

## Sample Specifications for Factory Mutual Approved High Density Polyethylene Pipe and Fittings

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1. General Terms and Conditions
  - 1.1 Scope: This specification covers requirements for Factory Mutual Approved PE 3608 high density polyethylene pipe and fittings for fire protection lines underground.
  - 1.2 Engineers Approved Plans: Fire protection lines located underground shall be constructed in accordance with plans and specifications prepared by a Professional Engineer.
  - 1.3 Standards. All standards and specifications referenced shall be the latest edition and version thereof. This includes ASTM, ANSI, and Federal specifications and standards.
  - 1.4 Licenses and Permits. All construction work related to underground fire protection systems shall be performed by a licensed and bonded General Contractor. Permits and licenses must be obtained prior to construction.
  - 1.5 Inspections. An Authorized Representative of the Owner shall inspect all work. The Authorized Representative shall have the authority to halt construction if these specifications, construction standards, or OSHA or Owners safety policies are not being followed. Construction shall be halted until the portion of the specification or standard is corrected. Written notice of the violation is required. A copy of the written notice shall be filed with the Contractor's license application for future review. If the deficiencies are not corrected, the contractor's surety shall be required to complete the work.
  - 1.6 Warranty and Acceptance. Materials and workmanship shall have a one-year warranty to be free from defects in workmanship and materials. The warranty will be from the date of completion of construction. If work has been done to the requirements of this specification, a letter of acceptance shall be provided to the contractor upon final inspection. If deficiencies are discovered during the warranty period, the Contractor shall be required to correct these deficiencies without additional charge to the Owner or his agent. The Project Engineer shall determine the need for warranty repair work to be performed by the Contractor. The Project Engineers determination of a deficiency will bind the Contractor to make a repair in accordance with this Contract.

ISCO Industries, LLC has carefully checked the accuracy and standards used in the preparation of these sample specifications, it does not guarantee or warranty piping installations. Sample specifications are to be used as a guide to assist engineers and owners of piping systems. Sample specifications do not cover all situations or applications. These specifications are not intended to provide installation training or instructions. Since every job is different, a trained professional engineer should be used to determine the needs of a particular job.

## 2.0 High Density Polyethylene Pipe and Fittings

- 2.1 Qualifications of Pipe Manufacturers. The HDPE pipe shall be manufactured in a plant approved by Factory Mutual, and supplied by ISCO Industries, LLC. The facility shall have the necessary testing equipment to verify that the pipe meets the requirements of Factory Mutual and ASTM standards.
- 2.2 Qualifications of the Fittings Manufacturer. The HDPE fittings shall be manufactured in a facility approved by Factory Mutual, and supplied by ISCO Industries, LLC. The facility shall have the necessary testing equipment to verify that the fittings meet the requirements of Factory Mutual standards.
- 2.3 Materials. Polyethylene pipe and fittings shall be made from resin meeting the requirements of the Plastic Pipe Institute as PE 3608. The resin shall meet the requirements of ASTM D3350 with a cell classification of 345464C. The requirements of this cell classification are:

### HDPE Resin Specifications

PROPERTY		SPECIFICATION	UNIT	TYPICAL VALUE
Material Designation		PPI / ASTM		PE3608
Material Classification		ASTM D 1248		III C 5 P34
Cell Classification		ASTM D 3350		345464C
Density	(3)	ASTM D 1505	g/cm <sup>3</sup>	0.955
Melt Index	(4)	ASTM D 1238	gm/ 10 min	0.11
Flexural Modulus	(5)	ASTM D 790	psi	135,000
Tensile Strength	(4)	ASTM D 638	psi	3,200
Slow Crack Growth				
ESCR		ASTM D 1693	hours in 100% igepeal	>5,000
PENT	(6)	ASTM F 1473	hours	>100
HDB @ 73 deg F	(4)	ASTM D 2837	psi	1,600
UV Stabilizer	(C)	ASTM D 1603	%C	2.5%

- 2.4 Interchangeability of Pipe and Fittings. High-density polyethylene pipe and fittings can be supplied by different manufacturers as long as the materials are approved by Factory Mutual and meet the above ASTM D 3350 cell classification.
- 2.5 HDPE Fire Protection Main Pipe. The HDPE pipe shall be Factory Mutual Approved, marked according to its pressure designation as Class 150 or 200, and be marked with the Factory Mutual diamond logo. Each production run of pipe shall be tested for melt index, density, % carbon, and dimensions.
- 2.6 Butt Fusion Fittings. HDPE fittings shall be PE3608 HDPE, Cell Classification of 345464C as determined by ASTM D 3350, and approved for FM use. Molded butt fusion fittings shall have a manufacturing standard of ASTM D 3261. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records. HDPE fittings shall be molded or fabricated. Factory Mutual approval shall be marked with the Factory Mutual diamond logo.

- 2.7 Pipe Manufacturer's Quality Control. The pipe manufacturer shall have an on-going Quality Control program for incoming and outgoing materials. High-density polyethylene (HDPE) resins for manufacturing of pipe shall be checked for density, melt flow rate, and contamination. The manufacturer of the HDPE resin shall certify the Cell Classification as indicated in section 2.3. These incoming resins shall be approved by plant Quality Control before being converted to pipe. Pipe shall be checked for outside diameter, wall thickness, length, roundness, and surface finish on the inside and outside and end cut.
- 2.8 Fittings Manufacturer's Quality Control. The fitting manufacturer shall have an on-going Quality Control program for incoming and outgoing materials. The resin shall be checked as indicated in section 2.3. Pipe for fabricated fittings shall be checked as indicated in 2.6. Molded fittings shall be inspected for voids and knit lines. All fabricated fittings shall be inspected for joint quality and alignment. All fabricated fittings welds shall be made using a DataLogger. A record of the temperature, pressure and graph of the fusion cycle shall be maintained by the fitting manufacturer.
- 2.9 Permanent Records. The Manufacturer of the pipe and fittings shall maintain permanent QC and QA records. DataLogger records shall be maintained on fabricated fittings.
- 2.10 Compliance Testing. If requested, the pipe or fittings manufacturer can be required to retest or verify certification data. All retesting shall be at the requestor's expense, and shall be performed as required in the specifications.

### 3.0 Joining

- 3.1 Plain end pipe and fittings shall be made using butt fusion. The butt fusion procedures shall be in accordance with the manufacturer or the PPI. The fusion equipment operator shall receive training using the recommended procedure. The Contractor shall be responsible to verify that the fusion equipment is in good operating condition and that the operator has been trained within the past twelve months. The fusion equipment shall be equipped with a Datalogger. Records of the welds (heater temperature, fusion pressure, and a graph of the fusion cycle) shall be maintained for five (5) years. Fusion beads shall not be removed.
- 3.2 Heat Fusion Training. The supplier of the pipe and fittings shall provide a person certified by the pipe manufacturer and the fusion equipment manufacturer to train contractor fusion equipment operators and inspectors representing the Owner.
- 3.3 Electrofusion couplings. Polyethylene pipe and fittings may be joined using electrofusion couplings. Fittings shall be PE3608 HDPE, Cell Classification of 345464C as determined by ASTM D 3350. Electrofusion Fittings shall have a manufacturing standard of ASTM F 1055. Fittings shall have the same pressure rating as the pipe.

## 4.0 Installation

- 4.1 Installation. Pipe and fittings shall be installed using procedures recommended by the manufacturer.
- 4.2 General. Pipe and fittings shall be packaged in a manner suitable for shipment by a commercial carrier. Upon receipt at job site, a receiving inspection shall be prepared. The quantity shall be verified and any shipping damage shall be reported to the supplier within 7 days.
- 4.3 Excavation. Trenches shall be excavated in accordance with the plans and specifications. OSHA standards or Owner safety policies regarding safety shall be followed regarding trench safety. If groundwater is encountered, it shall be removed by the Contractor. Shoring of the trench, where required is the responsibility of the contractor.
- 4.4 Flange Installation. Flanges shall be attached to pipe and fittings using butt fusion. The flanges shall be aligned and centered relative to the pipe. Flanges should be square with the valve or other flange before tightening of bolts. Bolts should not be used to draw flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be used under flange nuts. Bolts shall be tightened using a "star tightening pattern". See manufacturer's recommendations. Twenty-four hours after first tightening the flange bolts, they must be re-tightened using the same "star tightening pattern" used above. The final tightening torque shall be as indicated by the manufacturer.
- 4.5 Foundation & Bedding. Install pipe on grade and on a stable foundation. Unstable soil or muck shall be removed from the trench bottom. A 6" foundation or bedding of compacted Class 1 material shall be installed in the bottom of the trench. This bedding material shall be installed on grade. Water shall be removed from the trench before bringing the bedding material and pipe to grade and backfilling. When a trench is cut through solid rock, it shall be excavated to 6" below the pipe bottom grade, and bedded with Class 1 bedding. All slabs of rock, boulders and large rocks shall be removed. ASTM D 2321 is the reference specification for installation of HDPE pipe. Bedding shall be Class 1 per this specification.
- 4.6 Pipe and Large Fitting Handling: A nylon fabric choker sling capable of safely handling the weight of the pipe or fitting, shall be used to lift, place and move pipe and fittings.
- 4.7 Backfilling. Class I and II backfill shall be used for pipe embedment backfill. This material shall be compacted to at least 90% Standard Proctor Density in 6" lifts to at least 6" above the crown of the pipe.
- 4.8 Final Backfilling. Final backfill shall be placed in the trench and compacted to finished grade. Native soils without roots, limbs, large rocks, boulders, clumps, or frozen clods or any object that could damage the pipe can be used.

## 5.0 Testing

- 5.1 Pressure testing shall be conducted in accordance with the ASTM F 2164, Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure. The HDPE pipe shall be filled with water, raised to test pressure and allowed to stabilize. The test pressure shall be 1.5 times the operating pressure at the lowest point in the system. In accordance with section 9.8, the pipe shall pass if the final pressure is within 5% of the test pressure for 1 hour. For safety reasons, hydrostatic testing only will be used.