit

The monitoring unit shall be microprocessor based and capable of monitoring up ~~to [7,500]~~ [3,000 feet of sensing string per cable, including sensor cable, probes and jumper cable, depending on cable type. The monitoring unit shall indicate when any liquid comes in contact with the sensor cable by sounding an alarm, actuating two output relays, and displaying a message that states a leak has been detected and shows the location of that leak on the sensing string.

The monitoring unit shall have a green LED on the front panel to indicate the unit is powered. A 2-line by 40-character backlit LCD shall be visible from the front of the unit to provide system data. A red LED on the front panel shall indicate an alarm condition has occurred.

The monitoring unit power requirements shall be 120/240 VAC, 50 VA, 50/60 Hz, single-phase or 24 VDC, 24VA. Monitoring units shall be equipped with an RS-232 and an RS485/232 communication ports and a minimum of one power failure relay, one common and one per cable SPDT output relay, rated for 250 VAC, 10 A. The ability to locate a leak shall not depend on battery backed up functions. In the event of power failure, system conditions and parameters shall be stored in nonvolatile memory allowing the unit to automatically resume monitoring, without resetting, upon restoration of power. An on-off switch shall be provided in the panel for servicing.

The monitoring unit shall be enclosed in a Type 12 (IP52) enclosure. The unit shall be UL Listed and CE certified. ~~The Zener Barrier Panel (if required) shall provide connections for intrinsically safe sensor circuits for use in Class I, Division 1, Groups C and D and Zone 0, Group IIB Hazardous Locations. [Optional:] [A NEMA 4X outer enclosure shall be furnished with viewing window for mounting in wet locations.] [A NEMA 7 explosion proof outer enclosure shall be furnished.]~~

3.2 Sensor Cable

The sensor cables shall be suitable for use with the monitoring unit. The sensor cables shall be of coaxial construction consisting of an insulated copper center conductor, a suitable spacer material, and an outer braid.

All coaxial sensor center conductors must not be less than 14 AWG for mechanical strength.

All cables must be capable of field installation of connectors by trained technicians. The cable shall be available in lengths up to 1,500 feet in bulk spools. All cables must be field repairable by trained technicians. Cable on flat surfaces shall have hold down clips every 8 feet and cable identification tags every 50 feet.

~~3.3 Sensor Cable In Polyurethane~~

~~The sensor cable installed in polyurethane foam insulation shall be a twisted-pair design consisting of 2 insulated 1.5 mm^2 insulated copper wires suitable for exposure to temperatures up to 135°C. The sensor cable shall detect water-based liquids. Maximum length of ATP cable sensor string shall be 5,000 feet.~~

Part 4 Installation

4.1 General

The system shall be installed per the manufacturer's recommended installation procedures. All local, state and federal codes and requirements shall be followed. The system shall be installed by properly trained personnel.

4.2 Graphic Locator Maps

A location map shall be provided with the system by the installing contractor; indicating the "As Installed" system configuration and sensing string layout. Footage along the cable shall be provided as references to locate leaks. Footage shall be based upon Calibration Points taken per Section 4.3.

4.3 Calibration Point

The installing contractor shall be responsible for taking and recording calibration points along the sensing string per the manufacturer's recommended procedures. All cable not in containment piping shall have cable tags every 50 feet.

4.4 Field Test of System

Tests shall be performed to demonstrate the ability of the system to detect and locate breaks, shorts and probes on the sensor string. The cable shall be shorted with the alarm and location verified. Leak testing shall be done per the following procedure to verify operation and ability to work with condensation pools of other static moisture.

A. Wet the sensor cable near the start of the sensor string and silence/acknowledge the detection/location alarm.
B. Increase the amount of cable wet and verify the second alarm and location. Clear the alarm queue.
C. Wet the sensor cable near the end of the sensor string with the first location still wetted and silence/acknowledge the detection/location alarm and clear the alarm queue.
D. Wet the sensor cable in three additional locations between the first and second leak location with each detection/location alarm being silenced/acknowledged and the alarm queue cleared with all prior leak locations still wetted.

Prepare and submit a report verifying leak location and detection accuracy for each event. Furnish a history print out of the test results from the panel. Submit TDR traces for each test run to allow verification of wet locations.

4.5 Field Technical Assistance

The contractor will provide manufacturer's technical assistance for contractor, training, installation inspection, start up and owner operating and maintenance training. Contractor is to follow the manufacturer’s instructions for installation. A time domain reflectometry graph of the cable installation shall be furnished at time of owner training.

The contractor is to comply with the manufacturer’s instructions in regards to installation of the system including design requirements.

END OF SECTION 336110

Adams Hall
4 STORY BRICK

PR 12" RCP
S=2.86%
LF=17.5±

PR CB-1
RIM=143.55
INV=141.3

INV=140.8
SILT SACK
EX DCB
RIM=143.42
INV=140.8

PR INV=140.8

PR 8" PVC
S=1.00%
LF=20.0±

PR INV=141.0

PR PAVED CONCRETE SIDEWALK

THRESHOLD ELEV.=159.14

LIMIT OF WORK

SEE L.ARCH PLANS FOR FINALIZED GRADING & BOULDER RETAINING AREAS

ST

FOLLOW EXISTING STEAM PATH

PROPOSED FINAL STEAM PATH AND FINAL GRADING

Scale: 1"=20'
0 10' 20' 40'

CSK-1
9/17/13

General Notes:

1. THE SITE IS LOCATED IN KINGSTON, RHODE ISLAND ON THE CAMPUS OF THE UNIVERSITY OF RHODE ISLAND.
2. THE SITE IS NOT WITHIN A:
   - GROUNDWATER PROTECTION AREA (RIDEM)
   - NATURAL HERITAGE AREAS (RIDEM)
   - NARROW RIVER SPECIAL AREA MANAGEMENT PLAN (CRMC)
   - SALT PONDS SPECIAL AREA MANAGEMENT PLAN (CRMC)
   - GROUNDWATER PROTECTION OVERLAY DISTRICT (TOWN)
3. THERE ARE NO EXISTING STRUCTURES ON THE SITE LOCATED IN THE NATIONAL HISTORIC REGISTER OR THAT HAVE BEEN RECOGNIZED AS HAVING HISTORICAL VALUE. THERE ARE NO KNOWN HISTORIC CEMETERIES LOCATED WITHIN OR ADJACENT TO THE SUBJECT PROPERTY.
4. ALL EXISTING UTILITIES SHOWN ARE FROM VISIBLE INFORMATION, DRAWINGS FROM OTHERS, OR INFORMATION PROVIDED TO DIPRETE ENGINEERING AND ARE SUBJECT TO CHANGE. THE LOCATIONS OF UNDERGROUND PIPES AND CONDUITS HAVE BEEN DETERMINED FROM AFOREMENTIONED PLANS OF RECORD AND ARE APPROXIMATE ONLY. PRIOR TO CONSTRUCTION, THE PROPER UTILITY ENGINEERING DEPARTMENTS SHALL BE CONTACTED AND THE ACTUAL LOCATION OF SUBSURFACE STRUCTURES SHALL BE DETERMINED IN THE FIELD. CALL THE DIG SAFE CENTER TOLL FREE AT 1-888-344-7233, 72 HOURS PRIOR TO EXCAVATION. ANY DAMAGE TO UTILITIES WHICH ARE SHOWN ON THE PLANS OR DETAILED BY DIG SAFE SHALL BE THE SITE CONTRACTORS RESPONSIBILITY.

ADA Notes:

1. ALL IMPROVEMENTS SHALL COMPLY WITH THE "AMERICANS WITH DISABILITIES ACT ACCESSIBILITY GUIDELINES (ADAAG)" BY THE DEPARTMENT OF JUSTICE.
2. MAXIMUM RUNNING SLOPE ALONG ALL ACCESSIBLE PATHS OF TRAVEL SHALL BE 4.5% OR 0.045 '/, AND MAXIMUM CROSS SLOPE ALONG ALL ACCESSIBLE PATHS OF TRAVEL SHALL BE 0.015'/,.
3. MAXIMUM SLOPE IN ALL DIRECTIONS FOR ALL ACCESSIBLE PARKING SPACES AND LOADING AREAS SHALL BE 0.015'/,.
4. A 5'x5' LANDING WITH A MAXIMUM SLOPE OF 1.5% OR 0.015'/, IN ALL DIRECTIONS SHALL BE PROVIDED IN FRONT OF ALL PUBLICLY ACCESSIBLE BUILDING ENTRANCES/EGRESSES.
5. SIDEWALK CURB RAMPS SHALL COMPLY WITH DIPRETE ENGINEERING DETAILS THAT MEET OR EXCEEDING RIDOT STANDARDS 43.3.0, 43.3.1, & 43.4.1 AS SHOWN ON THE DETAIL SHEET.
6. PLEASE NOTE THAT THE GRADING AND PLAN VIEWS AS WELL AS THE STANDARD DETAILS MAY NOT SHOW THE DETAIL NECESSARY TO CONSTRUCT WALKWAYS AND RAMPS TO ADA STANDARDS. THE CONTRACTOR IS RESPONSIBLE TO PROVIDE THE LEVEL OF CARE NECESSARY TO BE CERTAIN THAT THE CONSTRUCTED PRODUCT MEETS ADA STANDARDS. IN THE EVENT OF ANY CONFLICTS THE CONTRACTOR SHALL NOTIFY THE DESIGNER BEFORE CONSTRUCTION FOR ADVICE IN FINDING A RESOLUTION.

Plan References:

1. "UNIVERSITY OF RHODE ISLAND ADDITIONS/ RENOVATIONS TO BUTTERFIELD HALL KINGSTON, RI 02881" TOPOGRAPHIC SURVEY SHEET C1.1" PREPARED BY WELCH ASSOCIATES LAND SURVEYORS INC. DATED 12-21-12.

Grading and Utility Notes:

1. THE CONTRACTOR IS RESPONSIBLE FOR ALL SOIL EROSION AND SEDIMENT CONTROL ONSITE. THE CONTRACTOR IS TO NOTIFY THE DESIGN ENGINEER, ARCHITECT AND UNIVERSITY OF RHODE ISLAND AT LEAST 48 HOURS PRIOR TO THE START OF CONSTRUCTION. THE CONTRACTOR IS TO NOTIFY DIG SAFE 72 HOURS PRIOR TO THE START OF CONSTRUCTION.
2. CONTRACTOR TO OBTAIN ALL FEDERAL, STATE, AND MUNICIPAL APPROVALS PRIOR TO THE START OF CONSTRUCTION.
3. DIPRETE ENGINEERING MAKES NO REPRESENTATION THAT THE UTILITIES SHOWN ON THIS PLAN ARE ALL THE UTILITIES THAT MAY BE PRESENT. THE CONTRACTOR IS RESPONSIBLE FOR DAMAGE TO ANY UTILITIES WHETHER SHOWN ON THIS PLAN OR NOT.
4. CONSTRUCTION TO COMMENCE SUMMER 2013 OR UPON RECEIPT OF ALL NECESSARY APPROVALS.
5. ALL WORK PERFORMED HEREIN SHALL BE GOVERNED BY THE RHODE ISLAND STANDARD SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION AND TOWN OF SOUTH KINGSTOWN STANDARD SPECIFICATIONS AND DETAILS.
6. SEQUENCE OF CONSTRUCTION PROVIDED MAY BE MODIFIED AS FIELD CONDITIONS WARRANT WITH PRIOR APPROVAL FROM THE OWNER OR OWNER'S REPRESENTATIVE.
7. THE CONTRACTOR SHALL COORDINATE WITH ALL OF THE APPROPRIATE UTILITY COMPANIES FOR AGREEMENTS TO SERVICE THE PROPOSED BUILDING. THIS SHALL BE DONE PRIOR TO CONSTRUCTION. NO REPRESENTATIONS ARE MADE BY DIPRETE ENGINEERING THAT UTILITY SERVICE IS AVAILABLE.
8. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING FINISH GRADING AND DRAINAGE AROUND THE BUILDING TO ENSURE SURFACE WATER AND/OR GROUND WATER ARE DIRECTED AWAY FROM THE STRUCTURE.
9. ALL PROPOSED UNDERGROUND UTILITIES SERVING THE SITE AND BUILDINGS TO BE COORDINATED WITH APPLICANT, ARCHITECT, AND ENGINEER PRIOR TO INSTALLATION.
10. ALL TRAFFIC CONTROL SHALL CONFORM TO THE MANUAL FOR UNIFORM TRAFFIC CONTROL DEVICES 2003 INCLUDING ALL REVISIONS.
11. ALL RETAINING WALLS AND STEEP SLOPES ARE SHOWN SCHEMATICALLY ONLY AND DIPRETE ENGINEERING IS NOT PROVIDING THE DESIGN OF THESE ITEMS. THE ACTUAL WALLS AND SLOPES ARE TO BE BUILT UNDER THE DIRECTION OF A GEOTECHNICAL ENGINEER AND CERTIFIED TO THE OWNER PRIOR TO THE COMPLETION OF THE PROJECT. SHOP DRAWINGS TO BE SUBMITTED PRIOR TO CONSTRUCTION.
12. ALL CUT AND FILL AREAS ARE TO BE DONE UNDER THE DIRECTION OF A GEOTECHNICAL ENGINEER WITH TESTING AND CERTIFICATION TO BE PROVIDED TO THE APPLICANT AT THE COMPLETION OF THE PROJECT. DIPRETE ENGINEERING ASSOCIATES, INC. IS NOT PROVIDING THE FILL SPECIFICATION, GEOTECHNICAL ENGINEERING, STRUCTURAL ENGINEERING SERVICES, OR SUPERVISION AS PART OF THESE DRAWINGS.
13. ALL COMPONENTS OF THE WATER SYSTEMS MUST BE ASBUILT PRIOR TO COVERING. ENGINEER TO BE NOTIFIED PRIOR TO COVERING TO SURVEY ASBUILT LOCATIONS. ENGINEER WILL NOT ACCEPT FIELD MEASUREMENTS FROM THE SITE CONTRACTOR.
14. NO STOCKPILING OF MATERIAL TO BE LOCATED IN TRAVEL PATHS AND NO OPEN TRENCHES ARE TO BE LEFT OVERNIGHT.
15. ALL LOAM IN DISTURBED AREAS TO BE STOCKPILED FOR FUTURE USE.
16. ALL EXCESS SOIL, TREES, ROCKS, BOULDERS, AND OTHER REFUSE, SHALL BE DISCARDED OFF SITE IN AN ACCEPTABLE MANNER AT AN APPROVED LOCATION. STUMPS SHALL BE GROUND ONSITE OR REMOVED.
17. NO STUMP DUMPS ARE PROPOSED ONSITE.
18. ALL EXISTING UTILITIES SHOWN ARE FROM VISIBLE INFORMATION, DRAWINGS FROM OTHERS, OR INFORMATION PROVIDED TO DIPRETE ENGINEERING AND ARE SUBJECT TO CHANGE. THE LOCATIONS OF UNDERGROUND PIPES AND CONDUITS HAVE BEEN DETERMINED FROM AFOREMENTIONED PLANS OF RECORD AND ARE APPROXIMATE ONLY. PRIOR TO CONSTRUCTION, THE PROPER UTILITY ENGINEERING DEPARTMENTS SHALL BE CONTACTED AND THE ACTUAL LOCATION OF SUBSURFACE STRUCTURES SHALL BE DETERMINED IN THE FIELD. CALL THE DIG SAFE CENTER TOLL FREE AT 1-888-344-7233, 72 HOURS PRIOR TO EXCAVATION. ANY DAMAGE TO UTILITIES WHICH ARE SHOWN ON THE PLANS OR DETAILED BY DIG SAFE SHALL BE THE SITE CONTRACTORS RESPONSIBILITY.
19. ALL PROPOSED ELECTRICAL WORK SHALL BE PERFORMED PER URI STANDARDS.
20. ALL PROPOSED GAS WORK SHALL BE PERFORMED PER NGRID STANDARDS.

Existing Utilities Legend:

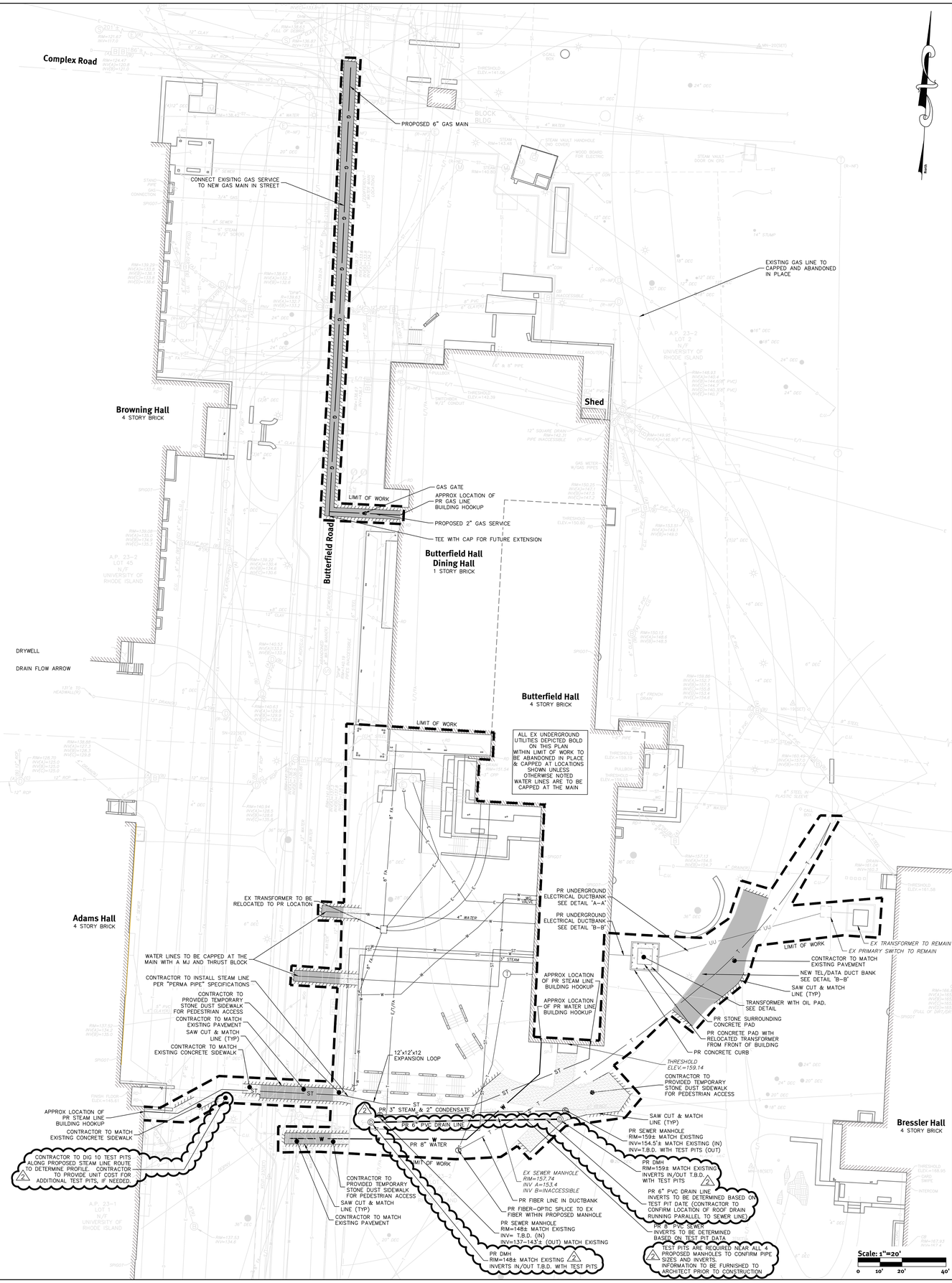
- OVERHEAD WIRES — OHW
- UNDERGROUND ELECTRIC — E — E
- GAS LINE — G — G
- WATER LINE — W — W
- DRAIN LINE — D — D
- WATER VALVE — WV
- HYDRANT
- ELECTRIC MANHOLE — (E)
- DRAINAGE MANHOLE — (D)
- CATCH BASIN — (C)
- LIGHT POLE

Proposed Utilities Legend:

- UNDERGROUND ELECTRIC — UU — UU
- ELECTRIC, TELEPHONE, CABLE LINE — ETC — ETC
- GAS LINE — G — G
- WATER LINE — W — W
- SEWER LINE — S — S
- STEAM LINE — ST — ST
- DRAIN LINE (2) — D — D

Legend:

- LIMIT OF WORK
- ASSESSOR LINE
- SAW CUT/MATCH AREA
- EDGE OF PAVEMENT
- CONCRETE CURB
- CONCRETE (PAD, SIDWALK)
- PAVEMENT
- TEMPORARY STONE DUST
- EX EDGE OF PAVEMENT
- EX BUILDING



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STAMP:

MOLLY R. TITUS
No. 7881
REGISTERED PROFESSIONAL ENGINEER
CIVIL

UNIVERSITY OF RHODE ISLAND UTILITY MODIFICATIONS TO BUTTERFIELD HALL KINGSTON, RI, 02881

PROJECT STATUS:
ISSUED FOR BIDDING

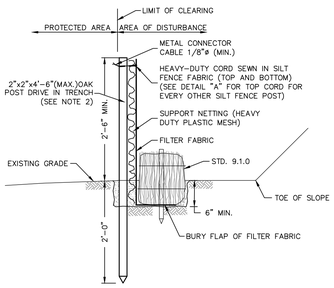
DATE:	5/31/2013
PROJECT NO:	12027a
DRAWN BY:	RBS
CHECKED BY:	MRT

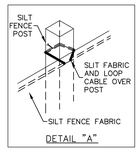
REVISIONS:

9/18/13	RBS	BID SET - ADDENDUM 2

DRAWING TITLE:
UTILITY PLAN

DRAWING NO.:
C1.2



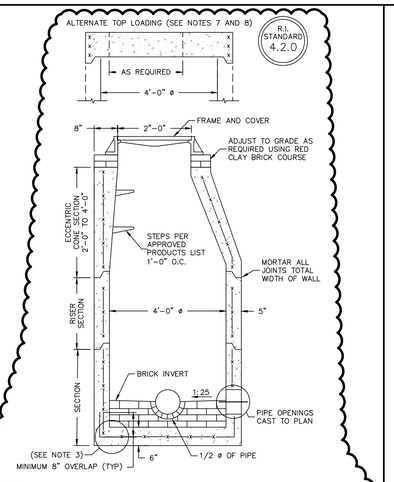


R.I. STANDARD 9.3.0

NOTES:
1. SHALL BE IN ACCORDANCE WITH SECTION 206 OF THE R.I. STANDARD SPECIFICATIONS.
2. STD. 9.1.0 IS INSTALLED "TIGHT" AGAINST SILT FENCE. THOROUGHLY COMPACT EXCAVATED SOILS BACK INTO TRENCH AFTER INSTALLATION OF EROSION CONTROL DEVICE. SILT FENCE FABRIC SHALL NOT BE SLIT. STD. 9.1.0 POST SHALL BE DRIVEN THROUGH SILT FENCE FABRIC. 2"x2"x4'-6" (MAX.) OAK POST FOR SILT FENCE SHALL BE LOCATED 8'-0" (MAX.) O.C. IN WETLAND AREAS AND 4'-0" (MAX.) O.C. IN WETLAND RAVINE, GULLY OR DROP-OFF AREAS AS SHOWN ON PLANS.
3. 1"x1"x4'-6" (MIN.) POSTS PERMITTED FOR PRE-FABRICATED SILT FENCE.
4. SILT FENCE AND BALED HAY SHALL BE INSTALLED BEFORE ANY GRUBBING OR EARTH EXCAVATION TAKES PLACE.
5. TO BE LOCATED AT ALL BASIN OUTFALLS.

BALED HAY EROSION CHECK AND SILT FENCE COMBINED

NOT TO SCALE



R.I. STANDARD 4.2.0

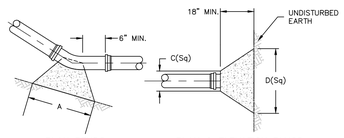
NOTES:
1. SHALL BE IN ACCORDANCE WITH SECTION 702 OF THE R.I. STANDARD SPECIFICATIONS.
2. CIRCUMFERENTIAL STEEL REINFORCEMENT REQUIRED = 0.12 SQUARE INCH/LIN. FOOT MINIMUM.
3. STEEL REINFORCEMENT FOR BASE SECTION BOTTOM SHALL BE A MINIMUM OF 0.12 SQUARE INCH/LIN. FOOT (BOTH WAYS).
4. ONE POUR MONOLITHIC BASE SECTION.
5. ANY NECESSARY ADJUSTMENTS DURING CONSTRUCTION WILL BE DONE BY SAWCUTTING AND/OR CORING ONLY. NO JACKHAMMERS, HAMMERS AND CHISELS OR PNEUMATIC TOOLS WILL BE ALLOWED.
6. STEPS SHALL CONFORM TO STD. 5.3.0 AND SHALL BE INSTALLED AT THE CASTING PLANT.
7. ALTERNATE TOP SLAB IS STEEL REINFORCED TO MEET OR EXCEED H-25 LOADING (SEE STD. 4.7.2).
8. ALTERNATE TOP SLAB IS ONLY FOR USE WHEN REDUCING SECTION DOES NOT FIT BECAUSE OF STRUCTURE DEPTH.
9. REFER TO STD. 5.2.0 FOR MAXIMUM PIPE SIZES.

PRECAST 4'-0" ROUND MANHOLE (2)

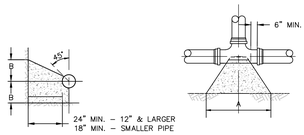
NOT TO SCALE

NOTES:
1. ALL CONCRETE SHALL BE 4000 P.S.I. @ 28 DAYS
2. CONCRETE THRUST BLOCKS SHALL BEAR AGAINST UNDISTURBED EARTH
3. FORMS TO BE USED AS NECESSARY.
4. ALL BOLTS AND NUTS TO BE PROTECTED FROM CONCRETE AND EASILY ACCESSIBLE WHEN THRUST BLOCK INSTALLED
5. REGISTERED PROFESSIONAL ENGINEER IN THE STATE OF RHODE ISLAND SHALL VERIFY CALCULATIONS DURING DESIGN TO MEET CONDITIONS OF PROJECT

SIZE	TEES		PLUGS		90° BEND		45° BEND		22.5° BEND		11.25° BEND	
	A	B	C	D	A	B	A	B	A	B	A	B
6"	20"	10"	10"	21"	24"	12"	18"	9"	13"	7"	9"	5"
8"	26"	13"	12"	26"	32"	16"	24"	12"	17"	9"	12"	6"
10"	34"	17"	14"	34"	40"	20"	30"	15"	22"	11"	15"	8"
12"	41"	20"	16"	41"	48"	24"	35"	18"	25"	13"	18"	9"
16"	54"	27"	20"	54"	64"	32"	47"	23"	34"	17"	24"	12"



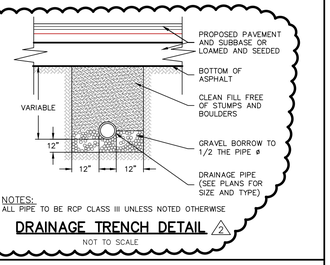
PLAN BENDS — PLAN & ELEVATION PLUGS



BENDS & TEES SECTIONS — PLAN TEES

THRUST BLOCK

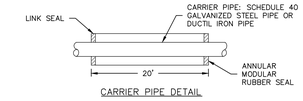
NOT TO SCALE



NOTES:
ALL PIPE TO BE RCP CLASS III UNLESS NOTED OTHERWISE

DRAINAGE TRENCH DETAIL (2)

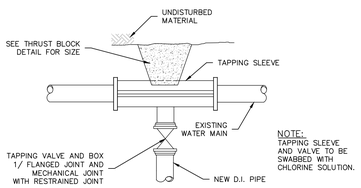
NOT TO SCALE



CARRIER PIPE DETAIL

WATER SLEEVE DETAIL

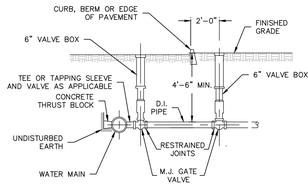
NOT TO SCALE



NOTE:
TAPPING SLEEVE AND VALVE TO BE SWABBED WITH CHLORINE SOLUTION.

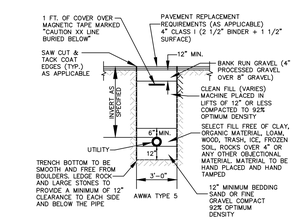
TAPPING SLEEVE AND VALVE

NOT TO SCALE

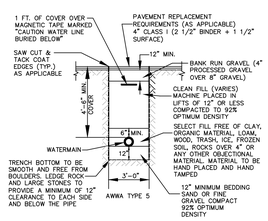


SERVICE CONNECTION GREATER THAN 4 INCHES

NOT TO SCALE

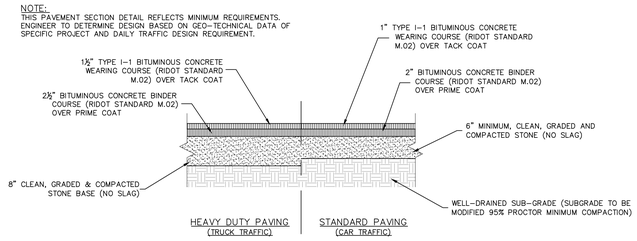


UTILITY TRENCH DETAIL N.T.S.



WATER TRENCH DETAIL N.T.S.

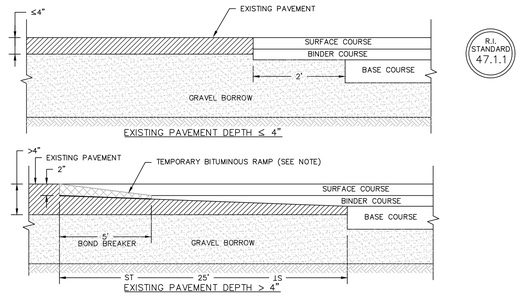
NOTE:
THIS PAVEMENT SECTION DETAIL REFLECTS MINIMUM REQUIREMENTS. ENGINEER TO DETERMINE DESIGN BASED ON GEO-TECHNICAL DATA OF SPECIFIC PROJECT AND DAILY TRAFFIC DESIGN REQUIREMENT.



TYPICAL PAVEMENT SECTION

NOT TO SCALE

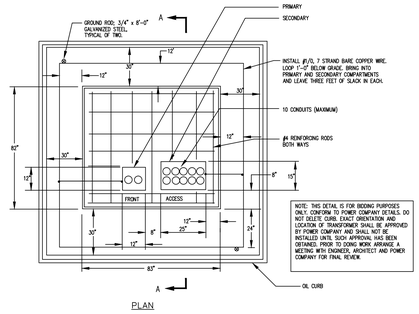
NOTE:
A BOND BREAKER (TAPERED OR EQUIVALENT) WILL BE PLACED 5'-0" FROM THE JOINT AND COVERED WITH THE BINDER COURSE AS THE TEMPORARY RAMP. PRIOR TO PLACING THE SURFACE COURSE, THE BINDER COURSE, AND BOND BREAKER WILL BE REMOVED.



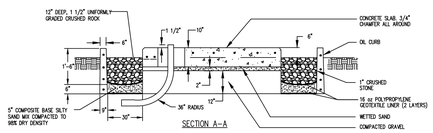
R.I. STANDARD 47.1.1

TRANSVERSE PAVEMENT CUT AND MATCH

NOT TO SCALE



PLAN

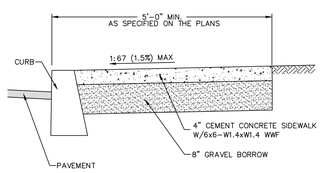


SECTION A-A

TRANSFORMER PAD WITH OIL CURB DETAIL

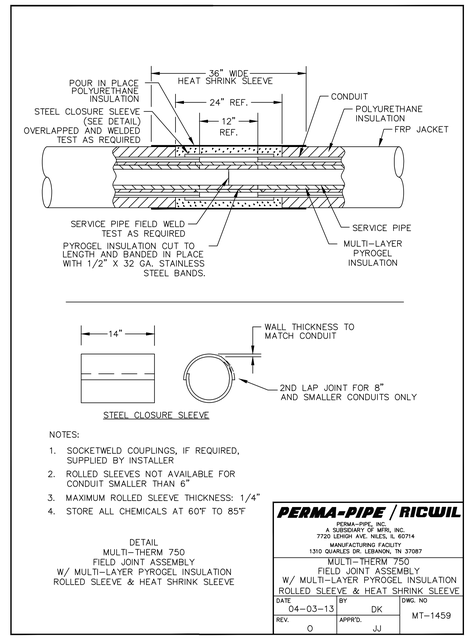
NOT TO SCALE (CONFORM TO POWER COMPANY STANDARDS)

NOTES:
1. SHALL BE IN ACCORDANCE WITH SECTION 905 OF THE R.I. STANDARD SPECIFICATIONS.
2. FOR CURB SETTING DETAIL REFERENCE STD. 7.6.0.
3. MEETS OR EXCEEDS GUIDELINES OF RIDOT STANDARD DETAIL 4.3.1.0.



CEMENT CONCRETE SIDEWALK

NOT TO SCALE



STEEL CLOSURE SLEEVE

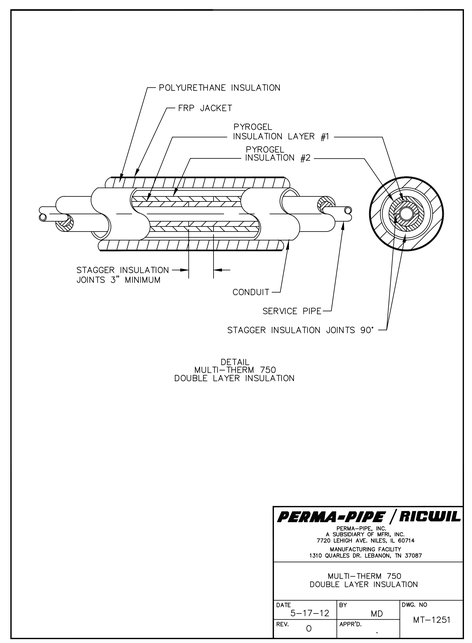
NOTES:
1. SOCKETWELD COUPLINGS, IF REQUIRED, SUPPLIED BY INSTALLER
2. ROLLED SLEEVES NOT AVAILABLE FOR CONDUIT SMALLER THAN 6"
3. MAXIMUM ROLLED SLEEVE THICKNESS: 1/4"
4. STORE ALL CHEMICALS AT 60°F TO 85°F

DETAIL
MULTI-THERM 750
FIELD JOINT ASSEMBLY
W/ MULTI-LAYER PYROGEL INSULATION
ROLLED SLEEVE & HEAT SHRINK SLEEVE

PERMA-PIPE / RICWIL
PERMA-PIPE, INC.
A SUBSIDIARY OF MPW, INC.
7720 LEHIGH AVE. NILES, IL 60714
MANUFACTURING FACILITY
1310 QUARLES DR. LEBANON, TN 37087

MULTI-THERM 750
FIELD JOINT ASSEMBLY
W/ MULTI-LAYER PYROGEL INSULATION
ROLLED SLEEVE & HEAT SHRINK SLEEVE

DATE	BY	DWG. NO
04-03-13	DK	MT-1459
REV.	APPR'D.	
0	JJ	



PRIMARY DUCTBANK DETAIL A-A

NOT TO SCALE

NOTES FOR DETAILS A-A & B-B:
1. TYPICAL CROSS-SECTION SUBJECT TO APPROVAL FROM PRIVATE COMPANIES PRIOR TO CONSTRUCTION.
2. CONTRACTOR SHALL PROVIDE 10' STEEL CONDUIT SWEEPS FOR ELECTRICAL CONDUIT AND 10' STEEL CONDUIT TANGENT SECTION PRIOR TO SWEEP.
3. E-ELECTRICAL, CONDUIT SIZE T.B.D.

TEL/DATA AND SECONDARY POWER DUCTBANK B-B

NOT TO SCALE

DETAIL
MULTI-THERM 750
DOUBLE LAYER INSULATION

PERMA-PIPE / RICWIL
PERMA-PIPE, INC.
A SUBSIDIARY OF MPW, INC.
7720 LEHIGH AVE. NILES, IL 60714
MANUFACTURING FACILITY
1310 QUARLES DR. LEBANON, TN 37087

MULTI-THERM 750
DOUBLE LAYER INSULATION

DATE	BY	DWG. NO
5-17-12	MD	MT-1251
REV.	APPR'D.	
0	.	

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PROJECT STATUS:
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DATE:	5/31/2013
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DRAWN BY:	RBS
CHECKED BY:	MRT

REVISIONS:

9/18/13	RBS	BID SET - ADDENDUM 2

DRAWING TITLE:
DETAIL SHEET

DRAWING NO.:
C1.3