

# APPENDIX A – HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS TECHNICAL SPECIFICATION

## A. GENERAL

### 1. DESCRIPTION:

- a. Scope – This section specifies high density polyethylene pipe (HDPE) and fittings for water utility use as indicated on the Construction Drawings, and as specified herein.
- b. Contractor shall furnish, install, and test HDPE pipe as indicated and specified in this section and as referred to in related sections and the Construction Drawings.
- c. The primary installation method is burial. The means and methods, including the testing for acceptance shall conform to all applicable standards as noted herein with the intention of providing a leak-free system to the owner.

### 2. REFERENCES:

- a. To the extent referenced in this specification section, the standards and documents listed below are included, and made a part of this specification.
- b. In the event of a conflict, the requirements of this specification section prevail.
- c. Unless otherwise specified, references to documents shall mean the latest published edition of the referenced document in effect at the bid date of the project.

#### **ANSI/AWWA ([www.awwa.org](http://www.awwa.org))**

ANSI/AWWA C901-08 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm) for Water Service

ANSI/AWWA C906-07 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission

ANSI/AWWA C651 Standard for Disinfecting Water Mains

#### **Plastics Pipe Institute, PPI ([www.plasticpipe.org](http://www.plasticpipe.org))**

PPI Handbook of Polyethylene Pipe – 2009 (2nd Edition)

PPI TR-33 Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe

PPI TR-34 Disinfection of Newly Constructed Polyethylene Water Mains

PPI TR-41 Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping

PPI TN-42 Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects (2009)

#### **NSF ([www.nsf.org](http://www.nsf.org))**

NSF / ANSI 61 Drinking Water System Components—Health Effects

#### **ASTM ([www.astm.org](http://www.astm.org))**

ASTM F 714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

ASTM F905 Standard Practice for Qualification of Polyethylene Saddle-Fused Joints

ASTM F 1055 Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing

ASTM F 1290 Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings

ASTM F 1412 Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems

ASTM F1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
ASTM F 2164	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 D 2239	Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM F 2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
ASTM D 2683	Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	Standard Specification for Polyethylene (PE) Plastic Tubing
ASTM D 2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D 3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3350-08	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

3. SYSTEM DESIGN PARAMETERS:

- a. The polyethylene system working pressure rating accommodates the normal operating pressure and the repetitive surges. The pressure rating applies at 80°F or less.
- b. Per AWWA 901 and C906, the repetitive surge pressure allowance is one half the pressure class of the pipe, and the occasional surge over pressure allowance is equal to the pressure class of the pipe. Allowable Total Pressure during Recurring Surge conditions equals 1.5 times the pipe's pressure class. Allowable Total Pressure during Occasional Surge conditions equals 2.0 times the pipe's pressure class.

Table 1 gives the Pressure Class per AWWA C901, Pressure Rating and Allowable Total Pressure During Recurring and Occasional Surge for PE4710 pipe at 80°F or less.

*Table 1. Pressure Class per AWWA C901 for PE 4710 at 80°F or less*

Pipe Dimension Ratio (DR)	Pressure Class	Pressure Rating	Allowable Total Pressure During Recurring Surge	Allowable Total Pressure During Occasional Surge
DR 9	250 psi	250 psi	375 psi	500 psi
DR 11	200 psi	200 psi	300 psi	400 psi
DR 14.3	150 psi	150 psi	225 psi	300 psi
DR 17	125 psi	125 psi	185 psi	250 psi
DR 21	100 psi	100 psi	150 psi	200 psi

4. SUBMITTALS:

- a. Affirmation that product shipped meets or exceeds the standards set forth in this specification. This shall be in the form of a written document from the manufacturer attesting to the manufacturing process meeting the standards.
- b. Manufacturers recommended fusion procedures for the products.

5. DELIVERY, STORAGE, AND HANDLING:

- a. Handle the pipe in accordance with the PPI Handbook of Polyethylene Pipe (2nd Edition), Chapter 2 using approved strapping and equipment rated for the loads encountered. Pipe shall not be dragged on the ground. Do not use chains, wire rope, forklifts or other methods or equipment that may gouge or damage the pipe or endanger persons or property. Field storage is to be in compliance with AWWA Manual of Practice M55 Chapter 7.
- b. If any gouges, scrapes, or other damage to the pipe results in loss of 10 percent of the pipe wall thickness, cut out that section or do not use.

**B. PRODUCTS FOR 3 INCH AND SMALLER PIPE PER AWWA C901**

See Section 504 of the *Standard Construction Specifications*. For pipe used on main lines the outside diameter of the pipe shall be based upon the iron pipe size (IPS) sizing system.

**C. PRODUCTS FOR 4 INCH AND LARGER PIPE PER AWWA C906**

1. PIPE:

- a. Polyethylene pipe shall be made from HDPE material having a material designation code of PE4710 or higher. The material shall meet the requirements of ASTM D 3350 and shall have a minimum cell classification of PE445474C. In addition, the material shall be listed as meeting NSF-61.
- b. The pipe and fittings shall meet the requirements of AWWA C906.
- c. HDPE pipe shall be rated for use at a pressure class of 200 psi. The outside diameter of the pipe shall be based upon the iron pipe size (IPS) sizing system.
- d. HDPE pipe shall be of domestic manufacture.

2. FITTINGS:

- a. Butt Fusion and Sidewall Fusion Fittings - Fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2B.01A. Butt Fusion Fittings shall meet the requirements of ASTM D3261. Fittings 12-inches and smaller shall be injection molded. Fittings larger than 12-inches, and crosses of any size, may be either injection molded or fabricated. Reducing tees shall be either injection molded or branch saddle tees. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified on the Construction Drawings. All fittings shall meet the requirements of AWWA C906 and NSF-61.
- b. Markings for molded fittings shall comply with the requirements of ASTM D 3261. Fabricated fittings shall be marked in accordance with ASTM F 2206.
- c. Electrofusion Fittings - Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted in 2B.01A. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the Construction Drawings and shall meet the requirements of AWWA C906 and NSF-61. All electrofusion fittings shall be suitable for use as pressure conduits and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting. Markings shall be according to ASTM F 1055.
- d. Flange and Mechanical Joint Adapters (MJ Adapters) – Flange and Mechanical Joint Adapters shall have a material designation code of PE4710 or higher and a minimum Cell Classification as noted in 2B.01A. Flange and Mechanical Joint Adapters can be made to ASTM D 3261 or if machined, must meet the requirements of ASTM F 2206. Flange and MJ Adapters shall have a pressure rating equal to the pipe unless otherwise specified on the Construction Drawings. All flange and MJ adapters shall meet the requirements of AWWA C906 and NSF-61. Markings for molded or machined flange adapters or MJ Adapters shall be per ASTM D 3261. Fabricated (including machined) flange adapters shall be per ASTM F 2206. Bolts and nuts shall meet the requirements of Section 501 of the *Standard Construction Specifications*.
- e. Van-Stone style, ductile iron (or stainless steel when specified), convoluted or flat-plate, back-up rings and bolt materials shall follow the guidelines of Plastic Pipe Institute Technical Note # 38, and shall

have the bolt-holes and bolt-circles conforming to one of these standards: ASME B-16.5 Class 150, ASME B-16.47 Series A Class 150, ASME B-16.1 Class 125, or AWWA C207 Class 150 Series B, D, or E. The back-up ring shall provide a long-term pressure rating equal to or greater than the pressure-class of the pipe with which the flange adapter assembly will be used, and such pressure rating shall be marked on the back-up ring. Back-up rings, bolts, and nuts shall be SAE Type 316 stainless steel when specified in the contract documents due to the presence of corrosive soils.

- f. Service Saddles – Service Saddles on HDPE mains shall be as follows:
  - i. 12" and smaller: Transition Saddles (Corp Saddles) by Central Plastics, Inc. or approved equal
  - 16" and larger: Series 415 by Poly-Cam, Inc. or approved equal.
  - ii. All service saddles shall have a brass threaded outlet with 1-inch or 2-inch AWWA/CC threads as appropriate. Saddles shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2B.01A.
- g. All fittings, including bolts, nuts, back-up rings, retainer glands, gaskets and other accessories, shall be of domestic manufacture.

3. PIPE AND FITTING IDENTIFICATION:

- a. The pipe shall be marked in accordance with the standards to which it is manufactured.
- b. Color identification by the use of stripes on the pipe or marking tape wrapped around the pipe every two feet shall be required. Stripes and marking tape shall be blue for potable water. Marking tape shall be non-detectable Terra Tape by Reef Industries, Inc., or approved equal.
- c. Locate balls shall be placed per the Standard Construction Specifications.

**D. EXECUTION**

1. JOINING METHODS:

- a. Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN-42.
- b. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician shall be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.
- c. Mechanical: Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and ductile iron fittings shall use flange or mechanical joint adapters and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6.
- d. Joint Recording - The critical parameters of each fusion joint, as required by the manufacturer and these specifications, shall be recorded by an electronic data logging device on pipe larger than 12-inch diameter and on smaller pipe when required in the Contract Documents. All fusion joint data shall be included in the Fusion Technician's joint report.

2. INSTALLATION:

See Section 204 of the Albany Standard Construction Specifications.

3. TESTING:

In addition to the testing requirements of Section 505 of the *Standard Construction Specifications*, Hydrostatic leakage testing shall comply with the following procedure in-lieu-of the procedures outlined in Section 505.01.02B.

The pipe shall be pressurized with water and maintained at 160 psi for a period of four hours prior to the start

of the pressure test. Once this step is complete, the pipe pressure shall be reduced to 150 psi and held for one hour, without adding additional water, with no more than a 5 percent drop in pressure. After the initial one-hour pressure test is successful, the pressure test shall be continued for an additional hour with no more than an additional 5 percent drop in pressure to ensure the integrity of all mechanical connections. If the pressure test is unsuccessful and needs to be repeated, the test section shall remain depressurized for a minimum of eight hours before retesting. Pneumatic (compressed air) leakage testing of HDPE pressure piping is prohibited for safety reasons.