

**SECTION 02730
SEWERS AND ACCESSORIES**

PART 1 GENERAL

1.01 SCOPE

- A. This Section describes products to be incorporated into sewers and accessories and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.
- B. General: Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. Latest revisions of all standards are applicable.

1.02 QUALIFICATIONS

If requested by the City, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

1.03 SUBMITTALS

Complete shop drawings, product data and engineering data, including shop drawings, shall be submitted to the City.

1.04 TRANSPORTATION AND HANDLING

- A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.
- B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front loader. Do not use material damaged in handling.
- C. Lined pipe shall be handled and transported to prevent damage to linings.

1.05 STORAGE AND PROTECTION

- A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.
- B. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two rows of timbers shall be placed

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between tiers and chocks, affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.

- D. Store joint gaskets in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

1.06 QUALITY ASSURANCE

- A. Product manufacturers shall provide the City with written certification that all products furnished comply with all applicable provisions of these Specifications.
- B. If ordered by the City, each pipe manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of five days during initial pipe installation.

1.07 RELATED SECTIONS

- 1. Section 02200-Basic Pipeline Construction

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE (DIP)

- A. Ductile iron pipe shall be utilized where shown on the Drawings. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet, with a bituminous outside coating.
- B. Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51. Sizes will be as shown on the Drawings. All ductile iron pipe shall have a minimum pressure rating as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

| Pipe Sizes (inches) | Pressure Class (psi) |
|---------------------|----------------------|
| 4 - 12 | 350 |
| 16 - 24 | 250 |

- C. Flexible Joint (Ball Joint) Pipe: Flexible, restrained joint pipe shall be minimum Thickness Class 56. Appropriate transition pieces shall be utilized on each end of run of flexible joint pipe.
- D. Fittings and Accessories
 - 1. Fittings shall be ductile iron and shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53 with a minimum rated working pressure of 250 psi, and shall be furnished with a bituminous outside coating.

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2. Thrust Collars: Thrust collars shall be welded-on ductile iron body type capable of withstanding a thrust due to 250 psi internal pressure on a dead end from either direction on that pipe size. Weld-on collars shall be continuously welded to the pipe by the pipe manufacturer.
 3. Solid Sleeves: Solid sleeves shall permit the connection of plain end ductile iron pipe and plain end PVC pipe. Solid sleeves shall meet the requirements of ANSI/AWWA C110 for long pattern and have a minimum pressure rating of 250 psi. Solid sleeves shall have a mechanical or restrained joint as specified in this Section and as shown on the Drawings. Solid sleeves shall be provided with gaskets suitable for the type of pipe to be connected. Solid sleeves shall be used only in locations shown on the Drawings or at the direction of the City. Solid sleeves shall be manufactured by ACIPCO, U.S. Pipe or McWane (Clow).
- E. Joints for Ductile Iron Pipe and Fittings
1. General
 - a. Joints for ductile iron pipe and fittings shall be mechanical joint, flanged joint, ball joint, restrained joint, or push-on joint as shown on the Drawings or specified herein.
 - b. Unless otherwise shown on the Drawings, specified or directed, all ductile iron pipe laid underground shall be joined using push-on type joints.
 - c. In all cases, gaskets shall be made of material that will not be damaged by the fluid being transported nor by the environment in which the pipe is installed.
 - d. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.
 2. Mechanical Joints
 - a. Joints shall conform to AWWA C111/ANSI A21.11.
 - b. Bolts and nuts shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A 242 to the dimensions shown in AWWA C111/ANSI A21.11.
 - c. Gaskets shall be in accordance with AWWA C111/ANSI A21.11 and shall be constructed of plain rubber.
 - d. Mechanical joint glands shall be ductile iron.
 3. Push-On Joints: Push-on joints and gaskets shall conform to AWWA C111/ANSI A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice such as ACIPCO "Fastite", McWane (Clow) "Bell-Tite", or U.S. Pipe "Tyton" joints.
 4. Flanged Joints
 - a. Flanged joints shall conform to AWWA C115/ANSI A21.15. Flanges shall be ductile iron and shall be furnished by the pipe manufacturer.
 - b. Gaskets shall be made of 1/8-inch thick, cloth reinforced rubber. Gaskets may be ring type or full face type.

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- c. Flanged ductile iron pipe shall have flanges cast solidly or threaded to the pipe barrel. Pipe threads shall be of such length that with flanges screwed home, the end of the pipe shall project beyond the face line of the flange. Flange and pipe shall then be machined to give a flush finish to the pipe and the flange and surface shall be normal to the axis of the pipe. Ductile iron flanges shall be of such design that the flange neck completely covers the threaded portion of the pipe to protect same against corrosion. All pipe with threaded type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by the City.
- d. Flange filler shall conform to AWWA C110/ANSI A21.10. Joint bolt length shall be increased by the thickness of the flange filler.
- e. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly.
- f. Bolt length and diameter shall conform to ANSI/AWWA C115 for Class 125 flanges shown in ANSI/ASME B16.1.
- g. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.
- h. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A 193, Grade B8. Nuts shall be heavy hex, stainless steel conforming to ASTM A 194, Grade 8.

5. Restrained Joints

- a. Restrained joints shall be ACIPCO "FLEX-RING" or "FAST-GRIP", or U.S. "TR-FLEX" or "FIELD LOK".
- b. Bolts and nuts shall be in accordance with the manufacturer's recommendations.
- c. Gaskets shall be in accordance with the manufacturer's recommendations.

F. Interior Lining: Ductile iron pipe and fittings shall be cement lined in accordance with ANSI/AWWA C104/A21.4.

2.02 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

A. Acceptability of PVC pipe for gravity sewers is indicated in the following table:

| Standard Min Thick Type PVC ¹ | Wall | Acceptable Manufacturers | ≤ 6 | 8 to 15 | 18 | 21 | 24 |
|--|------|-----------------------------|-----|---------|-----|-----|-----|
| ASTM D 3034 SDR 35 12454B | SW | Open | Yes | Yes | No | No | No |
| ASTM F-679 | SW | Open | No | No | Yes | Yes | Yes |

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| | | | | | | | |
|--------------------------------------|----|-----------|-----|----|----|----|-----|
| ASTM F 794 Series 46 12454C | OP | Ultra-Rib | No | No | No | No | Yes |
| ASTM F 794 Series 46 12454C | CP | Vylon | Yes | No | No | No | Yes |

¹ As specified in ASTM D 1784

SW Solid Wall
 OP Open Profile
 CP Closed Profile

Open shall mean any manufacturer whose products meet the specified standard is acceptable.

- B. All pipe shall have a minimum pipe stiffness of 46 psi at five percent deflection as determined by ASTM D 2412.
- C. PVC gravity sewer pipe shall be supplied in lengths not longer than 13 feet and shall be green in color.
- D. Each length of pipe shall be marked with the manufacturer's name, trade name, nominal size, class, hydrostatic test pressure, manufacturer's standard symbol to signify it was tested, and date of manufacture. Each rubber ring shall be marked with the manufacturer's identification, the size, the year of manufacture, and the classes of pipe with which it can be used.
- E. Fittings 15 inches in diameter and less shall be manufactured in accordance with ASTM D 3034. PVC compound shall be 12454B or 12454C as specified in ASTM D 1784.
 - 1. For sizes 8-inches and less in diameter, fittings shall be molded in one-piece with no solvent welded joints. Minimum socket depths shall be as specified in ASTM D 3034, Table 2.
 - 2. For sizes 10-inches and larger in diameter, fittings shall be fabricated from pipe conforming to ASTM D 3034 using solvent welding. No field fabrication of fittings will be allowed. All such fabrication shall be performed at the factory and the fittings shall be delivered ready for use.
- F. Joints: Joints for pipe and fittings shall be of the integral bell and spigot type with a confined elastomeric gasket having the capability of absorbing expansion and contraction without leakage, when tested in accordance with ASTM D 3212. Gaskets shall meet the requirements of ASTM F 477. The joint system shall be subject to the approval of the City and shall be identical for pipe and fittings.

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G. Manhole Connections

1. Solid Wall and Closed Profile Wall Pipe: The sewer shall be connected to manholes utilizing a standard pipe section.
2. Open Profile Wall Pipe: The sewer shall be connected to manholes with an adapter piece. The adapter piece shall have an open profile pipe bell and a solid wall pipe spigot for penetrating the manhole wall.

H. Acceptance: Acceptance will be on the basis of the City's inspection and the manufacturer's written certification that the pipe and fittings were manufactured and tested in accordance with the applicable standards.

2.03 HIGH-DENSITY POLYETHYLENE (HDPE) GRAVITY SEWER PIPE

A. Polyethylene Pipe and Fittings

1. Qualification of Manufacturers: The Manufacturer shall have manufacturing and quality assurance 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 the Owner or his Authorized Representative. The Project Engineer shall approve qualified Manufacturers.
2. Approved Manufacturers: Manufacturers that are qualified and approved by the Project Engineer are listed below. Products from unapproved manufacturers are prohibited. Performance Pipe, a division of Chevron Phillips Chemical Company LP, 2.3.
3. Materials: Materials used for the manufacture of polyethylene pipe and fittings shall be PE 4710 high density polyethylene meeting cell classification 345464C for black or 345464E for color and stripes per ASTM D 3350; and shall be Listed in the name of the pipe and fitting Manufacturer in PPI (Plastics Pipe Institute) TR-4 with a standard grade HDB rating of 1600 psi at 73°F. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements. The fitting material may be gray or black.
4. Interchangeability of Pipe and Fittings: Polyethylene pipe and fittings shall be supplied by the same qualified and approved manufacturer. . . : Pipe and fittings from different manufacturers shall not be interchanged)
5. Polyethylene Pipe: Polyethylene pipe shall be manufactured in accordance with ASTM F 714, and shall be so marked. Each production lot of material or pipe shall be tested for melt index, density and for black pipe, % carbon. Each production lot of pipe shall be tested for dimensions and ring tensile strength.
6. Polyethylene Fittings. Polyethylene fittings shall be molded or fabricated by the approved pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe.
7. Molded Fittings: Molded polyethylene fittings shall be manufactured in

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accordance with ASTM D 3261 and shall be so marked.

- a) X-Ray Inspection: The Manufacturer shall submit samples from each molded fittings production lot to x-ray inspection.
8. 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 at least equal to the full service pressure rating of the mating pipe.
9. Custom Fabrications & Manholes: Custom fabrications and manholes shall be constructed to shop drawings that have been approved by the Project Engineer. Manholes shall be designed in accordance with ASTM F 1759.
10. 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 (serrations) to promote gasketless sealing, or restrain the gasket against blowout.
11. Back-up Rings & Flange Bolts: Flange adapters shall be fitted with convoluted ductile iron backup rings. The back-up ring bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.
12. MJ Adapters: MJ Adapters shall have a stainless steel stiffener that is mechanically locked into the adapter.
13. Compliance Tests: Manufacturer's inspection and testing of the materials. In case of conflict with Manufacturer's certifications, the Contractor, Project Engineer, or Owner may request retesting by the Manufacturer or have retests performed by an outside testing service. All retesting shall be at the requestor's expense, and shall be performed in accordance with the Specifications.

2.04 MANHOLES AND PRECAST CONCRETE PRODUCTS

- A. Provide manholes and other precast concrete products, including pumping station wetwell and valve vault, in accordance with the following:
 1. Precast Concrete Sections
 - a. Precast concrete sections shall meet the requirements of ASTM C 478. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi.
 - b. The minimum wall thickness shall be one-twelfth of the inside diameter of the base, riser or the largest cone diameter. Additionally, the wall thickness shall be sufficient for the proper installation of the rubber boots.
 - c. Transition slabs which convert bases larger than four feet in diameter to four foot diameter risers shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the slab.

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- d. Seal joints between precast sections by means of rubber O-ring gaskets or flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of AASHTO M-198. Sealant shall be pre-formed type with a minimum nominal diameter of 1-inch. Butyl rubber sealant shall be equal to Kent Seal No. 2 or Concrete Sealants CS202.
 - e. Precast manhole bases, excluding pumping station wetwells and valve vaults, shall be provided with a minimum 8-inch wide extension.
 2. Brick and Mortar: Brick shall be whole and hardburned, conforming to ASTM C 32 Grade MS. Mortar shall be made of one part Portland cement and two parts clean sharp sand. Cement shall be Type 1 and shall conform to ASTM C 150. Sand shall meet ASTM C 144.
 3. Iron Castings
 - a. Cast iron manhole frames and covers shall meet the requirements of ASTM A 48 for Class 30 gray iron and all applicable local standards. All castings shall be tough, close grained, smooth and free from blow holes, blisters, shrinkage, strains, cracks, cold shots and other imperfections. No casting will be accepted which weighs less than 95 percent of the design weight. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking. All castings shall be thoroughly cleaned in the shop and given two coats of approved bituminous paint before rusting begins.
 - b. Manhole frames and covers shall be as shown on the Standard Detail Drawings.
 - c. All frames and covers shall have machined horizontal bearing surfaces.
 - d. All manholes shall have standard frames and covers except where specifically shown otherwise on the Drawings.
 4. Rubber Boots: Provide preformed rubber boots and fasteners equal to those manufactured by Kor-N-Seal or Press Seal Gasket Corporation.
 5. Interior Lining: See section 09972 - Concrete & Masonry Coatings
 6. Exterior Coating
 - a. The exterior of manholes, wetwells and valve vaults shall be coated with a coal tar epoxy equal to Carboline (Kop-Coat) Bitumastic 300M.
 - b. Surface preparation, application, inspection, handling and joints shall be as specified in Paragraph 5b above.
 - c. Coating shall be applied at the point of manufacture of the manhole and precast concrete product.
 7. Aluminum Floor Doors
 - a. Door shall be a single or double leaf type as shown on the Drawings built to withstand 150 pounds per square foot.
 - b. The frame shall be 1/4-inch extruded aluminum with built-in neoprene cushion and with strap anchors bolted to the exterior. Door leaf shall be 1/4-inch aluminum diamond plate reinforced with aluminum stiffeners as required. Stainless steel hinges shall be bolted to the underside and pivot on torsion bars

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that counterbalance the door for easy operation. The door shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release the cover for closing. Doors shall be equipped with a snap lock and removable handle. Bituminous coating shall be applied to the exterior of the frame by the manufacturer. All hardware shall be stainless steel.

- c. Door shall be Type S1R (single door) or S2R (double door), manufactured by Halliday or Type E, manufactured by Washington Aluminum Company.

8. Sand-Cement Grout

- a. Column baseplates, pipe support baseplates, tanks and miscellaneous small items of equipment shall be grouted in place using a sand-cement grout consisting of one part Portland cement, two parts fine aggregate and a maximum of 4.5 gallons of water per sack (cubic foot) of cement. Portland cement shall be Type III conforming to ASTM C 150. Fine aggregate shall be natural siliceous sand, consisting of hard, clean, sharp, dense, durable and uncoated particles.
- b. Fine aggregate shall be free from organic material and injurious amounts of deleterious substances and shall be graded as follows:

| Sieve Size No. | Percent (by weight) Passing |
|-------------------|-----------------------------------|
| 4 | 100 |
| 8 | 95 - 100 |
| 16 | 60 - 100 |
| 30 | 35 - 70 |
| 50 | 15 - 35 |
| 100 | 2 - 15 |

- c. Except as modified herein, fine aggregate shall conform to the requirements of ASTM C 144.
 - d. Fine aggregate to be used with epoxy binders shall be dried prior to use to remove any free moisture.
9. Non-Shrink Grout: All pumps, compressors, motors and other heavy equipment items shall be grouted in place with a nonmetallic, noncorrosive, nongaseous, nonshrink grout requiring no cutback or protective coating. Nonshrink grout shall show zero shrinkage from the placement volume or initial expansion volume as determined by ASTM C 827, and shall have an initial set time at 70 degrees F of not less than 45 minutes as determined by ASTM C 191. When tested in accordance with ASTM C 109, nonshrink grout shall have a one-day compressive strength of not less than 2,000 psi and a 28-day compressive strength of not less than 9,000 psi at a flow of not less than 100 percent determined in accordance with Corps of Engineers Specification CRD-C-621. The grout shall contain no corrosive irons, calcium chloride, oxidizing catalysts, gas-forming agents, harmful aluminums or corrosive chemicals and shall be resistant to oil, water

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and sewage. The grout shall be premixed and shall require only the addition of water prior to placement. The grout shall be delivered to the job site in unopened, plastic-lined bags and shall have the manufacturer's mixing instructions printed on the back of each bag. Nonshrink grout shall be EUCO N-S Grout as manufactured by the Euclid Chemical Company, Masterflow 713 Grout as manufactured by Master Builders Company, or Upcon High Flow Grout as manufactured by UPCO Division of Emhart Chemical Company.

2.04 MISCELLANEOUS ACCESSORIES

A. Flexible Adaptor Couplings

1. Couplings for pipe sizes 15-inches in diameter and less shall be elastomeric plastic sleeves designed to connect pipes of dissimilar materials. Adapters shall provide a positive seal against infiltration and exfiltration and remain leakproof and rootproof up to 4.3 psi. The adaptor manufacturer shall provide all stainless steel clamps and required accessories.
2. Couplings shall be products of Fernco and shall be installed in accordance with the manufacturer's recommendations.

B. Flexible Adaptor Donuts

1. Adaptor donuts shall be elastomeric polyvinyl chloride (PVC), compressible seals designed for sealing joints between sewer pipes of different sizes and/or dissimilar materials. Adapters shall provide a positive seal against infiltration and exfiltration and remain leakproof and rootproof up to 4.3 psi.
2. Donuts shall be products of Fernco and shall be installed in accordance with the manufacturer's recommendations.

C. Detection Tape and Tracer Wire: Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tapes shall be color coded in accordance with APWA color codes with the following legends: Sanitary Sewerage Systems, Safety Green, "Caution: Sewer Line Buried Below". Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed. Tape width shall be minimum 2-inches when buried less than 10-inches below the surface. Tape width shall be minimum 3-inches when buried greater than 10-inches and less than 20-inches. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape. In addition, prior to backfill of trench the Contractor shall furnish and install 12 gauge, stranded, green coated copper wire. The wire shall be installed along the pipe during the backfill operation. Wire shall be brought up at each manhole. Wire shall be spliced together using DRYCONN waterproof connectors.

D. Backwater Valves: It is recommended that a backwater valve be placed on all service connections to prevent backflow or waste from street sewers. Backwater Valves to include elastomeric seal in quick action flapper to ensure a water tight seal, threaded access cap with neoprene seal for positive sealing as well as a valve hub to fit DWV pipe of which can be adapted for sewer and drain pipe.

PART 3 EXECUTION

3.01 LOCATION AND GRADE

- A. The Drawings show the alignment and grade of the gravity sewer and the position of manholes and other appurtenances. The slope shown on the gravity sewer profile and/or called for in the Specifications is the slope of the invert of the pipe.
- B. After the Contractor locates and marks the manhole centerlines or baselines of the gravity sewer, the Contractor shall perform clearing and grubbing.

3.02 LAYING AND JOINTING PIPE AND ACCESSORIES

- A. Lay all pipe and fittings to accurately conform to the lines and grades established by the construction drawings.
- B. Pipe Installation (DI & PVC)
 - 1. Proper implements, tools and facilities shall be provided for the safe performance of the Work. All pipe, fittings and valves shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to sewer materials and protective coatings and linings. Under no circumstances shall sewer materials be dropped or dumped into the trench.
 - 2. All pipe, fittings, valves and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the City, who may prescribe corrective repairs or reject the materials.
 - 3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe which contains dirt shall be laid.
 - 4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.
 - 5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
 - 6. It is common practice to lay pipe with the bells facing the direction in which work is progressing.
 - 7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted.
 - 8. Polyethylene Encasement: Installation shall be in accordance with AWWA C105 and the manufacturer's instructions. All ends shall be securely closed with tape and all

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damaged areas shall be completely repaired to the satisfaction of the City.

C. Pipe Installation (HDPE)

1. General: When delivered, a receiving inspection shall be performed and any shipping damage shall be reported to the Manufacturer within 7 days. Installation shall be in accordance with ASTM D 2774, Manufacturer's recommendations and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with all applicable safety codes and standards.
2. Excavation: Trench excavations shall conform to the plans and drawings, as authorized in writing by the Project Engineer or his Approved Representative, and in accordance with all applicable codes. The Contractor shall remove excess groundwater. Where necessary, trench walls shall be shored or reinforced, and all necessary precautions shall be taken to ensure a safe working environment.
3. Large Diameter Fabricated Fittings: One plain-end connection of 16" IPS and larger fabricated directional fittings (elbows, tees, etc.) shall be butt fused to the end of a pipe length. The remaining fitting connections shall be made in the trench using butt fusion, flange or other connection means in accordance with G.2 listed below. Flange and other mechanical connections shall be assembled, and tightened in accordance with the connection manufacturer's instructions and C.4 listed below. Handling, lifting, moving or lowering a 16" IPS or larger fabricated fitting that is connected to more than one pipe length is prohibited. The installing contractor at his expense shall correct fitting damage caused by such improper handling.
4. Mechanical Joint & Flange Installation: Mechanical joint and flange connections shall be installed in accordance with the Manufacturer's recommended procedure. MJ Adapters and flanges shall be centered and aligned to the mating component before assembling and tightening bolts. In no case shall MJ gland or flange bolts be used to draw the connection into alignment. Bolt threads shall be lubricated, and flat washers should be used under the nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer. At least 1 hour after initial assembly, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the Manufacturer. The final tightening torque shall be as recommended by the Manufacturer.
5. Foundation & Bedding: Pipe shall be laid on grade and on a stable foundation. Unstable trench bottom soils shall be removed, and a 6" foundation or bedding of compacted granular material shall be installed to pipe bottom grade. Excess groundwater shall be removed from the trench before laying the foundation or bedding for the pipe. A trench cut in rock or stony soil shall be excavated to 6" below pipe bottom grade, and brought back to grade with compacted granular bedding. All ledge rock, boulders and large stones shall be removed.
6. Pipe Handling: When lifting with slings, only wide fabric choker slings capable of safely carrying the load shall be used to lift, move, or lower pipe and fittings.

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Wire rope and chain are prohibited. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Worn or damaged equipment shall not be used.

7. Backfilling: Embedment material soil type and particle size shall be in accordance with ASTM D 2774. Embedment shall be placed and compacted to at least 90% Standard Proctor Density in 6" lifts to at least 6" above the pipe crown. During embedment placement and compaction, care shall be taken to ensure that the haunch areas below the pipe springline are completely filled and free of voids.
8. Protection against shear and bending loads: In accordance with ASTM D 2774, connections shall be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle or tapping tee on a main pipe, and where pipes enter or exit casings or walls. The area surrounding the connection shall be embedded in properly placed, compacted backfill, preferably in combination with a protective sleeve or other mechanical structural support to protect the polyethylene pipe against shear and bending loads.
9. Final Backfilling: Final backfill shall be placed and compacted to finished grade. Native soils may be used provided the soil is free of debris, stones, boulders, clumps, frozen clods or the like larger than 8" in their largest dimension.

D. Installation

1. General: When delivered, a receiving inspection shall be performed and any shipping damage shall be reported to the Manufacturer within 7 days. Underground installation shall be in accordance with these specifications and ASTM D 2321.
2. Foundation and Grade: Pipe shall be laid on a stable foundation that provides continuous support without voids below the pipe. Unstable trench bottom soils shall be removed, and a 6" foundation or bedding of compacted Class I material shall be installed to pipe bottom grade. Excess groundwater shall be removed from the trench before laying the foundation or bedding and the pipe. A trench cut in rock or stony soil shall be excavated to 6" below pipe bottom grade, and brought back to grade with compacted Class I bedding. All ledge rock, boulders and large stones shall be removed. The trench bottom shall be graded to the required slope before placing the pipe in the trench. Where bedding must be removed to provide clearance for devices such as mechanical joints, bolted flanges or appurtenances, the bedding shall be replaced and compacted beneath the device before backfilling so that pipeline grade and continuous support without voids are maintained. All necessary precautions shall be taken to ensure a safe working environment in accordance with all applicable safety codes and standards.
3. Excavation: Trench excavations shall conform to the plans and drawings, as authorized in writing by the Project Engineer or his Approved Representative, and in accordance with all applicable codes. Where necessary, trench walls shall

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be shored or reinforced, and all necessary precautions shall be taken to ensure a safe working environment.

4. Large Diameter Fabricated Fittings: The plain-end inlet of 16" IPS and larger fabricated directional fittings (elbows, tees, etc.) shall be butt fused to the end of a pipe length. The remaining fitting outlet connections shall be made in the trench using butt fusion, flange or other connection means in accordance with 3.2. Flange and other mechanical connections shall be assembled, and tightened in accordance with the connection manufacturer's instructions and 4.5. Connecting pipe lengths to more than one outlet of a 16" IPS or larger fabricated fitting before placing the pipe in the trench is prohibited. The installing contractor at his expense shall correct fitting damage caused by such improper handling.
5. Mechanical Joint & Flange Installation: Mechanical joint and flange connections shall be installed in accordance with the Manufacturer's recommended procedure. MJ Adapters and flanges shall be centered and aligned to each other before assembling and tightening bolts. In no case shall MJ gland or flange bolts be used to draw the connection into alignment. Bolt threads shall be lubricated, and flat washers should be used under the nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer. At least 1 hour after initial assembly, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the Manufacturer. The final tightening torque shall be as recommended by the Manufacturer.
6. Pipe Handling: When lifting with slings, only wide fabric choker slings capable of safely carrying the load shall be used to lift, move, or lower pipe and fittings. Wire rope and chain are prohibited. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Worn or damaged equipment shall not be used.
7. Backfilling: Embedment material soil type and particle size shall be in accordance with ASTM D 2774. Embedment shall be placed and compacted to at least 90% Standard Proctor Density in 6" lifts to at least 6" above the pipe crown. During embedment placement and compaction, care shall be taken to ensure that the haunch areas below the pipe springline are completely filled and free of voids.
8. Final Backfilling: Final backfill shall be placed and compacted to finished grade. Native soils may be used provided the soil is free of debris, stones, boulders, clumps, frozen clods or the like larger than 8" in their largest dimension.

E. Alignment and Gradient

1. Lay pipe straight in alignment and gradient or follow true curves, where shown on the Drawings, as nearly as practicable. Do not deflect any joint more than the maximum deflection recommended by the manufacturer.

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2. Maintain a transit, level and accessories on the job to lay out angles and ensure that deflection allowances are not exceeded.
 3. The Contractor shall check the invert elevation at each manhole and the gravity sewer invert elevation at least three times daily, start, mid-day and end of day. Elevations shall be checked more frequently if more than 100 feet of pipe is installed in a day or if the gravity sewer is being constructed at minimum slope.
 4. The Contractor shall check the horizontal alignment of the gravity sewer at the same schedule as for invert elevations.
- F. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint or as approved by the City.
- G. Joint Assembly: Push-on, mechanical, flange and restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
- H. Joining
1. Heat Fusion Joining. Joints between plain end pipes and fittings shall be made by butt fusion using procedures that are recommended by the pipe and fitting Manufacturer. The Contractor shall ensure that persons making heat fusion joints have received training in the Manufacturer's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction.

External and internal beads shall not be removed.
 - a) Butt Fusion of Unlike Wall Thickness: Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR, for example, SDR 13.5 to SDR 17, or SDR 11 to SDR 13.5. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple (a short length of the heavier wall pipe with one end machined to the lighter wall) or by mechanical means or electrofusion. Standard DR's for polyethylene pipe are 9, 11, 13.5, 17, 21, 26, 32.5 and 41.
 - b) Heat Fusion Training Assistance: Upon request and at the requestor's expense, training personnel from the Manufacturer or his Authorized Representative shall be made available.
 2. Joining by Other Means: Polyethylene pipe and fittings may be joined together or to other materials by means of (a) flanged connections (flange adapters and back-up rings), (b) mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, (c) MJ Adapters or (d) electrofusion. When joining by other means, the installation instructions of the

joining device manufacturer shall be observed.

3. Branch Connections: Branch connections to the main shall be made with saddle fittings or tees.

- 1) Liner section joints: Joints between liner sections may be made with a full encirclement repair coupling over a full encirclement elastomeric gasket. Repair couplings shall be of stainless steel construction with a bolted seam, and shall be at least two pipe diameters in length.

4. Service Connections: A service connection to the installed liner shall be made using a mechanical strap-on saddle, an Inserta-Tee®1, or saddle fusion or electrofusion branch saddles.

Reconnect service laterals by installing a new section of lateral service pipe to the liner service saddle; then connecting it to the existing service lateral pipe with elastomeric tube connectors secured with stainless steel band clamps.

5. Manhole Connections: Connections to non-polyethylene manholes may be made with a mechanical seal such as a link seal, a chemical seal such as packing with oakum rope saturated with water-activated polyurethane sealant or other means approved by the Project Engineer. The seal shall be finished off in the manhole with low shrink grout.

I. Cutting Pipe

1. Cut ductile iron pipe using an abrasive wheel saw.
2. Cut PVC pipe using a suitable saw.
3. Remove all burrs and smooth the end before jointing.
4. The Contractor shall cut the pipe and bevel the end, as necessary, to provide the correct length of pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location. Only push-on or mechanical joint pipe shall be cut.

- J. House Connections: Install wyes or tees in locations designated by the City for future connection of service lines. Plug the branch of the wye or tee. Record the location of fittings installed on the Record Drawings.

3.03 CONNECTION TO AN EXISTING MANHOLE

Connection to an existing manhole shall be made by mechanically coring into the wall structure of the manhole. Cored opening shall be sized to properly accommodate a rubber boot seal as specified in this section.

3.04 CONNECTION AND REPAIRS TO AN EXISTING SEWER MAIN

Where connections or repairs are required, Contractor shall only use solid sleeves and provide

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all materials and labor necessary to make the connection or repair to the existing pipeline, excluding service lines 6" or smaller.

3.05 MANHOLE AND PRECAST CONCRETE PRODUCT CONSTRUCTION

- A. Construct manholes as shown on the Standard Detail Drawings.
- B. Precast Concrete: Handle sections carefully to prevent cracking or chipping. Provide uniform bedding of the bottom section to prevent uneven loading. Install gaskets and joint sealants in accordance with manufacturer's recommendations to produce a watertight structure.
- C. Brick: Bed the bottom and sides of every brick in mortar. Apply a smooth coat of mortar, 3/4-inch thick, on the inside and outside.
- D. Inverts: Form channels as shown on the Drawings, rounded, and troweled smooth. Maintain consistent grade through the invert. Use sand-cement grout.
- E. Top Elevations: Build manholes outside of paved areas to 18-inches above finished grade unless otherwise shown on the Drawings or directed by the City. Build manholes in paved areas to existing grades.
- F. Drop Connections: Manholes requiring drop connections are shown on the Drawings. Construct drop connections of the same materials as the upstream sewer and in accordance with the details shown on the Drawings.
- G. Frames and Covers: Unless frame and cover is at grade, the frame shall be cast into the cone section.
- H. Seal all manhole joints and lift holes, both inside and out, with grout. Between precast sections, this is in addition to joint sealant.
- I. Invert Elevations: The invert elevations shown on the Drawings shall be for the invert at the centerline of the precast concrete manhole. Prior to setting the laser or other vertical alignment control system for the sewer upstream of the manhole, the Contractor shall verify the elevation of the sewer installed at the manhole.
- J. Manholes shall be constructed such that their walls are plumb.
- K. Floor doors shall be integrally cast into the top slab, and shall be cast into the concrete in accordance with the manufacturer's recommendations.

3.06 CONCRETE COLLARS

Construct collars as shown on the Drawings.

3.07 DETECTION TAPE AND TRACER WIRE

Detection tape and tracer wire shall be provided over all sewers constructed by the open cut method, except those lengths of sewers directly underneath paved surfaces of City-owned roadways.

3.08 INSPECTION AND TESTING

- A. Clean and flush lines prior to testing. Clean and test lines before requesting final acceptance. Where any obstruction is met, clean the sewers by means of rods, swabs, or other instruments. When requested by the City, flush out lines and manholes before final inspection.

- B. Gravity Sewers: Pipe lines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.
 - 1. Infiltration Tests: Use only when groundwater is more than two feet above the top of the pipe.
 - a. Install suitable weirs in manholes selected by the City to determine the leakage of ground water into the sewer. The maximum length of line for each infiltration test shall be 5,000 feet. Measure leakage only when all visible leaks have been repaired and the ground water is two feet above the top of the pipe. If leakage in any section of the sewer line exceeds 25 gpd/inch diameter/mile, locate and repair leaks. Repair methods must be approved by the City. After repairs are completed, re-test for leakage.
 - b. Furnish, install, and remove the necessary weirs, plugs, and bulkheads required to perform the leakage tests. Where continuous monitoring of flow level is required, the City will provide and operate monitoring equipment.

 - 2. Exfiltration Tests: Choose one of the following when groundwater is less than two feet above the top of the pipe.
 - a. Hydrostatic Test
 - (1) Test pipe between manholes with a minimum of 10 feet hydrostatic pressure, measured at the center of the pipe at the upstream manhole.
 - (2) The ends of the pipe in the test section shall be closed with suitable watertight bulkheads. Inserted into the top of each bulkhead shall be a 2-inch pipe nipple with an elbow. At the upper end of the test section, a 12-inch riser pipe shall be connected to the 2-inch nipple. The test section of pipe shall be filled through the pipe connection in the lower bulkhead which shall be fitted with a valve, until all air is exhausted and until water overflows the riser pipe at the upper end.
Water may be introduced into the pipe 24 hours prior to the test period to allow complete saturation. House service lines, if installed, shall also be fitted with suitable bulkheads having provisions for the release of air while the test section is being filled with water.
 - (3) During the test period, which shall extend over a period of two hours, water shall be introduced into the riser pipe from measured containers at such intervals as are necessary to maintain the water level at the top of the riser pipe. The total volume of water added during the test period shall not exceed that specified for infiltration.

 - b. Low-Pressure Air Test
 - (1) Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the

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pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25 feet or less) using inflatable balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After this pressure is reached and the pressure allowed to stabilize (approximately two to five minutes), the pressure may be reduced to 3.5 psi before starting the test. If a 1.0 psi drop does not occur within the test time, then the line has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs, and retest the line. Minimum test time for various pipe sizes, in accordance with ASTM C 828 is as follows:

| Nominal Pipe Size, inches | T (Time Min/100) Feet |
|---------------------------|-----------------------|
| 6 | 0.7 |
| 8 | 1.2 |
| 10 | 1.5 |
| 12 | 1.8 |
| 15 | 2.1 |
| 18 | 2.4 |
| 21 | 3.0 |
| 24 | 3.6 |

- (2) Required test equipment, including inflatable balls, braces, air hose, air source, timer, rotameter as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi pressure gauge with gradations in 0.1 psi and accuracy of \pm two percent, shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air-Loc Testing Systems.
- (3) The Contractor shall keep records of all tests made. Copy of such records will be given to the City. Such records shall show date, line number and stations, operator, and such other pertinent information as required by the City.
- (4) The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

3. Deflection Test

- a. Test PVC gravity sewer for excessive deflection by passing a mandrel through the pipe. Deflection of the pipe shall not exceed the following:

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| Nominal Pipe Diameter | Maximum Allowable Deflection |
|--------------------------|------------------------------------|
| ≤ 12-inches | 5% |
| 15 to 30-inches | 4% |
| > 30-inches | 3% |

- b. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable manufacturing tolerances of the pipe. The mandrel shall have an odd number of legs, or vanes, with a quantity of such equal to or greater than nine. The legs of the mandrel shall be permanently attached to the mandrel. A mandrel with variable sizes shall not be allowed. The mandrel shall be constructed of steel aluminum or other material approved by the City, and shall have sufficient rigidity so the legs of the mandrel will not deform when pulling through a pipe. The mandrel dimensions shall be checked by the City before use by the Contractor.
 - c. Excavate and install properly any section of pipe not passing this test. Re-test until results are satisfactory.
 - d. This test shall be performed within the first 30 days of installation and during final inspection, at the completion of this contract.
 3. Closed Circuit Television: If deemed necessary by the City, the interior of the gravity sewers shall be subjected to a televised inspection. Prior to Final Acceptance the City shall be provided with one copy of the TV inspection report and video cassette showing the entire length of gravity sewer being tested. The report shall contain the condition of pipe, type of pipe, depth, location of services, length, type joint, roundness, and distance between manholes. Any

pipe found to be cracked, leaking, misaligned, bellied or otherwise defective shall be removed and replaced.
- C. Manholes: Prior to testing manholes for watertightness, all liftholes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced. Each manhole shall pass one of the following tests:
 1. Exfiltration Tests: The manhole, after proper preparation as noted above, shall be filled with water. The maximum allowable leakage shall be eight gallons per foot of depth per 24 hours for 48-inch diameter manholes. Tests shall last a minimum of eight hours. The manholes may be backfilled prior to testing.
 2. Vacuum Tests: The manhole, after proper preparation as noted above, shall be vacuum tested prior to backfilling. The test head shall be placed at the inside of the top of the cone section and the compression head inflated to 40 psi to effect a seal between the vacuum base and the manhole structure. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10-inches of mercury shall be drawn and the vacuum

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pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time is greater than 60 seconds for 48-inch diameter manholes. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc.

- D. Re-Testing: Any alterations made to pipeline or manholes performed after initial testing shall be re-tested and pass again, regardless of initial test results.
- E. Notification: The City of Thomasville shall be notified 24-hours in advance prior to Contractor performing any testing.
- F. Testing
 - 1. Fusion Quality: The Contractor shall ensure the field set-up and operation of the fusion equipment, and the fusion procedure used by the Contractor's fusion operator while on site.

Upon request by the Owner, the Contractor shall verify field fusion quality by making and testing a trial fusion. The trial fusion shall be allowed to cool completely; then test straps shall be cut out and bent strap tested in accordance with ASTM D 2657. If the bent strap test of the trial fusion fails at the joint, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.

- 2. Leak Testing: Leak testing shall be conducted in accordance with Performance Pipe Technical Note 802 "Leak Testing".

3.09 INSPECTION & TESTING (HDPE)

- A. Fusion Quality: The Contractor shall ensure the field set-up and operation of the fusion equipment, and the fusion procedure used by the Contractor's fusion operator while on site. Upon request by the Owner, the Contractor shall verify field fusion quality by making and testing a trial fusion. The trial fusion shall be allowed to cool completely; then test straps shall be cut out and bent strap tested in accordance with ASTM D 2657. If the bent strap test of the trial fusion fails at the joint, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.
- B. Leak Testing: Hydrostatic leak testing shall be conducted in accordance with Performance Pipe Technical Note 802 *Leak Testing*. Pneumatic pressure testing is prohibited.

END OF SECTION