

SECTION 331050

HIGH DENSITY POLYETHYLENE PIPE (HDPE)

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment, and incidentals required to install High Density Polyethylene (HDPE) pressure pipe, fittings, and appurtenances as shown on the Drawings and specified in the Contract Documents.
- B. High Density Polyethylene (HDPE) – North Port Utilities (NPU) has the option of approving the use of HDPE for pipeline crossings of roadways, ditches, canals, and environmentally sensitive lands. HDPE mains shall have the same equivalent internal diameter and equivalent pressure class rating as the corresponding PVC pipe, unless otherwise approved by NPU or the Engineer. For all roadway crossings requiring casing pipe, a steel or DR 11 HDPE casing pipe must be provided. The Department of Transportation having jurisdiction of said road and right-of-way must grant specific approval.

1.2 REFERENCED STANDARDS

- A. All standard specifications, i.e., Federal, ANSI, ASTM, etc., made a portion of these Specifications by reference, shall be the latest edition and revision thereof.

1.3 QUALIFICATIONS

- A. Furnish all HDPE pipe, fittings, and appurtenances by a single manufacturer, unless otherwise approved by the City or Engineer, who is fully experienced, reputable and qualified in the manufacture of the items to be furnished.

1.4 SUBMITTALS

- A. Submit to the Engineer, a list of materials to be furnished, the names of the suppliers, and the appropriate shop drawings for all HDPE pipe and fittings.
- B. Submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

- C. Submit shop drawings showing installation method and the proposed method and specialized equipment to be used.
- D. Submit certification documentation for all HDPE fusion welders.

1.5 INSPECTIONS AND TESTS

- A. All work shall be inspected by NPU or designee who shall have the authority to halt construction if, in their opinion, these specifications or standard construction practices are not being followed. Whenever any portion of these specifications is violated, NPU or designee, may order further construction to cease until all deficiencies are corrected.

1.6 WARRANTY AND ACCEPTANCE

- A. Warrant all work to be free from defects in workmanship and materials for a period of one year from the date of completion of all construction. If work meets these specifications, a letter of acceptance, subject to the one-year warranty period, shall be given at the time of completion. A final acceptance letter shall be given upon final inspection at the end of the one-year warranty period, provided the work still complies with these specifications. In the event deficiencies are discovered during the warranty period, the Contractor shall correct them without additional charge to the City before final acceptance. During the warranty period, NPU or designee will determine if warranty repairs or replacement work shall be performed by the Contractor. The decision of the NPU shall be binding upon the Contractor.
- B. Installer Certification for the Contractor installing thermal butt fused HDPE pipe is required for acceptance.

PART 2 - PRODUCTS

2.1 POLYETHYLENE PIPE AND FITTINGS

- A. Provide polyethylene pressure pipe manufactured from PE3408 polyethylene meeting AWWA C906 standards. When specified by the Engineer on the construction drawings, as an alternate to PVC, HDPE (ductile iron pipe sized) piping can be used for buried applications. Iron pipe sized (IPS) HDPE piping can be used for below-ground applications as determined by the Engineer.
- B. The diameter of DR 11 HDPE casing pipe provided for roadway crossings or other purposes shall conform to the construction drawings and as detailed in this specification.
- C. For HDPE pressure carrier pipes, casing spacers are not required when

HDPE DR11 (or DR17 for 42" to 54" or DR21 for 63") casing is used. The casing inside diameter shall be a minimum of two inches larger than the carrier pipe's outside diameter.

- D. HDPE to HDPE pipe connections shall be by thermal butt fusion. Thermal fusion shall be accomplished in accordance with the pipe manufacturer and fusion equipment supplier specifications. The Contractor installing thermal butt fused HDPE pipe shall be certified in this type of work and have a minimum of five-years' experience performing this type of work. The Contractor shall provide certification to the Engineer of Record.
- E. Qualification of Manufacturer: The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications. The Manufacturer's production facilities shall be open for inspection by NPU or designee. Qualified manufacturers shall be approved by NPU or designee.
- F. Manufacturers that are qualified for HDPE to Ductile Iron adapters are Independent Pipe Products, Specified Fittings and George Fisher Central Plastics. Products from other manufacturers proposed for the work must receive approval from NPU or designee prior to ordering.
- G. Materials: Materials used for the manufacture of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classification 345434C or 345434E per ASTM D3350; and meeting Type III, Class B or Class C, Category 5, Grade P34 per ASTM D1248; and shall be listed in the name of the pipe and fitting manufacturer in PPI (Plastics Pipe Institute) TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds, with a standard grade rating of 1600 psi at 73°F. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.
- H. Polyethylene Pipe: Polyethylene pipe shall be manufactured in accordance with ASTM F714, Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, for pipe outside diameter of 3.5-inch or larger, or ASTM D3035, Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter, and shall be so marked. Each production lot of pipe shall be tested for (from material or pipe) melt index, density, percentage carbon, (from pipe) dimensions and either quick burst or ring tensile strength (equipment permitting).
- I. Color Identification: HDPE must have at least three equally spaced horizontal colored marking stripes. Permanent identification of piping service shall be provided by adhering to the following colors.

Blue – potable water (Underground HDPE pipe shall be one of the following:

- a. Solid-wall blue pipe;
- b. Co-extruded blue external skin; or
- c. White or black pipe with blue stripes incorporated into, or applied to, the pipe wall.

White – raw water

Green – wastewater, sewage

Pantone Purple – non-potable irrigation, reclaimed or reuse water

- J. Polyethylene Fittings and Custom Fabrications: Polyethylene fittings and custom fabrications shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited.
- K. Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D3261.
- L. X-Ray Inspection: The Manufacturer shall submit samples from each molded fittings' production lot to x-ray inspection for voids and shall certify that voids were not found.
- M. Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full-service pressure rating of the mating pipe. Directional fittings 16" IPS and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets. Part drawings shall be submitted for the approval of the Engineer.
- N. Polyethylene Flange Adapters: Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to provide gasketless sealing, or to restrain the gasket against blow-out.

- O. Back-up Rings and Flange Bolts: Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.

2.2 MANUFACTURER'S QUALITY CONTROL

- A. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier and verified by Manufacturer's Quality Control. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing materials shall be checked for:

1. Outside diameter, wall thickness, and eccentricity as per ASTM D2122 at a frequency of at least once/hour or once/coil, whichever is less frequent.
2. Out of roundness at frequency of at least once/hour or once/coil, whichever is less frequent.
3. Straightness, inside and outside surface finish, markings and end cuts shall be visually inspected as per ASTM F714 on every length of pipe.

- B. Quality Control shall verify production checks and test for:

1. Density as per ASTM D1505 at a frequency of at least once per extrusion lot.
2. Melt index as per ASTM D1238 at a frequency of at least once per extrusion lot.
3. Carbon content as per ASTM D1603 at a frequency of at least once per day per extrusion line.
4. Quick burst pressure (sizes through four (4) inch) as per ASTM D1599 at a frequency of at least once per day per line.
5. Ring Tensile Strength (sizes above four (4) inch equipment permitting) as per ASTM D2290 at a frequency of at least once per day per line.
6. ESCR (size permitting) as per ASTM F1248 at a frequency of at least once per extrusion lot.

- C. X-ray inspection shall be used to inspect molded fittings for voids and knit line strength shall be tested. All fabricated fittings shall be inspected for joint quality and alignment.

2.3 COMPLIANCE TESTS

- A. In case of conflict with Manufacturer's certifications, the Contractor, Engineer, or NPU may request re-testing by the manufacturer or have re-tests performed by an outside testing service. All retesting shall be at the requestor's expense and shall be performed in accordance with the Specifications.
- B. Installation shall be in accordance with Manufacturer's recommendations and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with the applicable codes and standards.

PART 3 – EXECUTION

3.1 INSTALLATION OF HIGH-DENSITY POLYETHYLENE PRESSURE PIPE AND FITTINGS

- A. Install all high-density polyethylene (HDPE) pressure pipe by direct bury, directional bore, or a method approved by NPU or the Engineer prior to construction. If directional bore is used, or if directed by the NPU or the Engineer, surround the entire area of construction with silt barriers.
- B. Install all high-density polyethylene pressure pipe and fittings in accordance with Manufacturer's recommendations, and this specification. Take all necessary precautions to ensure a safe working environment in accordance with the applicable codes and standards.

3.2 HEAT FUSION JOINING

- A. Make joints between plain end pipes and fittings by butt fusion, and joints between the main and saddle branch fittings by using saddle fusion using only procedures that are recommended by the pipe and fitting Manufacturer. Ensure that persons making heat fusion joints have received training and certification for heat fusion in the Manufacturer's recommended procedure. Maintain records of trained personnel and certify that training was received not more than twelve (12) months before commencing construction. External and internal beads shall not be removed.

3.3 MECHANICAL JOINING

- A. HDPE pipe and fittings shall be fused together by heat welding when possible. HDPE pipe and fittings may be joined together or to other materials by means of flanged connections with back-up rings, by mechanical joint adapter with glands, or mechanical couplings designed for joining HDPE pipe or for joining HDPE pipe to another material. A stainless-steel sleeve insert shall be used with a mechanical coupling. Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins.

3.4 BRANCH CONNECTIONS

- A. Make branch connections to the main with saddle fittings or tees. Saddle fuse polyethylene saddle fittings to the main pipe.

3.5 EXCAVATION

- A. Excavate trenches in conformance to this specification, the plans and drawings, or as authorized in writing by NPU or designee, and in accordance with all applicable codes. Remove excess groundwater. Where necessary, shore or reinforce trench walls.

3.6 LARGE DIAMETER FABRICATED FITTINGS

- A. Butt fuse fabricated directional fittings 16" IPS and larger to the end of a pipe. Make up the flanged directional outlet connections in the trench.

3.7 MECHANICAL JOINT AND FLANGE INSTALLATION

- A. Install mechanical joints and flange connections in accordance with the Manufacturer's recommended procedure. Center and align flange faces to each other before assembling and tightening bolts. Do not use the flange bolts to draw the flanges into alignment. Lubricate bolt threads, and fit flat washers under the flange nuts. Tighten bolts evenly according to the tightening pattern and torque step recommendations of the Manufacturer. At least one hour after initial assembly, re-tighten flange connections following the tightening pattern and torque step recommendations of the Manufacturer. The final tightening torque shall be 100 ft-lbs or less as recommended by the Manufacturer.

3.8 FOUNDATION AND BEDDING

- A. Lay pipe on grade and on a stable foundation. Remove unstable or mucky trench bottom soils and install a six (6") inch foundation or bedding of compacted Class I material to pipe bottom grade. Remove excess groundwater from the trench before laying the foundation or bedding and the pipe. A trench cut in rock or stony soil shall be excavated to six (6") inches below pipe bottom grade and brought back to grade with compacted Class I bedding. Remove all ledge rock, boulders, and large stones.

3.9 PIPE HANDLINE

- A. When lifting with slings, use only wide fabric choker slings to lift, move, or lower pipe and fittings. Do not use wire rope or chain. Slings shall be of sufficient capacity for the load and shall be inspected before use. Do not use worn or defective equipment.

3.10 HYDROSTATIC TESTS OF PRESSURE PIPE

- A. After the pipe has been laid, and after inspection by NPU, all newly laid pipe shall be subjected to a hydrostatic pressure test in accordance with AWWA C600 Sec. 4. The Contractor shall perform a hydrostatic pre-test to provide reasonable assurance of acceptance prior to performance of the witnessed test. Upon accomplishing a successful pre-test, the Contractor shall contact the NPU at least 48 hours prior to the test. NPU or the NPU's designated representative shall be present during all tests.
- B. Slowly fill the pipe with water and allow it to stand for 24 hours. Expel all air from the pipe. Apply and maintain the specified test pressure by continuous pumping if necessary, for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the NPU. The pump suction shall be in a barrel or similar device or metered so that the amount of water required to maintain the test pressure may be measured accurately.
- C. Tapping tees shall be tested at 150-psi for 15 minutes before the tap is made and separate from the testing of the main lines and service connections.
- D. Each pressure test shall be a minimum of two (2) hours according to the following, unless otherwise directed by the NPU:
 - 1. Leakage shall be defined as the quantity of water necessary to hold the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L = \frac{SD\sqrt{P}}{1000}$$

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L = allowable leakage, in gallons per hour.

S = length of pipe tested, in feet.

D = nominal pipe diameter, in inches.

P = average test pressure, in psi (gauge).

2. Allowable leakage in gallon per hour per 1,000 feet of pipeline can be determined from the following chart.

Avg Test Pressure psi	Nominal Pipe Diameter - Inches										
	3	4	6	8	10	12	14	16	18	20	24
450	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82
400	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12
275	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85
225	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01
100	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80

3. Test service connection pipe by either testing in conjunction with the main at the test pressure required for the main, or by testing at the normal hydrostatic main pressure after the main has been completely installed and tested. Inspect visually for leaks and repair any leaks before backfilling. Duration of the test shall be a minimum of 15 minutes.
4. Pressure pipe containing polyethylene piping in any section shall be tested as follows:
 - a) Test all pressure pipe sections (valve to valve) constructed of PVC and ductile iron piping at a 150-psi test pressure with the allowable loss as already described.
 - b) Sections (valve to valve) containing polyethylene piping shall be tested at a 150-psi test pressure. The test pressure shall initially be advanced to 50-psi. The pressure should then be advanced in gradual additions until the test pressure is achieved. The test pressure should be maintained for three hours to allow for pipe expansion, adding water as necessary. Immediately after the three

(3) hour expansion period, test pressure should be reduced to 140-psi and addition of water stopped. If the pressure remains steady (within 7-psi) for one (1) hour, no leakage is indicated.

3.11 DISINFECTION (Potable Water Only)

- A. Before main disinfection, the main shall be filled to eliminate air pockets and flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 ft/sec unless NPU determines that conditions do not permit the required flow.
- B. The continuous feed method of chlorination shall be used in accordance with AWWA C601, Section 5.2. The chlorinated mixture shall be prepared from a liquid chlorine gas-water mixture; or a calcium or sodium hypochlorite solution. Direct feed chlorinators shall not be used.
- C. If the calcium hypochlorite method is used, first mix the dry powder with water to make a thick paste, then thin to approximately a one percent solution (10,000 ppm chlorine). If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a one percent solution. The following proportions for hypochlorite to water will be required:

<u>Product</u>	<u>Quantity</u>	<u>Water</u>
Calcium Hypochlorite (1) (65-70 percent Cl)	1 lb	7.5 gal.
Sodium Hypochlorite (2) (5.25 percent Cl)	1 gal.	4.25 gal.

1. The procedure for chlorinating the main shall be in accordance with AWWA C601, Section 5.2
2. Placing concentrated quantities of commercial disinfectants such as calcium hypochlorite granules in the line prior to filling with water is not allowed.
3. Water entering the newly laid section of pipe being disinfected shall receive a dose of chlorine solution fed at a constant rate such that the water will have not less than 40 ppm nor more than 50 ppm of free chlorine.
4. Acceptance of satisfactory disinfection shall be based on compliance with AWWA C601, the procedures outlined herein and satisfactory bacteriological samples. Any positive bacteriological samples or non-compliance with AWWA C601 shall be evaluated by NPU.

3.12 DISINFECTING

- A. The Contractor shall provide all labor, materials, equipment (water to be furnished by the NPU, as necessary to complete disinfecting the mains and appurtenances, as specified herein; including installation of pipe taps necessary for chlorination or taking samples and including paying for all bacteriological testing by Department of Health and/or an approved independent laboratory.
- B. The Contractor shall disinfect all installed water mains in accordance with the requirements of AWWA C651, except as amended or added below:
 - 1. Discuss the procedure with NPU and obtain approval before doing the work.
 - 2. All newly installed water mains shall be flushed at a minimum velocity of 2.5 ft/sec before and after disinfection.
 - 3. Form of chlorine: Calcium hypochlorite granules or sodium hypochlorite solution.
 - 4. Method of chlorine application: Continuous feed method or slug method.

3.13 BACTERIOLOGICAL TESTING (Potable Water Only)

- A. Chlorinated water shall be flushed from the main until measured levels of chlorine leaving the main are no higher than background levels prevailing in the system.
- B. A neutralizing agent shall be applied to the chlorinated discharge if there is a question as to whether this discharge will damage the environment.
- C. Bacterial samples shall be collected at the end of each line and along the main as directed by NPU. At least one sample shall be collected from each new main or branch.
- D. Sampling shall be the responsibility of the Contractor. Samples will be taken on two consecutive days by the Department of Health (DOH) in the presence of NPU's representative in accordance with F.A.C. 17-555. The Contractor shall contact NPU at least 48 hours prior to chlorination to coordinate witnessing chlorination by NPU.
- E. If bacteriological results do not show an absence of total coliform at all

sample stations for two consecutive days, the Contractor will be required to rechlorinate and flush the line at no additional cost to the City.

END OF SECTION