

**SECTION XXXXX –  
DIRECT BURIED PIPING SYSTEM FOR HIGH & MEDIUM TEMPERATURE WATER, STEAM  
AND CONDENSATE**

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Note: Highlighted portions require project specific modifications or input by the consultant. Portions of this specification that are not highlighted shall not be modified without Fund approval.

## PART 1 - GENERAL

### 1.01 SCOPE OF WORK

- A. This Section defines the general requirements for furnishing and installing a direct-buried, high-density polyethylene (HDPE) jacket piping system as indicated herein, and on the Contract Documents. The HDPE jacket shall be continuous, with no breaks or leaks along the entire length of the direct-buried pipe.
- B. The direct-buried piping system shall include all miscellaneous piping materials, including but not limited to, piping, fittings, outer jacket, conduit, insulation, field joint assemblies, pipe supports, anchors, guides, end seals, expansion loops and other components as required for the proper installation of the system.
- C. The Contractor shall furnish all supervision, labor and materials required to accomplish the work associated with the installation of the equipment specified herein and indicated on the Contract Drawings.

### 1.02 REFERENCES

- A. All work performed and material supplied under this Section shall be in accordance with the latest addenda thereto of the applicable codes, standards, specifications, regulations, procedures, and tests as cited in Section XXXXX – “Summary of the Mechanical Work”.
- B. All items shall be in accordance with the latest edition and revisions of the following Codes and Standards where applicable.
  - 1. American Society of Mechanical Engineers (ASME)
    - a. B31.1 – 2010 Power Piping
    - b. Boiler Pressure and Vessel Code (BPVC)
  - 2. American Welding Society (AWS) B2.1/B2.1M Specification for Welding Procedure and Performance Qualifications.
- C. In the event of a conflict between the requirements of this specification, drawings, or any referenced Code or Standard, the most stringent shall apply.

### 1.03 QUALIFICATIONS

- A. The manufacturer shall have a minimum of five years’ experience in the fabrication of direct-buried, HDPE jacket piping systems as specified herein. The manufacturer must provide references for a minimum of 10 similar installations. The references shall include location, contact name, contact telephone number, project cost, and description of the project including direct-buried products used.
- B. Manufacturer’s Field Advisor:
  - 1. The direct-buried pipe manufacturer shall assign to the project a factory trained Field Advisor with expertise in the installation of direct-buried piping.
  - 2. The Field Advisor shall also be experienced in the use and installation of the product.
  - 3. The Field Advisor shall be required to:
    - a. Attend a pre-installation conference per section 1.08.
    - b. Immediately visit the job site if requested, to inspect all aspects of the work or to resolve questions or problems which may arise during the Work.
    - c. Make a minimum of 4 one-day visits in addition to the pre-installation conference. Site visits shall be scheduled at the beginning of the project (completion of first field joint assembly), 5%, 20% and 50% completion to inspect all aspects of the ongoing contract work.

- d. Submit all recommendations in writing.

C. Installation

1. The installer of the direct-buried piping shall have a minimum experience of three similar projects. Provide written proof of experience with the submittals, including project location, value, description of products used, contact person, and phone number. Failure to provide sufficient documentation and proof of experience shall be grounds for rejection of the Contractor's qualifications.

1.04 SUBMITTALS

A. General

1. Furnish a detailed layout for the direct-buried piping. The layout shall include the following:
  - a. Layout drawing at 1/4"=1'-0" scale, showing size, type and location of each component used in the system.
  - b. Transition point to aboveground system (i.e., manholes and buildings).
  - c. Anchor details.
  - d. Grade and pipe elevations. Sections shall be shown on the same sheets as plan views.
  - e. Location and identification number assigned to the field joints.
2. At the completion of the project provide an as-built drawing from the manufacturer along with a final piping stress analysis.
3. Submit calculations provided by the manufacturer and sealed by a NYS registered Professional Engineer for the following:
  - a. Heat loss calculations for the interface temperature between the foam and steel conduit.

B. Specific Submittals include the following:

1. Piping
2. Fittings
3. Insulation
4. Field Joint Assemblies
5. Anchors
6. Quality Assurance Procedures for Insulation Installation
7. Welding Procedure Specifications (WPS)
8. Welder/Welding Operator Performance Qualifications (WPQ)
9. Welder Certifications and Continuity
10. Records of Welds and Field Joint Assembly

1.05 WELDING PROCEDURE QUALIFICATIONS

- A. Welding Procedure Qualification shall be determined for each group of materials to be welded in accordance with Section IX ASME BPVC, ASME B31.1, AWS B2.1/B2.1M and as specified. Submit for approval a completed Welding Procedure Specification on the ASME BPVC form QW-482 for every welding procedure to be utilized on the project along with the supporting PQR on ASME BPVC form QW-483. The welding procedures shall specify end

preparation for butt welds, including cleaning, alignments, and root openings. Type of backing rings or consumable inserts, if used, will be described and, if they are to be removed, the removal process shall be described. Approval of any procedure does not relieve the Contractor of the sole responsibility for producing acceptable welds. Welding procedure qualifications shall be identified individually and shall be referenced on the Shop Drawings or suitably keyed to the Contract Drawings.

#### 1.06 WELDING PERFORMANCE QUALIFICATIONS

A. Performance qualification shall be determined in accordance with Section IX, "ASME Boiler and Pressure Vessel," ASME B31.1, AWS B2.1/B2.1M and as specified. Each welder/welding operator assigned to work covered by this specification shall be required to be qualified as part of the project by performance tests using the submitted WPS. Welders/welding operators who pass a qualification tests will be considered performance-qualified for the welding procedure used.

1. Qualifications: The Welder/Welding Operator Performance Qualification (WPQ) shall be submitted on the ASME BPVC form QW-484A/B for every welder/welding operator assigned to the project. Qualification of all welder/welding operators working on this project shall be completed by the same American Welding Society accredited welding facility. Qualification is to be obtained only for welders or welding operators working on this project. The qualification procedure shall be done on steel pipe in the 6G test position using a nominal pipe size of 2-3/4" with a wall thickness of 5/8" using the weld processes identified in the submitted WPS. The qualification shall include an ASME required visual inspection and a radiographic examination.
2. Certification: Submit certification information including continuity records for all weld processes and previous tests.
3. Identification: Each welder/welding operator shall be assigned an identifying number, letter, or symbol that shall be used to identify all of its welds. A list of the welders' names and symbol of each shall be submitted. Each welder or welding operator shall apply his mark adjacent to this weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal.
  - a. Renewal of Qualification: Requalification of a welder/welding operator during the project shall be required if there is specific reason to question ability to make welds that will meet the requirements of the specification.

#### 1.07 RECORDS OF WELDING AND FIELD JOINT ASSEMBLY

A. Contractor is to provide an administrative procedure for approval by the Owner which is required to record, locate and monitor and maintain the quality of both the carrier pipe welds and the installation of the field joint assemblies. Provide drawings that will act as a key plan along with a spreadsheet that contains the required data to be collected on the welds and field joint assemblies.

1. Identifying the location of each weld of the carrier pipe by a unique identification tag, the name of the welder and their assigned identification number letter or symbol along with the date, location, outside temperature and time the weld was performed and the WPS utilized.
2. Identifying the location of each field joint assembly by a unique identification tag, the name of the installer and their assigned identification number letter or symbol along with the date, location and time the installation was performed.

## 1.08 PRE-INSTALLATION CONFERENCE

1. Required attendees include the installing Contractors, Manufacturers Field Advisor, the Designer of Record of the system, SUCF, Site Representative, Construction Manager, and Inspection Agency.
2. The conference is to be scheduled prior to installation of the piping system.
3. The purpose of this conference is;
  - a. The Manufacturers Field Advisor shall demonstrate the proper installation procedure of a field joint through the mock-up assembly to the Contractor's employees as part of the pre-qualification procedure.
  - b. Discuss the proper handling, installation and testing of the piping system including additional procedures for cold weather conditions (<50°F) prior to commencement of the work.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. The direct-buried piping system shall be triple-wall construction as specified herein. The design shall include an outer jacket of heavy-duty high-density polyethylene (HDPE) covering a layer of urethane foam insulation. The insulation shall be applied to a 10-gauge steel conduit. The carrier pipe shall be supported within the conduit, and shall be insulated with mineral wool insulation.
- B. The system shall be designed to permit field-testing of all field joints. Field-testing shall include hydrostatic testing of the carrier pipe, and air testing of the conduit, and air testing of the field joint assembly.
- C. The system shall be factory-fabricated, including all fittings, end seals, anchor plates and expansion loops to the greatest extent possible to minimize field fit up and assembly.
- D. The design conditions for High or Medium Temperature Water systems are XXX psig and 400 deg. F and for Steam and Condensate systems are XXX psig and XXX deg. F
- E. The system shall be furnished with sufficient flexibility to avoid large stresses from thermal growth. Cold springing of the direct-buried pipe will not be allowed for any reason.

### 2.02 DIRECT-BURIED PIPING SYSTEM

- A. Carrier Pipe
  1. All carrier pipe and fittings shall be fabricated in accordance with ASTM A53, grade B seamless pipe for sizes larger than 2 inches. All carrier piping 2 inches and less shall be fabricated in accordance with ASTM A106, grade B seamless.
  2. All pipe except condensate, shall be Schedule 40 seamless carbon steel up to 10 inches, beyond 10 inches it shall be Standard Schedule. All condensate piping regardless of size shall be Schedule 80 seamless carbon steel.
  3. All pipe joints shall be made using specified and approved welding procedures. All pipes shall be furnished with plain ends, beveled for welding. All fittings shall match the pipe in size and wall thickness. Socket weld couplings may be used up to and including 1-1/2 inches.
  4. The carrier pipe supports shall be located at no more than 9 feet on centers. Supports shall allow for continuous airflow between the carrier pipe and conduit, and shall not restrict drainage of the conduit. Supports shall provide for insulation to thermally isolate the carrier pipe from the outer conduit. The insulation shall be protected at the support by a metal sleeve not less than 12-inches long, fitted with transverse and rotational

arresters. Support shall allow for 1-inch of air space between the insulation and I.D. of the conduit.

#### B. Conduit

1. All conduit and fittings shall be electric resistance welded (ERW) steel pipe conforming to ASTM A134, A135 or A139. The wall thickness shall be 0.1345 inch (10 gauge).
2. All field joints shall be fabricated with steel sleeves compatible with the conduit.
3. Each terminal point shall be provided with drain and vent connections for the interstitial space between the conduit and carrier pipe. Drains shall be piped to within 6-inches of the floor. Vents shall be piped to a minimum of 6-inches above grade.

#### C. Insulation

##### 1. Carrier pipe

- a. All carrier pipes shall be insulated with mineral wool insulation in accordance with ASTM C-547.
- b. The insulation shall be fabricated in half curved sidewall or V-grooved insulation sections. The bore shall be coated.
- c. The insulation shall be attached to the pipe with 0.5" x 0.015" stainless steel bands with matching seals.
- d. The minimum insulation thickness shall be provided as follows:
  - (1) 12 - 8 inch carrier pipe – 2.5 inch insulation thickness
  - (2) 6 - 3 inch carrier pipe – 2.0 inch insulation thickness
  - (3) less than 3 inch carrier pipe - 1.5 inch insulation thickness

##### 2. Conduit

- a. Conduit insulation shall be a minimum 1-inch thick spray-applied polyurethane foam having a nominal 2-pound per cubic foot density. Foam insulation shall conform to ASTM C591, and have a maximum thermal conductivity of  $k = 0.16 \text{ Btu-in/hr-ft}^2 \text{ } ^\circ\text{F}$ .
- b. The interface temperature between the foam and conduit shall not exceed 190°F. Foam to conduit interface temperatures up to 245°F are permitted if the foam provided has a continuous operating temperature of 300°F (minimum). Documentation shall be provided showing the foam temperature rating and the heat loss calculation of the interface temperature. All calculations shall be based on a ground temperature of 40°F, and a soil conductivity of 15 Btu-in/hr-ft<sup>2</sup> -°F.
- c. Quality assurance procedures for the insulation shall include either a visual check prior to jacketing, radiographic or infrared inspection of the entire length to ensure there are no voids. The manufacturer shall include the procedures with the submittal package. The procedures shall include repair methods for any voids found at the site.

#### D. Outer Jacket

1. The outer jacket and fittings shall be HDPE conforming to ASTM D 3350 with a minimum wall thickness of 125 mils for jacket sizes less than or equal to 12 inches, 150 mils for jacket sizes 14 inches to 24 inches, and 175 mils for jacket sizes larger than 24 inches.

#### E. Field Joint Assemblies

1. All field joint assemblies shall be factory-supplied assemblies, and shall be air-pressure testable to ensure the integrity of the system.
2. No field joint assembly shall be installed until the carrier pipe has completed a successful weld examination and hydrostatic test, and insulation has been installed at the joint.
3. Field joint assemblies shall include a rigid HDPE closure piece. The field joint assembly shall be air testable.
4. Field Joint interface temperature between the foam and conduit shall not exceed 190°F. Foam to conduit interface temperatures up to 245°F are permitted if the foam provided has a continuous operating temperature of 300°F (minimum). Documentation shall be provided showing the foam temperature rating and the heat loss calculation of the interface temperature. All calculations shall be based on a ground temperature of 40°F, and a soil conductivity of 15 Btu-in/hr-ft<sup>2</sup> -°F.
5. After the manufacturer's field joint assembly has successfully completed a 5-psig air pressure test, the test holes shall be sealed.
6. A heat shrink wrap seal and/or sleeve independent of the manufacturer's field joint assembly shall be installed around the joint to completely encase the entire joint area. Overlap the manufacturer's field joint assembly by 3 inches on each end.
7. All chemicals shall be stored at a temperature between 60°F and 85°F or otherwise recommended by the manufacturer.

#### F. Factory Joints

1. All factory joints shall be installed in accordance with the manufacturer's standard procedures including any additional requirements for cold weather conditions (<50°F). The manufacturer shall provide an additional shrink wrap seal and/or sleeve for each factory joint. The additional shrink wrap seal and/or sleeve shall be installed by the Contractor after all testing is completed. The shrink wrap shall be in addition to any material provided with the manufacturer's standard materials used for factory joints.

#### G. Miscellaneous Appurtenances

1. General
  - a. All miscellaneous appurtenances, including but not limited to anchor plates, end seals, and gland seals shall be designed and factory fabricated, and shall be watertight to a maximum head pressure of 7 ft of water.
  - b. All miscellaneous appurtenances shall provide zero bubbles when tested with a soap solution during the pneumatic testing of the field joints.
  - c. Miscellaneous appurtenances shall be defined by the Owner's Engineer, whose decision shall be final
2. Anchors
  - a. Anchors shall be fabricated with ½-inch thick steel plate. Plates shall extend a minimum of 3 inches beyond the outer jacket.
  - b. Anchor plates shall have vent and drain holes for free air passage and conduit drainage.
  - c. All anchor plates shall be furnished with an epoxy coating. No uncoated steel shall be in contact with the soil. Each anchor plate shall be furnished with a shrink wrap seal and/or sleeve seal to completely isolate the anchor plate.
3. End Seals

- a. All system terminal ends shall be provided with end seals. End seals shall be provided with threaded connections for drains and vents.
  - b. All end seals shall be shall be designed to allow for complete drainage and drying of the conduit.
4. Wall Penetrations
- a. The manufacturer of the piping system shall provide a hydrostatic seal consisting of mechanical type interlocking rubber links. The links shall seal the annular space between the system jacket and the wall sleeve or core-drill opening.

2.03 PREFABRICATED MANHOLES *(Remove section if no manholes or using concrete)*

A. General

- 1. Furnish and install a prefabricated manhole in each location shown on the Contract Drawings. The manhole shall be furnished with piping, valves and insulation as indicated.
- 2. All manholes shall be minimum 10 ft in diameter, unless otherwise indicated. Interior height of manhole shall be as indicated on the Contract Documents.

B. Construction

- 1. Manholes shell shall be fabricated from 3/8" carbon steel.
- 2. Each manhole shall be furnished with a high and low vent pipe. Each pipe shall be minimum 6" diameter, schedule 40 steel pipe. The low vent shall extend to within 12" of the bottom of the manhole. Each vent shall be furnished with a gooseneck and protective screen, and shall terminate a minimum of 12" above grade.
- 3. Each manhole shall be furnished with a 12-3/4" diameter sump. The sump walls and floor shall be constructed of 1/4" steel plate, and shall be a minimum of 12" deep.
- 4. Each manhole shall be provided with a steel chimney accessway. The access shall be 30" in diameter, and shall be fabricated from 1/4" steel plate. The accessway shall be provided with a waterproof cover with ring gasket and track head bolts.
- 5. Each pipe penetration shall be provided with a 10 gauge steel conduit stub-out for connecting to the direct-buried piping. In addition, the manhole shall be provided with two conduit stub-outs for a future 8" direct-buried supply and return line, and two conduit stub-outs for a future 6" direct-buried supply and return line. All future stub-outs shall be provided with end seal plates, and shall be furnished with drain and vent openings. ***(edit each project for requirements of future piping connections to manholes)***
- 6. The manhole shall be fabricated with a 1/2", oversized, steel plate bottom and top to allow for anchoring the manhole. The bottom and top steel plates shall each be reinforced with a minimum of two W6x25 structural steel members.
- 7. The top plate shall be furnished with two lifting eyes.
- 8. The manhole shall be provided with an inside and outside coating of phenolic paint and coated with a spray applied urethane coating. All coatings shall be a minimum thickness of 30 mils.
- 9. The manhole shall be provided with anchors for the HTHW piping as indicated on the drawings. The anchors shall include a dielectric isolation flange to isolate the HTHW piping from the manhole
- 10. The manhole shall be provided with sacrificial anodes for cathodic protection. The cathodic protection system shall include a test station at grade level and all wiring as



required to test the condition of the anodes. The sacrificial anodes shall be sized by the direct-buried pipe manufacturer.

### C. Piping

1. All pipe and fittings shall be fabricated in accordance with ASTM A53, grade B seamless pipe for sizes larger than 2 inches. All piping 2 inches and less shall be fabricated in accordance with ASTM A106, grade B seamless. All piping in the manhole shall conform to the requirements of Section XXXXX – “Mechanical Piping”.
2. All piping in the manhole shall be insulated with a minimum of 3-1/2” of mineral wool, and cover with a 0.016-inch nominal thickness aluminum jacket. All insulation shall be furnished in accordance with Section XXXX – “Insulation”. The insulation shall be shipped loose, for installation by the Contractor at the site. Prior to installation of the insulation, the pipe welds in the manhole shall be visually inspected by the owner’s representative. The owner reserves the right to radiographically examine the piping welds inside the manholes in accordance with Part 3.06 of this specification.
3. All piping in the manhole shall be provided with pipe labels indicating service and flow arrows. All un-insulated piping, including manhole vents, shall be painted with one prime coat and one finish coat of silicone alkyd paint. The manhole shall be furnished with vent and drain piping for all active conduits. All piping shall be 1” minimum. Drain piping shall extend to the manhole sump, and vent piping shall extend to the manhole high vent. The vents and drains for all future connections shall be furnished with plugs.
4. All pipes shall be provided with either two gate valves (drains) or one gate valve and one globe valve (vent) at entrance and exit points to the manhole. Drains shall be furnished when the piping in the manhole is at a low point, and vents shall be furnished when the piping in the manhole is at a high point.
5. Unless otherwise specified, all isolation valves for the pipe shall be furnished with a 3/4” bypass, including a 600 lb. globe valve.

### 2.04 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, furnish the products of one of the following manufacturers: **(Three manufacturers must be listed)**
  1. XXXXX
  2. XXXXX
  3. XXXXX

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. The direct-buried piping shall be covered before it is transported to the site. The piping shall not be shipped with the HDPE casing exposed to sunlight.
- B. All off-loaded materials shall be inspected for damage prior to placement in the trench. All damaged HDPE jackets shall be repaired as recommended by the manufacturer. All repairs shall provide a continuous and permanently sealed HDPE jacket. A shrink wrap seal and/or sleeve over a damaged area is not acceptable. After all repairs have been completed, provide an additional shrink seal around the damaged area independent of the manufacturer’s repair. Any repairs that result in the creation of a field joint shall be repaired with a field joint assembly.
- C. Storage of materials shall be in locations as shown on the Contract Drawings. The Contractor shall cover all HDPE piping with light colored tarps after it is off-loaded. The

HDPE pipe shall be covered at all times. The Contractor shall cover the pipe in the storage area, as well as any pipe that is moved to the trench locations.

- D. The system shall be installed in accordance with this specification and the written instructions furnished by the manufacturer and under guidance of the Manufacturer's Field Advisor.
- E. Supply all trenching and shoring, as required to obtain the proper depth and width needed to install the system. All piping shall be placed on a permanent bedding material as specified. No temporary supports are permitted.
- F. All direct-buried piping shall be pitched to ensure all sections drain to either a manhole or a building. Low points between manholes are not permitted.
- G. Backfill the trench as specified in Section XXXX – "Excavation, Backfill and Compaction", and as indicated herein. Furnish and install a 6-inch layer of sand on the bottom of the trench. The sand shall be placed and tamped to provide uniform bedding for the direct-buried pipe. The trench shall be evenly backfilled in 6-inch compacted layers to a minimum height of 12 inches above the top of the HDPE jacket. The remaining trench shall be backfilled in uniform layers with suitable excavated soil.
- H. All pipes in manholes shall be insulated using mineral wool covered with a metal jacket. All insulation work shall conform to the requirements of Section XXXXX – "Mechanical Insulation".
- I. Drying of Annular Space
  - 1. The Contractor shall ensure the annular space between the carrier pipe and conduit is dry before sealing the conduit. The Contractor shall use a dry gas purge method to remove all moisture for the piping system.
  - 2. The Contractor shall furnish all air compressors, desiccant dryers, pressure regulators, flow meters, inlet and outlet dew point meter, piping, valves, etc. as required to dry the piping.
  - 3. The Contractor shall circulate dry, compressed air through the space to absorb any moisture. The compressed air shall have a maximum pressure of 5 psig, and a dew point less than -20°F. The Contractor shall provide dew point meters at the compressed gas inlet and outlet to the piping system.
  - 4. The flow rate shall ensure the velocity of compressed air through the annular space is between 10 and 20 ft/sec.
  - 5. The Contractor shall circulate the compressed air for a minimum of 48 hours. After the initial dry out period, the Contractor shall secure the compressed air for a minimum of four hours to allow the annular space to reach equilibrium. The compressed gas system shall then be started, and the inlet and outlet dew point shall be measured. The dew point at the outlet from the annular space shall 20°F or less. The process shall be repeated if the dew point at the outlet from the annular space exceeds 20°F.
  - 6. Drying the annular space using the carrier pipe is not permitted.

### 3.02 MOCK-UP ASSEMBLY

- A. For the dryable/testable/drainable pre-manufactured direct buried underground piping system; provide a field joint "mock-up assembly" at the site location. The purpose of the mock-up assembly is to demonstrate to the Contractor's employees the procedure for completing a field joint assembly.
- B. Contractor and manufacturers field advisor shall demonstrate the successful completion of a mock-up filed joint assembly as specified herein, to the satisfaction of the SUCF

representative prior to receiving approval for use of a piping system. The mock-up shall be comprised of two 4-foot long sections of 12.75-inch diameter conduit complete with a 6-inch diameter welded steel carrier pipe, carrier pipe insulation, four corrugated spacers, air space, welded steel conduit, conduit insulation, and HDPE outer jacket. The field joint shall be constructed with the manufacturer's pressure testable field joint assembly and a heat shrink wrap seal and/or sleeve. The contractor shall perform the welding together of the steel carrier pipe sections, installation of the carrier pipe insulation, installation of corrugated spacers, welding together of the steel conduit sections prior to the preinstallation conference. The contractor and manufacturer's field advisor as part of the preinstallation conference shall demonstrate the pneumatic testing of the conduit and field joint assembly including bubble testing, installation of the field joint assembly, insulation of the conduit, sealing of test holes, and installation of shrink wrap seal and/or sleeves.

### 3.03 PIPE ROUTE

- A. Install the direct-buried piping as shown on the Contract Drawings.
- B. Prior to any excavation work, mark-out all utilities along the installation path as shown on the drawings and be responsible for any repairs to existing utilities shown on the Contract Drawings that are damaged by the excavation work.
- C. Be aware that the stresses on the pipe for the route shown on the Contract Drawings are within allowable limits as specified in ASME B31.1. The pipe shall be installed as indicated on the drawings. Do not deviate from the pipe route for any reason other than unforeseen circumstances unless a stress analysis stamped by a New York State Professional Engineer is provided. Any deviations shall be submitted and approved by the Engineer before any piping is installed. Any additional materials, labor or other costs that result from the deviation for any reason other than unforeseen circumstances shall be paid for by the installer.

### 3.04 WELDING

- A. No welding shall start prior to the approval of the WPS and the WPQ submittals identified in Part 1 of this specification.
- B. The Owner reserves the right to remove any welder from the project for any reason.
- C. If a welder fails 10% of the Owners visual inspection and/or radiographic examination the Owners testing agency shall bring this to the attention of the Owner.
- D. Welding of all carrier pipes shall conform to the requirements of **Section XXXX – "Mechanical Piping"**, and to the requirements as specified herein.
- E. All welding of pipe joints and procedures shall be in accordance with the following:
  - 1. Section IX - Welding and brazing qualifications of the ASME Boiler and Pressure Vessel Code.
  - 2. American Welding Society B2.1 – Specification for Welding Procedure and Performance Qualifications.
  - 3. ASME B31.1 Power Piping.
- F. Parts that are to be joined by welding may be held in alignment during the welding process by the use of bars, jacks and clamps.
- G. Socket weld couplings shall be used for welded line joints, where specified, in nominal pipe sizes 1-1/2 inches and smaller.
- H. Piping

1. Weld end preparations for field joints and for joining to supplied items shall be in accordance with Chapter V of ASME B31.1. All weld ends preparation dimensions shall be in accordance with ASME B16.25.
2. Base pipe material shall be prepared in accordance with the following:
  - a. The edges or surfaces of the parts to be joined by welding shall be machined and cleaned of all oil, grease, scale, rust, or other deleterious materials.
  - b. Maximum joint gap distance shall be 3/16" for 2 1/2 NPS pipe and larger and 1/8" for 2" NPS and smaller.

#### I. Welding Processes

1. Welding shall be performed by one or more of the following processes. Other processes may be permitted when the technical adequacy has been demonstrated to the satisfaction of the Owner and Engineer.
  - a. Shielded Metal Arc (SMAW) - Only low hydrogen electrodes shall be permitted.
  - b. Gas-Tungsten Arc (GTAW) – Non-consumable tungsten electrodes shall be AWS A5.12 Class EWTh-2. Filler metal addition shall be used with the gas-tungsten arc process.
2. The following shall establish, at a minimum the quality controls that shall be incorporated with any of the above mentioned welding processes:
  - a. Initiation points of all weld passes and weld layers shall be staggered.
  - b. When using the shielded metal arc process, the depth of weld metal deposited in each layer shall not exceed 3/16 inch.
  - c. Vertical position welding shall proceed uphill.
  - d. Complete penetration and fusion shall be achieved in all regions of the weld zone.
  - e. All slag, flux or foreign materials remaining on any bead of welding shall be removed by grinding, chipping or wire brushing before depositing the next or successive bead.
  - f. Any cracks, slag incursions, incomplete fusion or blow holes that appear on the surface of any bead of welding shall be removed by chipping or grinding before depositing the next successive bead of welding.
  - g. Preheat at all welds to a minimum temperature of 250°F.
  - h. Each welder or welding operator shall apply his mark adjacent to this weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal.

#### J. Filler Materials

1. All welding filler materials, including any consumable inserts, shall comply with the requirements of ASME or AWS filler material specifications as submitted.
2. All welding filler materials shall be stored in a clean, dry location protected from contamination.
3. After opening of new sealed electrode containers or removal of electrodes from drying ovens, all electrodes, which are not immediately issued for use, shall be stored in holding ovens at a minimum temperature of 200°F.

### 3.05 VISUAL EXAMINATION OF WELDS

- A. Visual examinations will be performed by the Owner on 100% of all field weld joints post welding. The Owner will retain the services of a qualified commercial inspection or testing agency to examine the welds. Provide access to all welds for testing, and provide full cooperation with the testing agency. Include all labor and materials as required to permit the visual examination.
- B. The visual examination will examine each weld for any defect. The visual examination will be performed in accordance with Section V, Article 9, of the ASME Boiler and Pressure Vessel Code and with ASME B31.1, Section 136.4.2. Repair any defects noted in the visual examination at no additional cost to the Owner. All repairs will be re-examined. Welds that are shown by visual examination to have any of the following types defects are unacceptable:
  - 1. Cracks – external surface.
  - 2. Undercut on surface, which is greater than 1/32 deep.
  - 3. Weld reinforcement greater than 5/32 inch.
  - 4. Lack of fusion of surface.
  - 5. Incomplete penetration (applies only when inside surface is readily accessible).
  - 6. Any other linear indications greater than 3/16" long.
  - 7. Surface porosity with rounded indications having dimensions greater than 3/16" or four or more rounded indications separated by 1/16" or less edge to edge in any direction. Rounded indications are indications which are circular or elliptical with their length less than three times their width.
- C. The following additional visual quality examinations shall be performed:
  - 1. Arc strikes shall be removed by grinding and the area examined for freedom from defects by liquid penetrate. Any crack or linear indications are unacceptable.
  - 2. Grinding shall not result in a reduction in wall thickness below the minimum required by the applicable code, material specification, or design calculation.
  - 3. Each weld shall be uniform in width and size throughout its full length.
  - 4. Wash pass welding (re-melting cover pass to smooth weld contour) is prohibited.
  - 5. Butt welds shall be full penetration.
  - 6. Socket welds, depth of insertion of pipe or tube within the socket or sleeve shall be 3/8 inch minimum.
  - 7. Attachment Welds: All temporary welded attachments used for erection purposes shall be removed by mechanical cutting or air-arc cutting the attachment a distance from the supporting metal surface sufficient to preclude damage, but in no case less than 1/8 inch. The remainder of the attachment shall be ground flush with the base metal surface. The ground area shall then be examined visually to ensure freedom from defects. Under no conditions are temporary attachments to be removed by hammer blows.
- D. Written reports for each visual examination performed by the Owner's testing agency will be available for review. The Owner's testing agency shall have the final word in determining the acceptability of any welds.

### 3.06 RADIOGRAPHIC EXAMINATION OF WELDS

- A. Radiographic examinations will be performed by the Owner on butt and full penetration welds. The Owner will retain the services of a qualified commercial inspection or testing agency to examine the welds. Provide access to all welds selected by the Owner for testing, and provide full cooperation with the testing agency. Include all labor and materials as required to permit the radiographic examination.
  - 1. The Owner will randomly select 10% of the carrier pipe welds for radiographic examination from the piping direct buried, within manholes and box tunnels. 100% of the carrier pipe welds located interior to the building and in walk-in tunnels will be radiographic examined.
- B. Any unacceptable defects encountered during the radiographic examination shall be repaired at no additional cost to the Owner. All repairs will be re-inspected. In addition, if any weld joints of the first 10% of the total are found unacceptable, a second 10% of the total pipe welds will be selected by the Owner for radiographic examination. The additional examination shall continue until a full block of 10% of the selected weld joints is found acceptable at the first testing of the joint. All costs associated with retesting failed welds and testing of additional welds as a result of failed welds will be the responsibility of the Contractor.
- C. All radiographic examinations shall be performed in accordance with Article 2 of Section V of the ASME Boiler and Pressure Vessel Code and ASME 31.1 section 136.4.5, except that the requirements of T-274 are to be used as a guide but not for the rejection of radiographs unless the geometrical unsharpness exceeds 0.07 in. Welds that are shown by radiography to have any of the following types of discontinuities are unacceptable:
  - 1. Any type of crack or zone of incomplete fusion or penetration.
  - 2. Any other elongated indication which has a length greater than:
    - a.  $\frac{1}{4}$  inch for  $t$  up to  $\frac{3}{4}$  inch inclusive.
    - b.  $\frac{1}{3} t$  for  $t$  from  $\frac{3}{4}$  inch to  $2\frac{1}{4}$  inch inclusive
    - c.  $\frac{3}{4}$  inch for  $t$  over  $2\frac{1}{4}$  inch
  - 3. Any group of indications in line that have an aggregate length greater than  $t$  in a length of  $12t$ , except where the distance between the successive indications exceeds  $6L$  where  $L$  is the longest indication in the group.
  - 4. Porosity in excess of that shown as acceptable in Appendix A-250 of Section I of the ASME Boiler and Pressure Vessel Code.
  - 5. Root concavity when there is an abrupt change in density, as indicated on the radiograph.
- D. Written reports for each radiographic examination performed by the Owner's testing agency will be available for review. The Owner's testing agency shall have the final word in determining the acceptability of any welds.

### 3.07 MAGNETIC PARTICLE EXAMINATION OF WELDS

- A. Welds that are unable to be examined by radiographic examination shall have a surface examination utilizing magnetic particle for ferrous piping.

### 3.08 TESTING

- A. Hydrostatic Testing of Carrier Pipe

1. Hydrostatically test all new piping. Tests for all new piping shall be performed in accordance with part C2.270 of Section VII of the ASME Boiler and Pressure Vessel Code, and the requirements noted in this Section of this Specification. All materials and equipment required to perform the hydrostatic test shall be furnished. All tests shall be performed successfully prior to insulation, completion of the field joint assembly and backfilling.
2. Sanitary water of a potable quality shall be used for hydrostatic testing. Test pressures shall be maintained in the systems for at least 30 minutes with no visible leaks or loss of pressure.
3. Unless otherwise specified, all piping shall be subjected to a minimum pressure of 1.5 times the system design pressure.
4. All tests shall be witnessed, certified and documented by the Owner's Site Representative.
5. Any defective joints shall be repaired; their welds re-examined, and re-tested. Successfully complete a hydrostatic test of the carrier pipe prior to insulation, completion of the field joint assembly and backfilling the trench.

#### B. Pneumatic Testing of Conduit

1. The Contractor shall test all conduit field joints with 15 psig air pressure held continuously as the field joints are bubble tested. Acceptable joints shall have zero bubbles.
2. The Contractor shall successfully complete the 15 psig air test before backfilling the trench.

#### C. Pneumatic Testing of Outer Jacket

1. Test all HDPE field joints on the system with 5 psig air pressure held continuously as the field joints are bubble tested. Acceptable joints shall have zero bubbles.
2. The Contractor shall test all factory joints on both sides of the field joints by bubble testing while applying 5 psig to the field joints. No factory joints shall leak during the testing of the field joints. The manufacturer shall repair any leaking factory joint as required to pass the pneumatic test. Repairs to all factory joints shall consist of welding the HDPE, installing a polyethylene wrap, providing a new elbow section, or other means acceptable to the Engineer that will provide a continuous jacket. After all repairs are completed, the Contractor shall install a shrink wrap seal and/or sleeve around the factory joints. The shrink wrap seal and/or sleeve shall be in addition to any material provided with the manufacturer's standard materials used for the factory joints.
3. After successfully testing the field joint, the Contractor shall install a shrink wrap seal and/or sleeve around each field joint to completely encase the manufacturer's joint material. The shrink wrap seal and/or sleeve shall be in addition to any material provided with the manufacturer's standard materials used for the field joints. Installer shall write their assigned identification number letter or symbol along with the date, joint identification and time the installation was performed with a paint pen.
4. Successfully complete the 5 psig air test before backfilling the trench.

### 3.09 PRE-QUALIFYING PERSONNEL

- A. Pre-qualify all employees that will be installing the field joint assemblies. Pre-qualification shall be accomplished by the employee attending the Field Advisor's demonstration of the mock-up assembly during the Pre-installation conference, and by successfully completing three field joint assemblies. Successful completion shall be demonstrated by testing the joint per the testing criteria contained in this specification.

- B. All qualifying tests shall be witnessed by the Owner's Site Representative and the manufacturer's Field Advisor. The field advisor shall provide written verification of acceptance for each employee. After successfully completing the three field joint assemblies, the employee will be permitted to perform the field joint assemblies for the system. Any field joint assembly installed by a non-qualified employee shall be rejected, and replaced at no additional cost to the owner.
- C. Include all labor and materials as required for each qualifying employee to perform the three field joint assemblies necessary to qualify the employee.

### 3.10 CLEANING

- A. Piping shall be clean inside and outside at time of shipment. All waste, such as metal chips and filings, welding rods and stubs, waste, rags, debris, shall be removed from the interior of each piping unit. All mill scale, rust, oil, grease, chalk, crayon, paint marks, sand and other deleterious material shall be removed from interior and exterior surfaces.
- B. Thoroughly clean all new piping of all contaminants such as oil, grease, welding slag and spatter, loose mill scale, dirt, corrosion product, or any other foreign substances. Install temporary vents and drains with isolation valves on all new carrier piping to permit flushing of the pipe.
- C. Fill and flush the system a minimum of two times using potable water. Supply all labor and materials to flush the system. Potable water will be available from the facility.

END OF SECTION