

# **San Antonio Water System Standard Specifications for Construction**

## **Item No. 1100 Slip-Lining Sanitary Sewers**

**1100.1 DESCRIPTION:** This item shall govern the designing, fabricating, furnishing, slip-line installation, and joining of High Density Polyethylene (HDPE) pipe and fittings for conveyance of wastewater.

1. The pipe size, centerline alignment, and grades are presented in the project Drawings.

**1100.2 REFERENCED STANDARDS:** Reference standards cited in this Specification Item No. 1100 refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification Item No. 1100, unless a date is specifically cited.

1. San Antonio Water System (SAWS)
  - a. Specification for Water and Sanitary Sewer Construction
  - b. SAWS Material Specifications
2. City of San Antonio (COSA)
  - a. Utility Excavation Criteria Manual.
  - b. Standard Specifications for Construction
3. Texas Commission on Environmental Quality (TCEQ)
  - a. Design Criteria for Sewage Systems (30 TCEQ § 217)
  - b. Edwards Aquifer Recharge Zone (30 TCEQ § 213)
4. ASTM – American Society for Testing and Materials:
  - a. ASTM F 412 - Standard Terminology Relating to Plastic Piping Systems.
  - b. ASTM 585, Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers
  - c. ASTM D 618 – Standard Practice for Conditioning Polyethylene Plastic Pipe Based on Controlled Outside Diameter.
  - d. ASTM F 714 - Standard Specification for 3 - 63 inch (SDR-PR) Polyethylene Pipe.
  - e. ASTM D 1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials.
  - f. ASTM D 2122 - Determining Dimensions of Thermoplastic Pipe and Fittings.
  - g. ASTM D 2657 - Standard Practice for Heat-Joining Polyolefin Pipe and Fittings.
  - h. ASTM D 2774 - Underground Installation of Thermoplastic Pressure Piping.
  - i. ASTM D 2837 - Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pressure Piping.
  - j. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR), Based on Outside Diameters.
  - k. ASTM D 3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
  - l. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and

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Fittings Materials.

- m. NSF Standard #14 - Plastics Piping Component and Related Material.
- n. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch, for Water Distribution.

**1100.3 SUBMITTALS:** Contractor shall submit manufacturer's product data, instructions, recommendations, shop drawings, and certifications. All submittals shall meet the Engineer's requirements and be approved by the Engineer prior to delivery.

**1100.4 MATERIALS:** Acceptable manufacturers for materials shall conform to the applicable specifications contained within the latest revision of SAWS Material Specifications and SAWS Standard Specifications for Construction, except as modified herein.

1. Dimensions and Pressure Rating:
  - a. Pipe Dimensions: The nominal inside diameter of the pipe shall be true to the specified pipe size. Minimum standard laying lengths shall be 40 feet  $\pm$  2 inches.
  - b. Fitting Dimensions: Fittings such as couplings, wyes, tees, adaptors, etc. for use in laying pipe shall have standard dimensions that conform to ASTM D 3261.
  - c. Pipe and Fitting shall be minimum SDR 21 for slip-lining pipe sections, unless otherwise shown on the Plans. Provide all required couplings, transitions and fittings between different HDPE pipe sections, and between HDPE pipe and other pipe materials. Line sizes shown are nominal inside diameter (ID). Final slip lining pipe and fitting wall thickness shall be based upon Contractor's approved Slip Lining Installation Plan.
2. HDPE Pipe: Materials used for the manufacture of polyethylene pipe and fittings shall be PE 3408 high density polyethylene meeting cell classification 345464C for black or 345464 E for stripes per ASTM D 3350; and shall be listed in the name of the pipe and fitting Manufacture in PPI (Plastics Pipe Institute) TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds, 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.
3. Polyethylene pipe shall be manufactured in accordance with AWWA C901-96 for sizes 1 ¼: thru 3" IPS diameters and to the requirements of ASTM D3035. Pipe 4" IPS and DIPS 4" and above shall be manufactured to the requirement of ASTM F714 and AWWA C906-99 (IPS). Each production lot of material or pipe shall be tested for melt index, density and % carbon. Each production lot of pipe shall be tested for dimensions and ring tensile strength.
4. Permanent identification of the piping service shall be provided by co-extruding color stripes into the pipe outside surface. The striping material shall be the same material as the pipe material except for color. Stripes printed on the pipe outside surface shall not be acceptable. IPS sized pipes shall have four equally spaced, longitudinal color stripes. DIPS sized pipes shall have three equally spaced pairs of longitudinal color stripes. The strip color shall be green.

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5. Molded fittings shall be manufactured in accordance with ASTM D 3261 and shall be so marked.
6. 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.
7. Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion-joining machine without the use of stub-end-holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves (serrations) to promote gasket less sealing, or restrain the gasket against blowout.
8. Polyethylene fittings and custom fabrications shall be molded or fabricated by the Approved Pipe Manufacturer. All fittings and custom fabrications shall be pressure rated for the same internal pressure rating as the mating pipe. Reduced pressure-rated (de-rated) fabricated fittings are prohibited.
9. Pipe material supplied for the project shall be certified by the manufacturer as to the structural integrity of the pipe based on the installation requirements and installation depths described and shown on the plans.
10. The pipe shall have a maximum allowable long-term deflection of 5 percent of the initial diameter under the burial conditions and depths shown on the Drawings.
11. Manufacturer's and Installer's Qualifications:
  - a. Manufacturer shall have at least five years' experience in producing, and installer shall have at least five years' experience in installing similar type materials, and show evidence with their submittals of at least five installations similar to this project in satisfactory operation.
  - b. HDPE pipe joint fusion and installation shall be completed by the qualified installers certified as fusion technicians by the HDPE pipe manufacturer and/or fusion equipment manufacturer, and approved by the ENGINEER. The CONTRACTOR may complete installation under direct and continuous supervision of the qualified installer, when approved by the ENGINEER. Installer shall have demonstrated experience with slip-lining installation of similar size and length HDPE piping systems.
12. The pipe and fittings manufacturer shall have an established quality assurance program responsible for inspecting incoming and outgoing materials. At a minimum, incoming polyethylene materials shall be inspected for density per ASTM D 1505 and melt flow rate per ASTM D 1238. The ENGINEER may require polyethylene materials certification from the supplier. Certification shall be verified by CONTRACTOR and ENGINEER. Incoming materials shall be approved by Manufacturer's Quality Assurance before processing into finished goods.
13. The pipe and fittings manufacturer shall have an established quality assurance program responsible for assuring the long term performance of materials and products. Representative samples of polyethylene materials shall be tested against the physical property requirements of this specification. Each extrusion line and molding machine shall be qualified to produce pressure rated products by taking representative production samples and performing sustained pressure tests in

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- accordance with ASTM D 1598.
14. All outgoing materials shall be inspected for diameter, wall thickness, length, straightness, out-of-roundness, concentricity, toe-in, inside and outside surface finish, markings, and end cut. Manufacturer's Quality Control shall perform tests of density, melt flow rate, carbon content, and carbon dispersion on finished pipe. In addition, samples of the pipe provided shall be tested for hoop tensile strength and ductility by either quick burst per ASTM D 1599 or ring tensile per ASTM D 2290. Molded fittings shall be subject to x-ray inspection for voids, and tests for knit line strength. All fabricated fittings shall be inspected for fusion quality and alignment.
  15. Pipe and fittings shall be produced from similar materials meeting the requirements of this specification. Special or custom fittings may be exempted from this requirement.
  16. Pipe and fittings shall be pressure rated to meet the service pressure requirements specified by ENGINEER. Whether molded or fabricated, fittings shall be fully pressure rated to at least the same service pressure rating as the pipe to which joining is intended.
  17. Molded fittings shall meet the requirements of ASTM D 3261 and this specification. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the diameter and wall thickness specifications of the mating system pipe. Fitting markings shall include a production code from which the location and date of manufacture can be determined. Upon request, the manufacturer shall provide an explanation of his production code.
  18. Fabricated elbows produced from mitered-curve assemblies shall be de-rated or additional mass added to maintain required pressure rating as the pipe itself. Miter-fabricated elbows shall be shop fabricated, unless otherwise allowed by the Engineer, and shall be documented per ASME B31.3(96) through shop drawing submittal as meeting the design pressure rating.
  19. Transition Fittings shall be stainless or M.J. Adapter kits with stainless steel stiffeners.
  20. Marking:  
Each standard and random length of pipe and fitting in compliance with this standard shall be clearly marked with the following information.
    - a. ASTM Standard Designation.
    - b. Pipe Size.
    - c. Class and Profile Number.
    - d. Production Code.
    - e. Standard Dimension Ratio.
  21. Slip-Lining Grout:
    - a. Slip-Lining Grout shall meet the requirements of SAWS Specifications for Construction Item No. 1101, Slip-Lining Grout', and shall be cementations, flowable type, specifically designed for pipeline annulus injection. Grout type, flowability, weight density, injection method, air evacuation technique, hydration heat, and setting time shall be defined in the Slip-Lining Installation Plan.

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22. Acceptable Manufacturers:
  - a. Slip-Lining HDPE pipe manufacturers must have approval through SAWS Standards Committee prior to product use and must meet all requirements set forth in the specification section.

**1100.5 CONSTRUCTION:** Existing sanitary sewers remain in operation during slip-lining process, with sewage flow diverted around operations in progress. Sewage flows from the upstream line and from the services are pumped as required to prevent overflows and provide continual service. Sewer services are reconnected to the new pipe through small excavations from the surface.

All excavations required for reconnecting and pumping service flows, entry pits, exit pits, obstruction removal, point repairs, among others, are to be kept to a minimum and all damage to surface and underground features, facilities, utilities and improvements are to be repaired.

1. Bypass Pumping: Shall meet the requirements of Specifications Item No. 865-S1, "Bypass Pumping Small Diameter Sanitary Sewer" and Specification Item No. 864-S2, ("Bypass Pumping Large Diameter Sanitary Sewer"
2. Sewer Main Cleaning and Television Inspection: Contractor shall clean and inspect the existing host sanitary sewer prior to beginning excavation of insertion or access pits.
  - a. Sanitary sewer main cleaning shall meet the requirements of SAWS Standard Specifications for Construction Item No. 868 "Sanitary Sewer System Cleaning".
  - b. Sanitary sewer main television inspection shall meet the requirements of SAWS Standard Specifications for Construction Item No. 866 ons for Main Television Inspection.
3. Obstruction Removal and Point Repair: Make point repairs and remove obstructions, such as roots, rocks and other debris, prior to installing liner pipe. Inspector is to first validate the need for either an obstruction removal or point repair. Point repairs shall meet the requirements of SAWS Standard Specifications for Construction Item No. 1103, "Point Repairs and Obstruction Removals."
4. Insertion or Access Pits:
  - a. Locate pits so that the total number is minimized and footage of liner pipe installed in a single pull is maximized. Where possible, use excavations at point repair locations for insertion pits.
  - b. Before excavating, check with various utility providers (e.g., CPS Energy, AT&T, Time Warner, etc.), and determine locations of utilities in or near the work area. Costs of utility repairs, temporary service and other costs arising out of damage to, or interruption of, utilities, resulting from operations under this Contract, shall be borne by Contractor at no additional cost to SAWS.
  - c. Insertion or access pit excavation and backfill shall meet the requirements of SAWS Standard Specifications for Construction Item No. 804, "Excavation, Trenching and Backfill."
  - d. Perform excavation requiring trench safety in accordance with OSHA

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standards and the requirements of SAWS Standard Specifications for Construction Item No. 550, "Trench Excavation Safety Protection."

Install and operate necessary dewatering and surface water control measures.

5. Installation and Jointing: Install HDPE slip-lining pipe in accordance with the approved Slip-Lining Installation Plan, continuously recording applied tension and other controlled installation parameters, including required 'relaxation' time to relieve applied insertion tension elongation.. Heat fusion joints between plain end pipes and fittings shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made using saddle fusion. The butt fusion and saddle fusion procedures used shall be 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.
- 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. Transition 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. SDR's for polyethylene pipe are 7.3, 9, 11, 13.5, 17, 21, 26, 32.5, and 41.
- Joining by other Means. Polyethylene pipe and fittings may be joined together or to other materials by means of (a) mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, (b) MJ Adapters or (c) electrofusion, where necessary and approved by the ENGINEER. When joining by other means, the installation instruction of the joining device manufacturer shall be observed.
- a. ID Stiffener and Restraint. A stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where an MJ Adapter is used.
  - b. All fabricated bends shall be encased with reinforced concrete, with #4 Bars at 12-inches on center each way completely around pipe, approximately centered in the encasement thickness, and extending one pipe diameter each direction along trench measured from the pipe interior bend point.
  - c. Allow installed HDPE pipe at least 48 hours to normalize (rebound) in length following slip-lining installation to relieve tensile expansion before cutting, fittings installation, or grouting.
- Slip-liner Pipe Collar/Closure:  
Install slip-liner pipe collar closure pieces in accordance with manufacturer's recommendations.

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6. Field Quality Control: After liner installation, perform the following tests:
  - a. Service lateral connection test: After all service laterals have been completed for a particular sewer section, verify integrity of re-connections at points where they join liners and existing service lines by performing smoke test.
  - b. Air and deflection testing shall meet the requirements of SAWS Standard Specifications for Construction Item No. 849, "Sanitary Sewer Pipe Air and Deflection Testing," for applicable test procedures.
7. Sealing Liner in Manhole:
  - a. Allow liner pipe to normalize to ambient temperatures and recover from imposed stretch before cutting to fit between manholes, sealing at manholes and shaping manhole invert. Allow at least 12 hours for normalization of polyethylene.
  - b. Cut liner so it extends 4 inches into manholes. Make smooth, vertical cuts and slope areas over top of exposed liner using non-shrink grout.
  - c. Seal annular spaces between liner and sanitary sewer main at each manhole with chemical seal and non-shrink grout. Place strips of oakum soaked in sealer in a band to form effective water-tight gasket in annular space between liner and existing pipes in manhole. Make width of the sealing band at least 12 inches, or one-half pipe diameter, whichever is greater.
  - d. Finish seal liner pipe to host pipe with non-shrink grout placed around annular space from inside manhole. Apply grout in a band measuring at least 6 inches wide. Obtain the Engineer's approval of sealing methods, including seal chemicals and materials.
  - e. Use cementitious grout to form smooth transitions with reshaped inverts and raised manhole benches to eliminate sharp edges of liner pipe, concrete benches, and channeled inverts. Build up and smooth manhole invert to match flow line of new liner.
8. Grouting Annular Space:
9. Pressure test each slip-line HDPE section prior to grouting.
10. Completely fill each slip-lined HDPE pipe section with water, evacuating all air, and cap water-tight prior to grouting the annulus space of both lines, to prevent HDPE pipe deflection during grout placement and curing.
11. Place grout by pumped tremie and withdrawal method, or other approved method defined in the Slip-Lining Installation Plan. Record installed grout volume and calculated annulus space volume to confirm complete grout filling.
12. Drain water from completed slip-lined HDPE section after grout curing (48-hours minimum), and perform deflection test.
13. Provide the Inspector with a NASSCO- (PACP) standard video, Specifications 866 "Sewer Main Television Inspection," and 868, "Sanitary Sewer System Cleaning."
14. Final Cleanup: Upon completion of installation and testing, clean and restore project area affected by work of this Section. No separate pay item for final cleanup.

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### **1100.6 TESTING:**

- a. After the existing sewer is completely replaced, internally inspect with television camera and DVD video as required. The finished tape will be continuous over the entire length of the sewer between two manholes and be free from visual defects.
- b. Defects which may affect the integrity or strength of the pipe in the opinion of the Engineer or Inspector will be repaired or the pipe replaced at the Contractor's sole expense.
- c. The Contractor shall smoke test to verify all sewer service connections.
- d. Testing shall be per SAWS, Specification Item No. 849 Sanitary Sewer Acceptance Testing.

### **1100.7 MEASUREMENT:**

- a. Measurement for slip-lining is on a linear foot basis for installed liner pipe, measured from center line of upstream manhole to center line of downstream manhole. Depth range for payment is based on depth measured at sewer main from natural ground level to flow line of sanitary sewer for each pipeline segment.

**1100.8 PAYMENT:** Payment for items included in this specification shall be in accordance with the pay items listed below. Work included in these items shall include and the price provided by the Contractor will be considered as full compensation for furnishing and placing of all materials, labor, tools, and equipment; cleaning, preparation, repairs, obstruction removal, inspection; and phasing, protecting, work execution and any other work necessary to complete the project.

- a. Installed Pipe: The inserted pipe will be paid for per linear foot of pipe installed using slip-lining method for the pipe diameter, type, quantity, and depth specified and will include all pipe installation materials, all submittals. Insertion pits, access pits, clamp installation, embedment (bedding, haunching and initial backfill), field quality control (testing), sealing liner at manholes, grouting annular space, building up, shaping and reworking manhole inverts and benches, and pre-installation and post-installation cleaning and television inspection of completed work are included in slip-lining unit price and not paid for separately.
- b. Excavations initially begun as obstruction removals or point repairs which the Contractor later decides to use as insertion pits are considered as insertion pits and not paid for separately.
- c. Trench safety systems, well pointing and other applicable bid items associated with insertion pits will be paid for at their respective contract unit prices.
- d. Bypass Pumping: Payment will be made in accordance with SAWS Specifications Item No. 865, "Bypass Pumping Small Diameter Sanitary Sewer" and Item Specification No. 864, ("Bypass Pumping Large Diameter Sanitary Sewer". There will be no additional or separate payment for documentation, required submittals, and associated or related work.

**- End of Specification -**