SECTION 027
SPECIFICATIONS - PIPE MATERIALS FOR SEWERS

Pipe material used to construct, repair or modify sewers shall conform to the specifications within this Section.

1.0 Clay Pipe

Construction of clay pipe shall be in accordance with Section 035 of these Specifications. Clay pipe for sanitary sewers shall be used only with written approval of the Engineer.

Clay pipe for sanitary sewers may be constructed only when and where approved by the Engineer and, if approved, in depths from four (4) feet to sixteen (16) feet deep. Clay sewer pipe shall not be laid in depths greater than sixteen (16) feet.

All pipe and fittings for sewers of 6-inch to 24-inch diameter shall be extra strength vitrified clay pipe, conforming to the ASTM Designation C-700, as amended.

Compression joints for all vitrified clay bell and spigot pipe shall meet or surpass ASTM designation C-425, as amended. Compression couplings for (6) inch to (12) inch vitrified clay plain-end pipe shall be furnished with a factory installed PVC collar instead of a clay bell and shall meet or surpass the performance requirements of ASTM C-425, as amended. The PVC collar shall conform to the requirements of ASTM D-1784, Class 12454-B.

2.0 Pre-stressed Concrete Cylinder Pipe

Construction of pre-stressed concrete cylinder pipe shall be in accordance with Section 035 of these Specifications. Pre-stressed concrete cylinder pipe for sanitary sewers shall be used only with written approval of the Engineer.

Pre-stressed concrete cylinder pipe and fittings for sanitary sewers shall conform to AWWA C-301 and shall consist of a welded steel cylinder with steel joint rings welded to its ends, reinforcing cage of steel bars, or welded wire fabric; and a wall of dense concrete both inside and out.

Pre-stressed concrete cylinder pipe shall have bell and spigot ends formed by steel joint rings welded to the steel cylinder. Joints shall conform to AWWA C-301, rubber gasket shall be a special rubber designed to resist hardening and disintegration from contact with sewage and water.

3.0 PVC Pipe

Pipe shall be homogenous throughout and free from cracks, holes, foreign inclusions or other injurious defects. Pipe shall be uniform as practicable in: color, opacity, density and any other physical property.

Routine inspection, sampling and testing shall be performed during pipe and fitting production to assure a product quality which exceeds the minimum requirements stated herein. Certificates of Conformance to verify conformance with the standard specifications for pipe and accessories shall be submitted by the manufacturer for approval prior to installation.

3.1 PVC Pipe for Gravity Sanitary Sewers

Unless specified otherwise by the Engineer, PVC pipe constructed for gravity sanitary sewers shall have a standard dimension ratio (SDR) of 26 and and may be laid in depths from four (4) feet to twenty-five (25)

feet with specified bedding and ditch widths. PVC sewer pipe shall not be laid in depths greater than twenty-five (25) feet. PVC pipe with a SDR of 35 shall not be allowed.

Polyvinyl chloride (PVC) sewer pipe for gravity sanitary sewers is approved for 6-inch through 36-inch diameter. PVC pipe with a nominal diameter greater than twelve-inches (12") may be used only with the approval of the Engineer.

3.1.1 PVC Pipe for Gravity Sanitary Sewers Constructed Using Excavation Methods

Pipe installation and bedding shall be in accordance with Section 035 of these Specifications. When constructed using excavation methods, PVC pipe and fittings sized from 6-inches to 15-inches shall conform to ASTM D-3034, Type PSM and shall be standard dimension ratio (SDR) 26. Pipe and fittings sized 18-inch up to 60-inches shall conform to ASTM F679, PS115. Pipe shall be provided in the maximum laying lengths available to minimize the number of joints. All joints for PVC gravity sanitary sewers shall conform to ASTM standard D-3212 and have flexible elastomeric seals.

3.1.2 PVC Pipe for Gravity Sanitary Sewers Constructed Using Pulling Methods

As specified by the Engineer, construction of PVC pipe using pulling methods shall be in accordance with Sections 071 and 079 of these Specifications. Unless specified otherwise by the Engineer, when constructed using pulling methods including horizontal directional drilling or trenchless pipe replacement methods, PVC pipe and fittings shall be Certa-Lok, C900/RJ or C905/RJ pipe, as manufactured by the Certainteed Corporation, or an equal approved prior to the receipt of proposals. The pressure class of the pipe shall be specified by the Engineer. However, restrained joint integral bell (RJIB) pipe, as manufactured by the Certainteed Corporation, shall not be allowed. Pipe shall be provided in the maximum laying lengths available to minimize the number of joints.

3.2 PVC Pipe for Force Main Sewers

PVC pipe materials, not including fittings, to be used in the construction of force mains shall be that specified in Subsection 3.1.2 above titled "PVC Pipe for Gravity Sanitary Sewers Constructed Using Pulling Methods". All fittings for PVC pipe constructed for pressure pipe applications shall be ductile iron pipe in accordance with these Specifications.

Joints between PVC, Certa-Lok, C905/RJ, DR 25, pipe and DIP fittings shall be mechanical. Mechanical joints shall be constructed on plain-end PVC, Certa-Lok, C905/RJ, DR 25, pipe using either Series 2000PV mechanical joint restraint for PVC pipe as manufactured by EBAA Iron, Inc., or PVC Stargrip, Series 4000, mechanical joint wedge action restraint as manufactured by Star Pipe Products, or an equal approved prior to the receipt of proposals for the completion of the Project. Mechanical joints constructed on plain-end PVC, Certa-Lok, C905/RJ, DR 25, pipe shall be constructed in accordance with the recommendations of the restraint and PVC product manufacturers.

Pipe installation shall be in accordance with Sections 035 or 071 of these Specifications as specified by the Engineer.

Fasteners, including, but not limited to, all bolts, nuts, and washers used on ductile-iron fittings, retainers, etc., shall be constructed using Type 316 stainless steel. Allowable fasteners made of materials other than stainless steel shall be approved by the Engineer before the opening of bids.

4.0 Ductile Iron Pipe

Construction of ductile iron pipe (DIP) shall be in accordance with Section 035 of these Specifications. DIP for sanitary sewers shall be used only with written approval of the Engineer. DIP for non-pressurized sanitary sewers shall meet the requirements of ASTM Specification A746. Unless specified otherwise by the Engineer, the class thickness for pipe diameters of four (4) inches through sixty (60) inches shall be determined by using a Type 4 laying condition and Class B Bedding as specified by ASTM C12. DIP used in gravity situations shall conform to ANSI/AWWA C150/A21.50.

DIP used in pressure applications shall conform to ANSI /AWWA C151/A21.51. Unless specified otherwise by the Engineer, DIP used in pressure applications shall conform to Pressure Class 350.

Including, but not limited to, tees, bends and wyes, ductile-iron fittings with mechanical joints and sized up to twenty-four inches (24") shall be rated for 350 psi working pressure and meet the provisions of the current versions of standards ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/A21.11. Ductile iron fittings with mechanical joints and sized thirty inches (30") through forty-eight inches (48") shall be rated for 250 psi working pressure. Flanged ductile-iron fittings sized up to twenty-four inches (24") shall also be rated for 350 psi.

Unless specified otherwise by the Engineer, interior surfaces of all ductile iron pipe, couplings and fittings shall be lined with Protecto 401-brand ceramic epoxy lining or an equal approved in writing by the Engineer prior to the opening of bids. The applied thickness of ceramic epoxy linings shall be 40 mils. Cut surfaces of ductile iron pipe shall be sealed using Protecto 401 Joint Compound brushed on to a dry film thickness equal to the nominal thickness of the applied Protecto 401 ceramic epoxy liner.

Unless directed otherwise by the Engineer, joint locations shall be planned and located to minimize the total number of joints. Joints between ductile iron pipe and DIP fittings shall be mechanical and meet the requirements of ANSI/ AWWA C111/A21.11. Mechanical joints shall be constructed on plain-end ductile iron pipe (DIP) using Megalug Series 1100 mechanical joint restraint for DIP as manufactured by EBAA Iron, Inc., or an equal approved prior to the receipt of proposals for the completion of the Project. Mechanical joints constructed on plain-end ductile iron pipe (DIP) shall be constructed in accordance with the recommendations of the restraint and DIP product manufacturers. Joints for ductile iron pipe installed by jacking and tunneling shall be as specified in Section 051 of these Specifications.

Connections between DI pipe and other pipe materials shall be made with a Band Seal Adapter or equal. A gasket shall be provided to fit over the plain end of the DI pipe so the adapter can be tightened around both pipes to make a water tight and structural seal.

Fasteners, including, but not limited to, all bolts, nuts, and washers used on ductile-iron fittings, retainers, etc., shall be constructed using Type 316 stainless steel. Allowable fasteners made of materials other than stainless steel shall be approved by the Engineer before the opening of bids.

5.0 High Density Polyethylene Pipe

High-density polyethylene (HDPE) pipe may be used for gravity sanitary sewers and force main sewers. Medium-density polyethylene (MDPE) pipe, low-density polyethylene (LDPE) pipe and linear low-density (LLDPE) pipe shall not be allowed. The sizing of HDPE pipe shall be in accordance with ASTM F714 and shall be based upon the DIPS, outside diameter sizing system. The dimension ratio (DR) of pipe to be installed shall be shown on the project Plans.

All HDPE pipes shall be of virgin material and from the same manufacturer. Except that obtained from the manufacturer's own production of the same formulation, no recycled materials shall be used.

Upon delivery to the site(s) of work, both the outside and inside surfaces of the HDPE pipe shall be inspected for damage such as, but not limited to, cuts, scrapes, gouges, tears, cracks, punctures. If any damages are found, the Engineer shall be the sole judge of the damages and the acceptability of the pipe. If rejected, the Contractor shall be responsible for removing the defective pipe from the site(s) of work and replacing it with new.

Resin compounds used in the manufacture of HDPE pipe to be used in non-pressurized, sanitary sewers shall be in accordance with cell classification number or property value PE3608 as defined within the latest versions of both ASTM D3350 and ASTM F714. For pressurized, sanitary sewer application, resin compounds used in the manufacture of HDPE pipe shall be in accordance with cell classification number or property value PE4710 as defined within the same. PE material compounds shall meet Specification code C. Resins shall be in accordance with all requirements of the latest versions of both ASTM D3350 and ASTM F714.

The Contractor shall provide to the Engineer a certification, signed by an authorized agent of the manufacturer, demonstrating that the pipe provided was manufactured, sampled, tested and inspected in accordance with ASTM D3350 and ASTM F714 and that the pipe meets the requirement therein. The Contractor shall provide to the Engineer the results of all tests performed by the manufacturer on the material and pipe for the purpose of demonstrating compliance with these Specifications.

Pipe will be legibly marked in accordance with those requirements specified in the latest version of ASTM F714. Pipe not marked as directed will be rejected.

HDPE pipe lengths shall be as from the manufacturer. Lengths shall be such that the number of joints between pipes is minimized; however, the pipe must be easily and safely transportable, handled, stored, protected and constructed in accordance with the manufacturer's recommendations, the project Plans, these Specifications and all applicable laws, ordinances and regulations. Lengths shall be such that storage on the project site(s) is achievable without unacceptable traffic disruptions or disruption and peril to local residents or existing development. Any discrepancy between the recommendations of the pipe manufacturer, these Specifications, the project Plans and the recommendations of the manufacturers of any equipment used towards the completion of the project shall be brought to the attention of the Engineer before the commencement of construction.

Prior to and during construction, HDPE pipe shall not be dragged, pushed or rolled over the ground surface. HDPE pipe shall be moved using other means in accordance with the recommendations of the manufacturer of the pipe and the Engineer.

For each pipe, the outside and inside surfaces shall be inspected. The Engineer shall be the sole judge of the acceptability of pipe. If rejected, the Contractor shall be responsible for removing the defective pipe from the project and replacing it with a new that judged to be acceptable.

Testing of installed HDPE pipe shall be in accordance with these Specifications and ASTM F714. Testing of HDPE pipe shall be performed by an independent, third-party testing firm with experience in performing such testing as acceptable to the Engineer. To confirm conformance with the specifications, the Engineer may require that pipe be tested. If required by the Engineer, the Contractor shall propose a laboratory and submit to the Engineer information about the laboratory including their qualifications. The Engineer may require that two (2) samples are tested for every delivery of HDPE pipe, if construction will use methods that rely on pulling forces, or for every four-hundred (400) feet of constructed HDPE pipe if constructed using traditional excavation methods. The Contractor and the approved laboratory shall be responsible for the construction of

testing samples, transportation samples to the site(s) of testing, performance of the tests as well as the provision of testing results to the Engineer in an approved format. Test results shall be the exclusive property of the Engineer.

Connections to HDPE pipe shall be made using sewer tapping methods in accordance with Section 031 of these Specifications. Additional specifications for the adjoining of HDPE pipe to manholes may be included in the other subsections of these Specifications.

All fittings attached to HDPE pipe shall be constructed of ductile-iron materials.

5.1 Joining HDPE Pipe

Joints between mainline HDPE pipes shall be constructed using heat fusion techniques in accordance with the instructions of the pipe manufacturer. Unless approved by the Engineer prior to the opening of proposals, mechanical connections of HDPE pipe constructed using pulling techniques shall not be allowed. The joining of HDPE pipes using heat fusion techniques is understood to be the joining of HDPE pipes by heating two surfaces of the pipe to a designated temperature then fusing them together by application of a sufficient force. If allowed by the manufacturer of the pipe, types of heat fusion allowed to be used towards the completion of the project include butt and electrofusion (EF). It is understood that EF utilizes electrical currents to heat the pipe; comparatively, butt fusion utilizes more conventional heating methods. The Contractor shall submit to the Engineer documentation, in a form acceptable to the Engineer, demonstrating acceptance by the pipe manufacturer of the heat fusion method proposed by the Contractor.

Joints between HDPE pipes shall be complete throughout the pipe circumference, the thickness of the pipe walls and the length of pipe heated for fusion purposes. Absolutely no leaks shall be allowed through fused joints.

Heat fusion of HDPE pipe shall be in accordance with the recommendations of the manufacturers of both the heat fusion equipment and the pipe. The Contractor shall provide to the Engineer, in a satisfactory format, recommendations and instructions for the construction of joints between HDPE pipe using heat fusion techniques. If accepted as an alternative by the pipe manufacturer, the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, TR-33/2005, or the most-recent version, as published by the Plastic Pipe Institute (PPI), may govern the construction of joints between HDPE pipes. Prior to the joining of any HDPE pipe as part of the project, evidence of acceptance of the PPI standard by the pipe manufacturer shall be presented to the Engineer in the form of an original correspondence from the pipe manufacture to the Engineer demonstrating such acceptance.

Fusions shall be made by trained operators using machinery in good condition and specifically designed for the type of heat fusion selected. Operators and supervisory personnel utilized by the Contractor towards the completion of the project shall be trained by the manufacturers of the fusion equipment and pipe. The Contractor shall provide the Engineer satisfactory evidence of acceptance by the manufacturers of the training and experience of the Contractor and participating personnel.

For all joints, after completion of the joining process, excessive HDPE materials (beads) near pipe joints on both the external and internal surfaces of the pipe shall be removed using methods approved by the Engineer and the pipe manufacture. The purpose of removing beads is to reestablish smooth internal and external pipe walls to improve flow internally and reduce drag externally. Both internal and external bead removal shall be performed using equipment specifically designed for the purpose and in accordance with the recommendations of the manufacturers of the pipe and the internal bead removal system. External bead removal shall be performed using equipment such as the external bead remover as

manufactured by McElroy Manufacturing, Inc. Internal bead removal shall be performed using equipment such as the internal bead trimmer as manufactured by R & L Manufacturing. Proposed bead removal systems shall be acceptable to the manufacturer of the pipe. Prior to bead removal, the Contractor shall submit evidence acceptable to the Engineer of the acceptance by the pipe manufacturer of the proposed bead removal systems. Additionally, the Contractor shall provide the Engineer satisfactory evidence of acceptance by the manufacturer(s) of the bead removal system(s) of the training and experience of the Contractor and participating personnel in the operation of bead removal equipment.

The maximum length of assembled but uninstalled pipe shall not exceed the recommendations of both the manufacturer of both the HDPE pipe and the equipment used for construction via horizontal directional drilling and trenchless pipe replacement systems, where applicable.

To confirm joint integrity, operator procedure and equipment, the Engineer may require that fused joints may be destructively tested. Destructive laboratory tests of tensile specimens prepared from heat fusion joined pipes may be performed per ASTM D638 or ASTM F2634. If required by the Engineer, the Contractor shall propose a laboratory and submit to the Engineer information about the laboratory including their qualifications. The Engineer may require that two (2) samples are tested for every pull of HDPE pipe, if constructed using methods that rely on pulling forces, or for every four-hundred (400) feet of constructed HDPE pipe if constructed using traditional excavation methods. The Contractor and the approved laboratory shall be responsible for the construction of testing samples, transportation samples to the site(s) of testing, performance of the tests as well as the provision of testing results to the Engineer in an approved format. Test results shall be the exclusive property of the Engineer.

For each joint, the outside and inside surfaces shall be inspected. The Engineer shall be the sole judge of the acceptability of each joint. If rejected, the Contractor shall be responsible for correcting the defective joint in accordance with the directions of the manufacturer of the joining equipment and the pipe.

Data loggers can be used to record length of heating, fusing and cooling time, as well as temperature and pressure of each joint to ensure and record quality control.

5.2 Joining HDPE Pipe to Manholes

Connections of constructed HDPE pipe to new manholes shall be made using press seal boots unless otherwise specified by the Engineer. If joining to an existing manhole, joints between the pipe and the existing opening shall be constructed using hydraulic cement or a material approved by the pipe manufacturer and shall extend throughout the circumference of the pipe in such a manner as to form a smooth, uniform, watertight joint.

For all joints between HDPE pipe and manholes, a fixed diameter HDPE pipe stiffener, dimensioned specifically for the constructed HDPE pipe shall be inserted into the pipe at the manhole joint prior to the finalization of the joint. Pipe stiffeners shall be manufactured using Type 316 stainless steel, in accordance with ASTM 240, and installed into the pipe in accordance with the recommendations of the manufacturers of both the pipe and the stiffeners. Pipe stiffeners shall fit tightly into the pipe without the ability to be moved linearly along the alignment of the pipe or rotated in a circular manner. All stiffeners shall have a lip that prevents such movement. If the HDPE pipe is constructed using pulling methods, additional requirements for the construction of joints between manholes and the pipe can be found within other sections of these Specifications and the project Plans.

Additional specifications for the adjoining of HDPE pipe to manholes may be included in the other subsections of these Specifications.

5.3 Joining HDPE Pipe to Pipe and Fittings Manufactured of Other Materials

Connections of constructed HDPE pipe to pipe and fittings manufactured using materials other than HDPE shall be constructed in accordance with the directions of the manufacturers of the HDPE pipe and the pipe manufactured of other materials, these Specifications and the project Plans.

HDPE pipe to DIP connections shall be constructed using appropriately-sized MJ adapters as manufactured by Fusion Support Services, LLC, or an equal approved prior to the receipt of proposals for the completion of the Project.

END OF SECTION