SECTION 15XXX

SPECIFICATION FOR ISCO HDPE DUAL CONTAINED PIPE, FITTINGS AND JOINING/FUSION

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. This specification covers the material (pipe and fittings), joining methods and general installation practice for Dual Contained High Density Polyethylene (HDPE) piping systems, including containment access ports/structures and low point inspection points.

1.02 SUBMITTALS

A. Submit product data to the Engineer for review in accordance with the Section XXXXX for all dual contained pipe, fittings, and related appurtenances.

B. Contractor shall also submit the following to the Engineer for approval:

1. Certified dimensional as-built drawings/profile of all installed pipe, fittings, and structures.

2. The Supplier of the material shall submit, through the Contractor, a Certificate of Compliance that the pipe, fittings and other products or materials furnished for this project have been inspected at the plant and meets or exceeds the standards set forth in this specification. The Contractor shall submit these certificates to the Engineer for approval prior to installation of the pipe materials.

3. Provide a statement that personnel responsible for fusing the pipe have been trained and qualified.

C. For items that do not meet all of the requirements of this specification, the bid/submittal shall include a written description of the deviations, along with data that show the magnitude and the justification for the deviation from the specification. The decision to accept material deviating from this specification shall be the responsibility of the specifying engineer and must be approved in writing.

1.03 REFERENCE DOCUMENTS AND STANDARDS

Unless otherwise specified, references to documents shall mean the latest published edition of the referenced document in effect at the project bid date.

ANSI/AWWA

- ANSI/AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm) for Water Service
- ANSI/AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission
- AWWA M55 Manual of Water Supply Practices, PE Pipe–Design and Installation

Plastics Pipe Institute, PPI

- PPI Handbook of Polyethylene Pipe – 2009 (2ndEdition)
- PPI Material Handling Guide for HDPE Pipe and Fittings
- PPI TR-38 Bolt Torque for Polyethylene Flanged Joints
- PPI TN-42 Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects
- PPI TR-46 Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe

ASTM

- ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- ASTM D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
- ASTM F2880 Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3⁄4 in. to 65 in.
- ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- ASTM F585 Standard Guide for Insertion of Flexible Polyethylene Pipe Into Existing Sewers
- ASTM F714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- ASTM F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
- ASTM F1962 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings
- ASTM F2164 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
- ASTM F2206 Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
- ASTM F2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
- ASTM F3124 Standard Practice for Data Recording the Procedure Used to Produce Heat Butt Fusion Joints
- ASTM F3183 Standard Practice for Guided Side Bend Evaluation of Polyethylene Pipe Butt Fusion Joint
- ASTM F3190 Standard Practice for Heat Fusion Equipment (HFE) Operator Qualification on Polyethylene (PE) and Polyamide (PA) Pipe and Fittings

PART 2 – PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE MATERIALS

A. Resin and Material Requirements

1. All pipe and fitting material shall be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D3350 with a minimum cell classification of 445474C. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black of not less than 2 percent.

B. Dual Contained HDPE Pipe

1. Pipe used to fabricate the dual contained system shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2.01.A.

2. Both the carrier and containment pipe shall have an IPS (Iron Pipe Size) OD and, when required, pipe shall meet AWWA C901 (1/2" to 3") or AWWA C906 (4" to 63"), and shall be listed as meeting NSF-61. Pipe sizes 3" and large shall have a manufacturing standard of ASTM F714, while pipe smaller than 3" shall be manufactured to the dimensional requirements listed in ASTM D3035.

3. The carrier pipe will have a nominal OD of X" with Dimension Ratio (DR) of X . The containment pipe will have a nominal OD of X" with Dimension Ratio (DR) of X. (Alternatively, the size and DR of the dual containment pipe combinations shall be as specified on plans.)

4. Dual Contained pipe shall be prefabricated prior to shipment to the jobsite. No on-site fabrication to the pipe, fittings or system shall be allowed without express written consent of the engineer and the piping supplier. Each end of pipe will have a centralizer that is thermally bonded to both the OD of the primary carrier and the ID of the secondary containment piping and designed such that movement will be restrained between the two piping systems during the simultaneous butt fusion process.

5. Centralizer shall be thermally bonded to the primary carrier pipe, and maintain position and alignment of the primary carrier in relation to the secondary containment piping.

6. Dual Contained Pipe shall be manufactured by an ISO 9001 certified manufacturer. The pipe manufacturer shall have a minimum 10 years of experience in manufacturing and production of dual contained piping and related fittings. The dual containment piping system shall be ISCO Dual Contained pipe and fittings as manufactured by ISCO Industries, Inc., or approved equal.

C. Dual Contained HDPE Fittings

1. General- Fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2.01.A. The pressure rating of carrier fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans or accepted by owner/engineer. Where required, all fittings shall meet the requirements of AWWA C901 or C906.

2. End Terminations – End termination fittings shall be used to seal the system at both ends. The fitting shall be simultaneously butt fused to the carrier and containment pipe to seal the annular space. Terminations that are not butt fused in the system will not be allowed. This fitting will also provide the transition to single wall piping using the following components and guidelines:

    a. Flange Adapters shall meet the dimensional and material requirements of ASTM F2880.

    b. Ductile Iron, Stainless Steel, or Steel back-up rings (Van-Stone style lap joint flanges) shall have a radius on the inside diameter of the bore so as to be compatible with HDPE Flanges. Back up rings shall have bolt pattern that will mate with AWWA C207 Class D (or B or E), ASME/ANSI B 16.5 Class 150, ASME/ANSI B 16.1 Class 125, or ASME/ANSI B16.47 Series A.

    c. Flange assemblies shall be assembled and torqued according to PPI TN-38, "Bolt Torque for Polyethylene Flanged Joints."

    d. Threaded transition fittings may be used in lieu of flanges, but unions must be employed to allow connections where pipe will not have any freedom of movement.

3. Centralizers- Centralizers used for pipe ends will be either molded from HDPE Pipe Grade resins or machined from HDPE Pipe Grade sheet. Manual or hand cut centralizers are not permitted since they have a low degree of dimensional accuracy. Centralizers should have at least two openings that will permit the flow of liquid between the carrier pipe and the containment pipe. The OD of the centralizer shall match the ID of the containment piping as closely as possible. Centralizer spacing for prefabricated pipe will have a spacing of X", or standard spacing based on ISCO Industries, Inc catalog listing.

D. Dual Contained HDPE Manholes and Structures

1. General- Structures and manholes shall be supplied by the same supplier as dual containment pipe and fittings. Structures shall meet the specific requirements of Section XXXXX of the specification and details on the plan drawings.

E. Fusion Unit Requirements

1. All Fusion Equipment, whether new or used, rented or owned, shall be approved by the Dual Contained piping system supplier. The butt fusion equipment used to join the pipe shall be capable of meeting all normal butt fusion requirements: alignment, heating, trimming and fusion pressure.

2. If the contractor owns butt fusion equipment, the equipment must be serviced within 3 months prior to use for this project. The machine must be environmentally friendly and in satisfactory working order. The hydraulic system must be leak free. The pressure gage and thermometer must be checked for accuracy. For projects with pipe quantities of 5000' or longer, the fusion equipment should be serviced by a McElroy Authorized Service and Repair Center with at least one McElroy Certified Master Mechanic on staff within 3 months from the first fusion on the project.

3. Rental Fusion Equipment must be supplied by ISCO Industries, Inc. or approved alternate McElroy Authorized Service and Repair Center with at least one McElroy Certified Master Mechanic on staff. When requested by owner or his authority, an inspection report detailing the components inspected within 3 months prior to arrival at jobsite will be provided.

F. Approved Suppliers

1. All Pipe, Fittings, and Fusion Equipment shall be provided by one supplier. Approved suppliers are ISCO Industries, Inc. or approved equal.

2.02 PIPELINE LOCATING MATERIALS

A. A. Detectable Marker Tape- Plastic marker tape shall be 5 mil minimum thickness with a solid aluminum core of .35mil minimum thickness and a minimum width of 2". The background of the tape shall be colored based on pipe service with black lettering continuously printed. Marker tape shall have a minimum 35 lbs./inch tensile strength. The installation of the tape shall be at 18 inches below finish grade.

B. Tracer Wire- All HDPE pipe 4" and greater shall be installed with an extra high-strength, copper clad steel tracer wire including 45 mil HDPE jacket that has a minimum average break load of at least 1150 lbs. The jacket shall be colored based on pipe service, with blue for potable water or green for sewer. Tracer wire gauge shall be 12 AWG, 10 AWG, or 8 AWG depending upon application and installation procedure. This wire shall to be continuous and brought up in the valve boxes at the ends of each line segment with splices made only by methods per the equipment manufacturer's recommendation. All miscellaneous splicing components shall be furnished and installed by the Contractor.

PART 3 – EXECUTION

3.01 GENERAL

A. All Dual Contained HDPE pipe and fittings shall be joined and installed in accordance with the manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel trained in working with dual containment polyethylene pipe systems.

3.02 TRANSPORTATION, UNLOADING, HANDLING AND STORAGE

A. The manufacturer shall package product in a manner designed to deliver the pipe and fittings to the project neatly, intact and without physical damage. Pipe ends shall be covered prior to shipment to prevent debris and / or liquid from entering pipe ends. During transportation each pipe shall rest on suitable pads, strips skids, or blocks securely wedged or tied in place.

B. During loading, transportation, and unloading, every precaution should be taken to prevent damage to the pipe. The handling of the pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Cuts or gouges that reduce the wall thickness by more than 10% are not acceptable and must be cut out and discarded.

C. Handle all piping material in accordance with the PPI Handbook of Polyethylene Pipe (2nd Edition), Chapter 2. All pipe and accessories shall be loaded and unloaded by lifting with hoists or by skidding in order to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be rolled or skidded against pipe on the ground. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or interior of the pipe. All pipe and fittings shall be subjected to visual inspection at time of delivery and before they are lowered into the trench to be laid.

D. Materials, if stored, shall be kept safe from damage and shall not be stacked higher than the limits recommended by the manufacturer. The bottom tiers shall be kept off the ground on timbers, rails, or concrete. Pipe shall not be stored close to heat sources. The contractor shall be responsible for all security, damage and loss of pipe, excluding Acts of God.

E. Sealing surfaces of mating components (i.e. flange faces) shall be kept free from dirt or foreign matter at all times. Flange face protection shall be used to keep the surface free from scratches and gouges.

3.03 RECEIPT INSPECTION

A. All pipe and fittings shall be subjected to visual inspection at time of delivery and before they are installed or lowered into the trench to be laid. Defective, damaged, or unsound pipe will be rejected. Cuts, punctures, or gouges that penetrate or reduce the wall thickness by 10% or more are not acceptable and must be removed and discarded. Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor.

3.04 PIPE JOINING AND INSTALLATION

A. General- Keeping the annular space of dual contained pipe and fittings clean and dry should be the goal of all installations. Contamination of the annular space could lead to either poor fusions or problematic false indications of leaks or loss of integrity of the carrier/containment pipe system.

B. Direct Burial

1. Buried HDPE pipe and fittings shall be installed in accordance with ASTM D2321 or ASTM D2774 for pressure systems and AWWA Manual of Practice M55 Chapter 8. The Design Window identified in AWWA M55 Chapter 5 (page 65 of 2006 version) shall be considered acceptable design and installation conditions based on the containment pipe DR.

2. Pipe embedment - Embedment material should be Class I, Class II, or Class III materials as defined by ASTM D2321 Section 6. Class IV or Class V materials are not recommended; however they may be used only with the evaluation and approval of the engineer at a demonstrated achievable compaction.

3. Bedding: Pipe bedding shall be in conformance with ASTM D2321 Section 8. Compaction rates should be as specified in ASTM D2321. Deviations shall be approved by the engineer.

4. Haunching and backfill shall be as specified in ASTM D2321 Section 9 with Class I, II, or III materials. Compaction shall be in excess of 85% Proctor, providing a minimum modulus of 1000 psi or greater.

C. Fusion Joining Requirements:

1. All Dual Contained HDPE pipe shall be joined using the simultaneous butt fusion welding process which produces homogeneous, seal, leak tight joints for both the carrier and containment pipe.

2. The Dual Containment supplier shall provide written simultaneous butt fusion welding procedure as part of the submittal package. The procedure should identify quality checks and incorporate principles outlined in ASTM F2620 or PPI TR-33. The procedure shall identify how the simultaneous butt fusion pressure is determined.

3. Fusion joints shall be made by personnel trained by the dual containment system supplier. A record or certificate of training for the fusion operator must be provided that documents training date.

4. Considerations should be given to adverse weather conditions, such as temperatures below freezing, precipitation, or wind. Provisions shall be accepted by the owner/engineer.

5. The open ends of all pipe sections of joined and/or installed pipe (not in service) shall be capped or plugged to prevent insects, animals, or foreign material from entering the pipe line or pipe section. Use waterproof caps to prevent the entrance of any type of contamination into the carrier or containment pipe and secure to the pipe in such a manner that the wind cannot blow loose. Where possible, the pipe shall be raised and supported at a suitable distance from the open end such that the open end will be below the level of the pipe at the point of support.

D. Fusion Operators:

1. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The employer is responsible for documenting all training and qualification records for that individual, including compliance to any code requirements for fusion/bonder operators.

2. All HDPE fusion equipment operators shall be trained by the dual containment system manufacturer to perform the simultaneous fusion procedure. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.

3. When the fusion machine operator is employed by the fusion machine and dual contained system supplier, the supplier shall maintain an ISO 9001 Certified Quality Management System.

E. Butt Fusion Equipment:

1. For 6” and larger pipe sizes, the pipe butt fusion machine shall be a self-contained hydraulic fusion machine capable of butt fusing HDPE pipe. The carriage must be removable from the chassis for in-ditch use. The machine must be compatible with an electronic data recording device. Accessories will include all butt fusion inserts for the specified range of pipe sizes, a pyrometer kit for checking the surface temperature of the heater, extension cord of appropriate gauge (25' minimum), and hydraulic extension hoses (minimum of four at 25’ each). The butt fusion machine will be McElroy, or approved equivalent.

2. Fusion Data Recording:

a. For containment sizes 6" and larger pipe sizes, McElroy DataLogger or equivalent fusion data recorder shall be used to record all fusion welds on hydraulically operated fusion machines. The device shall be capable of meeting the requirements of ASTM F3124, "Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings". The device, or combination of devices, shall record the following variables of each fused joint:
    1. Heater surface temperature- immediately before inserting the heater plate, measure with a pyrometer and manually enter into the weld record.
    2. Gauge pressure during the initial heat cycle
    3. Gauge pressure and elapsed time during the heat-soak cycle
    4. Heater removal (dwell) time
    5. Gauge pressure and elapsed time during the fusing/cool cycle
    6. Drag pressure
    7. Pipe diameter(s) and wall thickness(es)
    8. Type of HDPE material(Specification and Classification) and manufacturer
    9. Fusion Machine Identification

b. The device shall record the operator name and a unique operator ID number, along with the date and time of each weld.

c. Records showing the device is up to date on all required calibration should be available for review when requested.

d. All fusion welds should be traceable to the report (via operator and weld ID) with an indentation weld stamp or by permanent paint marker/pen next to fusion weld.

F. Butt Fusion Examination and Data Review:

1. Examinations

a. Visual examination of Containment fusion:
For pipe sections, examine the full exterior circumference of the containment for bead uniformity. All beads should have visually acceptable bead formation as shown in Fig 4 and Appendix X2 of ASTM F2620. In addition, the following characteristics are expected:
    i. There shall be no evidence of cracks or incomplete fusing
    ii. There shall be no evidence of captured objects (e.g., pipe shavings, facer ribbons) between bonded surfaces.
    iii. Variations in upset bead heights on opposite sides of the cleavage and around the circumference of fused pipe joints are acceptable.
    iv. The apex of the cleavage between the upset beads of the fused joint shall remain above the base material surface
    v. Fused joints shall not display visible angular misalignment, and outside diameter mismatch shall be less than 10% of the nominal wall thickness
    vi. Fusion data records, when required, shall be reviewed to meet acceptable fusion criteria can be used as additional verification of visual indicators.

b. Visual examination of Carrier fusion (as required):
    i. Visual examination of carrier fusion is not possible without destructive examination
    ii. Create test fusion
    iii. Cut and disassemble so that carrier bead can be exposed and inspected
    iv. Inspect carrier bead as described in Section F. 1. a.

c. Fusion Data Record Review

i. The fusion date record for each fused joint shall be compared to the approved fusion procedure. The reviewer shall verify the following:
    1. That all data required by section 3.04.E.2.a was recorded
    2. Pressure was within the acceptable range
    3. Heater surface temperature was within the acceptable range
    4. Butt fusion pressure applied during the fusing/cool cycle was correctly calculated to include drag pressure, fell within the acceptable range for the applicable size and agrees with the recorded hydraulic fusing pressure.
    5. Butt fusing pressure was reduced to a value less than or equal to drag pressure at the beginning of the heat soak cycle.
    6. Fusing machine was opened at the end of the heat soak cycle, the heater was removed, and the end were brought together at the fusion pressure with the acceptable time range
    7. Cooling time at butt fusing pressure met the minimum time specified
ii. If the recorded data is outside the limits of the acceptable range, the joint is unacceptable and must be removed and replaced.
iii. Frequency. Records for test fusion joints should be reviewed immediately after the joint is completed. Fusion joints for jobsite fusions should be reviewed daily or before being covered with backfill.

3.05 TESTING AND LEAKAGE

A. The contractor shall insure testing can be accomplished in a safe manner, including protection of personnel, equipment, and public in the event of a failure during testing. The contractor shall restrain pipe, components, and test equipment as required. All pumps, valves, temporary connections, meters, gauges and other measuring devices shall be furnished, installed and operated by the Contractor and all such equipment and devices and their installation shall be approved by the Owner's Engineer.

B. The pressure gauges or data recorders should be calibrated and sufficiently sized to provide mid-range data (pressure tested will not be below 10% or greater than 90% of gauge capacity) that result in easy reading, interpretation. Gauges shall be accurate to within 2% of full scale with increments no greater than X psi.

C. Test pressure shall not exceed the lowest rated component of the system, which may be a fitting or valve.

D. Containment Pipe Testing
1. Access to the annular space via low point drains or access ports will used to conduct containment pipe testing.
2. The annular space between the carrier and containment pipe shall be tested to a maximum of 10 psi air pressure. Air pressure should be allowed to equalize for 10 minutes, then monitor the pipe for the test period of 10 minutes, during which no drop in pressure shall be allowed.
3. Intermediate testing of containment annular space may be used for evaluation of fusion and pipe integrity prior to final testing. No hydrostatic test of the carrier is required for intermediate testing. Welding and subsequent removal of end terminations will likely be necessary to provide temporary closure of the annular space.
4. Final low pressure air testing of containment shall be conducted upon completion of the hydrostatic testing of the carrier pipe outlined in section 3.05.E.
5. Warning: All pneumatic test, regardless of pressure, can be dangerous and safety procedures shall be identified, documented, approved by the owner and engineer, and followed. ASTM F1417 may provide useful guidance and information for reference.

E. Carrier Pipe Testing

1. Carrier Pressure testing shall be conducted in accordance with requirements and recommendations of ASTM F2164 (Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure), AWWA Manual of Practice M55 Chapter 9, and PPI Handbook of Polyethylene Pipe Chapter 2 (2nd Edition). High pressure or pneumatic (compressed air) leakage testing of HDPE pressure piping is prohibited for safety reasons.

   i. The section of pipe to be tested shall be filled with potable or generally clean water (uncontaminated river/lake water) approved by the Owner/Engineer. While the system is being filled with water, air shall be carefully and completely exhausted. Due to the complexity of adding fittings in installed dual contained piping, systems requiring venting shall use air vent valves within containment structures located at high points during the design phase.

   ii. The test procedure for HDPE pipe consists of two steps: 1) the initial phase or expansion phase and 2) the test phase. During the initial/expansion phase, sufficient make-up water shall be added hourly for 3 hours to return to the test pressure. During the test phase, the expansion phase pressure is reduced by 10 psi to test phase pressure and monitored for at least one hour (3 hours maximum).

   iii. Under no circumstances shall the total time under hydrostatic test exceed eight (8) hours. If the test is not completed due to leakage, equipment failure or any other reason, depressurize the test section and permit the system to "relax" for eight (8) hours prior to the next testing sequence.

   iv. The test pressure shall be 1.5 times the operating pressure at the lowest point in elevation along the test section's vertical pipeline profile. In accordance with section 9.8 of ASTM F2164, the pipe shall pass if the final pressure is within 5% of the test phase pressure for the testing period (3 hours maximum). If the test section fails this test, the Contractor shall repair or replace all defective materials and/or workmanship at no additional cost to the Owner.

F. Test pressures require consideration of thermal conditions. Polyethylene piping materials are typically pressure rated at 73°F (23°C) and PE piping at temperatures greater than 80°F (26°C) require reduced test pressures. (Note that higher pipe temperatures should consider both ambient temperatures and radiant solar heating of exposed black HDPE pipe) Guidance for elevated temperatures can be found in the appendix of Chapter 3 (Material Properties) of the PPI Handbook of PE Pipe.

G. All pressure and leakage testing shall be done in the presence of a representative of the Owner and Engineer.

END OF SECTION