

SANITARY SEWER SYSTEMS

****From Hartford IM BLDG(10)**

- xx. DESCRIPTION. This work shall consist of the construction of sanitary sewer lines and appurtenances.

The work under this Section shall be performed in accordance with these provisions, the Plans, and Section 628 of the Standard Specifications.

- xx. MATERIALS. Materials shall meet the requirements of the following Subsections:

Crushed Gravel for Subbase.....704.05

- xx. HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS.

- (a) Reference Standards.

Reference:	Title:
AWWA C901	Polyethylene (PE) Pressure Pipe & Tubing, 1/2 inch through 3 inch for water service
AWWA C906	Polyethylene (PE) Pressure Pipe & Fittings, 4 inch through 63 inch for water dist.
ASTM D3035	Standard Specification for PE Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3261	Butt Heat Fusion PE Fittings for PE Pipe & Tubing
ASTM D3350	Standard Specification for PE Pipe & Fittings Materials
ASTM D1238	Melt Flow Index
ASTM D1505	Density of Plastics
ASTM D2837	Hydrostatic Design Basis
NSF Std.#14	Plastic Piping Components & Related Materials

All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications. Qualified manufacturers shall be: PLEXCO Division of Chevron Chemical Company, DRISCOPIPE as manufactured by Phillips Products Co., Inc., SCLAIRPIPE as manufactured by Dupont of Canada or equal.

- (b) Submittals. Submit Fabrication Drawings in accordance with Section 105.
- (c) Polyethylene Pipe. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell

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classification 345434C per ASTM D3350; and meeting Type III Class C, Category 5, Grade P34 per ASTM D1238.

High Density Polyethylene (HDPE) pipe shall comply with AWWA Specifications C901 or C906.

If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

Dimensions and workmanship shall be as specified by ASTM F714. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

HDPE pipe and accessories, shall be 160 psi at 73.4⁰F meeting the requirements of Standard Dimension Ration (SDR) 11 as MINIMUM STRENGTH.

The pipe Manufacturer must certify compliance with the above requirements.

- (d) Fittings. All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Engineer. No size on size wet taps shall be permitted.

All transition from HDPE pipe to ductile iron or PVC shall be made per the approval of Engineer and per the HDPE pipe manufacturer's recommendations and specifications. A molded flange connector adapter within a 316 stainless steel back-up ring assembly shall be used for pipe type transitions.

- (1) Transition from HDPE to ductile iron fittings and valves shall be approved by Engineer before installation.
- (2) No solid sleeves shall be allowed between such material transitions.
- (3) The pipe supplier must certify compliance with the above requirements.

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- (e) Pipe Identification. The following shall be continuously indent printed on the pipe or spaced at intervals not exceeding 5 feet:
- (1) Name and/or trademark of the pipe manufacturer.
 - (2) Nominal pipe size.
 - (3) Dimension ratio.
 - (4) The letters PE followed by the polyethylene grade in accordance with ASTM.
 - (5) D1248 followed by the hydrostatic design basis in 160's of psi, e.g., PE 3408.
 - (6) Manufacturing standard reference, e.g., ASTM F714 or D-3035, as required.
 - (7) A production code from which the date and place of manufacture can be determined.
 - (8) Color Identification, either stripped by co-extruding longitudinal identifiable color markings or shall be solid in color and GREEN for Sanitary Sewer.
- (f) Jointing Method. The pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657. All joints shall be made in strict compliance with the manufacturer's recommendations. A factory qualified joining technician as designated by pipe manufacturer or experienced, trained technician shall perform all heat fusion joints in the presence of the ENGINEER.

Lengths of pipe shall be assembled into suitable installation lengths by the butt-fusion process. All pipe so joined shall be made from the same class and type of raw material made by the same raw material supplier. Pipe shall be furnished in standard laying lengths not to exceed 50 feet and no shorter than 20 feet.

The polyethylene flange adapters at pipe material transitions shall be backed up by stainless steel flanges conforming to ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel as specified in ASTM A726 and ASTM A307. All bolts shall be tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly. After installation apply a bitumastic coating to bolts and nuts.

- (g) Installation. High Density Polyethylene (HDPE) Pipe shall be installed in accordance with the instruction of the manufacturer, as shown on the Drawings and as specified herein. A factory qualified joining technician as

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designated by the pipe manufacturer shall perform all heat fusion joints.

HDPE shall be installed in accordance with part (h) Open Trench Installation of this Subsection.

Care shall be taken in loading, transporting and unloading to prevent injury to the pipe. Pipe or fitting shall not be dropped. All pipe or fitting shall be examined before installation, and no piece shall be installed which is found to be defective. Any damage to the pipe shall be repaired as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor at the Contractor's expense.

Under no circumstances shall the pipe or accessories be dropped into the trench.

Care shall be taken during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.

Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe.

Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

Pipe shall be stored on clean level ground to prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 5 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges or scratches.

Pipe shall be laid to lines and grade shown on the Drawings with bedding and backfill as shown on the Drawings.

When laying is not in progress the open ends of the pipe shall be closed by fabricated plugs, or by other approved means.

Sections of pipe with cuts, scratches or gouges exceeding 5 percent of the pipe wall thickness shall be removed completely and the ends of the pipeline rejoined.

The pipe shall be joined by the method of thermal butt fusion as specified in part (f) Jointing Method of this Subsection. All joints shall be made in strict compliance with the manufacturer's recommendations.

Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps and tanks shall be through flanged connections which shall consists of the following:

- (1) A polyethylene flange shall be thermally butt-fused to the stub end of the pipe.
- (2) A 316 stainless steel back up ring shall mate with a 316 stainless steel flange.
- (3) 316 stainless steel bolts and nuts shall be used.

Flange connections shall be provided with a full-face neoprene gasket.

All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

If a defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required.

- (h) Open Trench Installation. Applicable portions of this Section including excavation, bedding, backfill, and testing shall apply in their entirety.

The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-in per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.

Good alignment shall be preserved during installation. Deflection of the pipe shall occur only at those places on design drawings and as approved by the Engineer. Fittings, in addition to those shown on the Drawings, shall be used only if necessary or required by the Engineer.

Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be "pulled" or "cramped".

Precautions shall be taken to prevent flotation of the pipe in the trench.

When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.

Restrained joints shall be installed where shown on the Drawings or as directed by the Engineer.

- (i) Testing. Refer to Pressure Testing requirements as outlined in TESTING OF SYSTEM, part (b) Pressure Pipe Testing of this Section.

xx. PRE-INSULATED DUCTILE IRON PIPE.

- (a) General. Pre-insulated pipes shall be Class 52 ductile iron pipes as specified herein. The pipe shall be insulated using the U.I.P. factory insulation process, as supplied by Urecon Ltd., complete with integral conduit for electric heat trace cable and 1.27 mm (50 mils) minimum black polyethylene jacket. Insulation of associated joints, fittings and accessories shall be as per Urecon's recommendations, depending on the size and type of pipe involved. The product shall be manufactured in accordance to ISO 9001-2000 Standards, or approved equal.
- (b) Heat Tracing Conduit(s). Heat tracing conduit(s) shall consist of an extruded molding and shall be applied to the pipe prior to application of the insulation. The conduit(s) will be securely fastened to the pipe to prevent the ingress of foam therein during the insulation process. All conduit(s) shall be checked after insulating to insure they are not plugged. The ends shall be sealed prior to shipping to prevent any foreign material from entering the conduit while in transit or during installation.
- (c) Insulation.
 - (1) Material: rigid polyurethane foam, factory applied.
 - (2) Thickness: 50 mm (2 in.) or as required.
 - (3) Density: (ASTM D 1622) 35 to 48 kg/m³ (2.2 to 3.0 lbs/ft³).
 - (4) Closed cell content: (ASTM D 2856) 90%, minimum.
 - (5) Water absorption: (ASTM D 2842) 4.0% by volume.

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(6) Thermal conductivity: (ASTM C518) 0.020 to 0.026 W/m•°C (0.14 to 0.17 Btu•in/ft²•hr•°F).

(d) System Properties.

(1) System compressive strength: (modified ASTM D 1621 with 50 mil jacket) approximately 414 to 552 kPa (60-80 lbs/in²), varies with pipe diameter.

(2) Temperature limitations:

a. in service: -45° to 85°C (-49° to 185°F)

b. installation: -34°C (-30°F)

(e) Outer Jacket on Pipe Insulation (with enhanced 'Cold Climate Handling' Properties).

The outer protective jacket shall consist of custom blended black polyethylene, Scapa Tape # 366, 1.27 mm (50 mils) factory applied. The jacket shall have a modified butyl rubber adhesive to ensure positive adhesion to the foam insulation and shall be applied hot in two counterwound and overlapping layers each 0.64 mm (25 mils) thick to ensure a shrink tightened waterproof bond throughout its entire length.

Outer jacket characteristics:

(1) Jacket material: polyethylene UV inhibited, specially formulated for superior cold environment properties, Scapa Tape #366.

(2) Sealant: butyl rubber and resin.

(3) Jacket thickness: 1.27 mm (50 mils.)

(4) Minimum elongation: (ASTM D 1000) 300%, 6 month test.

(5) Service temperature range:

a. installation: -34° to 82°C (-30° to 180°F)

b. in service : -45° to 85°C (-49° to 185° F)

(6) Tensile strength: (ASTM D-1000) 6.83 kg/cm wide (38 lbs/in wide).

(f) Insulated Pipe Joints. Insulated pipe joints shall be sealed with a 300 mm (12 in.) wide heat shrink sleeve.

(g) Insulation Kits For Fittings. Insulation kits for fittings shall consist of rigid polyisocyanurate or urethane foam insulation with a fully bonded polymer protective coating on all exterior and interior surfaces, including ends. Kits to be supplied complete with silicone caulking for seams,

stainless steel attachment straps and clips, and heat shrink sleeves to seal between pipe and insulation kit.

(1) Rigid Polyisocyanurate Or Urethane Foam Insulation.

- a. Density: (ASTM D1622) 27 to 32 kg/m³ (1.7 to 2.0 lbs/ft³).
- b. Compressive strength: (ASTM D1621) 131 to 158 kPa (19 to 23 lbs/in²).
- c. Closed cell content: 90%, minimum.
- d. Water absorption: (ASTM D2842) 4.0% by volume.
- e. Thermal Conductivity: (ASTM C 518) 0.027 W/m•°C (0.19 Btu•in/ft²•hr•°F).
- f. Thickness: to match pipe insulation thickness.

(2) Polymer Coating, Urecon BL-75-20EP.

- a. Two component high density polyurethane coating, black in color.
- b. Density: 1170 kg/m³ (73 lbs/ft³).
- c. Durometer D scale 60.
- d. Tensile strength: 11,100 kPa (1610 lbs/in²).
- e. Tear strength: 26.5 N/mm (151 lbs/in).
- f. Thickness: 1.9mm (75 mils) outside surfaces, 0.51mm (20 mils) inside surfaces.

(h) Electric Tracing System. A complete electric heat trace system shall be supplied to prevent freezing of the pre-insulated pipe. The electric tracing system and associated controls shall be as per the manufacturer's recommendations. Heat trace cable shall be Urecon's Thermocable with an output of 4 watts/ft. at 240 V or approved equal. An electronic thermostat with ground fault detection circuitry, 120-240 Vac, 30 A, 2 poles in a Nema 4 painted steel enclosure, factory set @ 3 deg C for protection of metal piping system shall be provided. In addition, a temperature sensor and power feed kit shall be provided. The electric heat trace system shall be installed per the manufacturer's recommendations and all applicable electric codes.

xx. LAYING PIPE. Concrete reaction blocking shall be provided as detailed at all pressure pipe bends, tees, crosses, reducers, valves, caps, and plugs. Pipe joint at these fittings shall be mechanical joint with retainer glands. The use of retainer glands does not reduce the requirements for thrust restraint.

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xx. TESTING OF SYSTEM. All piping shall be tested in accordance with the following test methods, in addition to any test required by State and local codes or building authorities:

(a) Manhole Leakage Test. Manholes shall be tested in accordance with Section AIR RELEASE, CLEANOUT, AND SEWER MANHOLES of these provisions.

(b) Pressure Pipe Testing.

(1) Leakage Test. The following procedure shall be used:

a. The allowable leakage is as follows:

(1) Leakage for buried pipe with sliptype or mechanical joints shall not exceed the rate determined by the following formula:

$$L = (S \times D \times \sqrt{P}) / 148,000$$

where:

L= allowable leakage in gallons per hour

S= length of pipe tested in feet

D= nominal diameter of pipe in inches

P= average test pressure in psi

xx. BACKFILLING.

(a) Pipe Bedding Area. Prior to laying pipe, bedding material shall be placed to the limits of the excavation and to a depth beneath the pipe as specified. This material shall be crushed gravel meeting the gradation requirements of Table 704.05A - Fine. As the pipe is laid, bedding material shall be extended to the spring line of the pipe and leveled along the width of the trench.

Where rock, boulders, or unsuitable bearing materials are not present, ductile iron pipe used for force main may be laid in the shaped trench bottom.

(b) Pipe Envelope Area. The pipe envelope for ductile iron pipe consists of selected suitable material placed from the spring line of the pipe to a depth of 300 mm (12 inches) over the top of the pipe. The pipe envelope for PVC pipe consists of crushed gravel meeting the gradation requirements of Table 704.05A - Fine placed from the spring line of the pipe to a depth of 300 mm (12 inches) over the top of the pipe. The material shall be carefully placed and spread over the width of the trench and compacted using an approved tamper.

xx. MANHOLES. Manholes shall conform to the requirements of Section AIR RELEASE, CLEANOUT, AND SEWER MANHOLES of these provisions and Section 604 of the Standard Specifications.

xx. TRANSFER OF EXISTING SYSTEM TO NEW SYSTEM. When new sewers are connected to existing manholes and existing pipe penetrations cannot be used, pipe openings shall be core drilled to accommodate the new pipe. Approved watertight boots or gaskets shall be furnished and installed per manufacturer's instructions, and then the opening around the gasket shall be grouted to a watertight seal. Existing manhole grouted inverts, flow lines, aprons, etc. shall be chipped out and re-grouted to accommodate the new piping. Grout holes or damage in manhole wall opening with non-shrink grout until flush with outside face of wall. The exterior of the manholes shall be coated with a bitumastic or other watertight sealant meeting the approval of the sewer owner.

xx. METHOD OF MEASUREMENT. The quantities of Special Provision (Ductile Iron Pipe, Cement Lined), Special Provision (Pre-Insulated Ductile Iron Pipe, Cement Lined), Special Provision (PVC Drain Pipe), Special Provision (PVC Sewer Pipe), and Special Provision (Sanitary Force Main) of the type and size specified to be measured for payment will be the number of meters (linear feet) of line installed in the complete and accepted work, as measured along the flow line of the pipe.

The quantity of Special Provision (Electric Heat Trace System) to be measured for payment will be on a unit basis for each system installed in the complete and accepted work.

xx. BASIS OF PAYMENT. The accepted quantities of Special Provision (Ductile Iron Pipe, Cement Lined), Special Provision (Pre-Insulated Ductile Iron Pipe, Cement Lined), Special Provision (PVC Drain Pipe), Special Provision (PVC Sewer Pipe), and Special Provision (Sanitary Force Main) of the type and size specified will be paid for at the Contract unit price per meter (linear foot). Payment shall be full compensation for furnishing, transporting, handling, installing, and testing the materials specified; for furnishing and placing concrete or other materials for reaction blocking; for making all necessary connections; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Excavation for sewer pipe, including bedding and backfill operations, and disposal of excavated material not suitable for backfill, will be paid for as follows:

(a) For pipes and fittings, excavation bedding and backfill (including seeding and mulching) shall be included in the linear foot unit price for the specific pipe. This is valid for all excavation with the exception of rock excavation, which shall be paid for under Contract item 204.21. All backfill with the specified materials (except as detailed below) to finished grade will be included in the pipe linear foot unit price, with the exception of paving, which will be paid for under the appropriate Contract paving items.

(b) When backfill is required to replace poor foundation material below the normal grade of the pipe, it shall be

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paid for at the Contract unit price per cubic yard for the type of backfill specified.

The accepted quantity of Special Provision (Electric Heat Trace System) will be paid at the Contract lump sum bid price. Payment shall be full compensation for all materials, labor, tools, and equipment necessary for providing a complete and functioning electric heat trace system. Items for payment under this lump sum include, but are not limited to, providing a new electric service and meter, heat trace control panel, thermostat, temperature sensor, and power feed kit; mounting all equipment as detailed; all wire, conduits, and junction boxes; all excavation, bedding, and backfill; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.640 Special Provision (Ductile Iron Pipe, Cement Lined)(X mm)(X")	Meter (Linear Foot)
900.640 Special Provision (Pre-Insulated Ductile Iron Pipe, Cement Lined) (X mm)(X")	Meter (Linear Foot)
900.640 Special Provision (PVC Drain Pipe) (X mm)(X")	Meter (Linear Foot)
900.640 Special Provision (PVC Sewer Pipe) (X mm)(X")	Meter (Linear Foot)
900.640 Special Provision (Sanitary Force Main) (X mm (X") Type)	Meter (Linear Foot)
900.645 Special Provision (Electric Heat Trace System)	Lump Sum