

San Antonio Water System Standard Specifications for Construction

ITEM NO. 900

**RECONSTRUCTION OF SANITARY SEWER BY
PIPE BURSTING/CRUSHING REPLACEMENT PROCESS**

900.1 DESCRIPTION: This specification includes requirements to rehabilitate existing sanitary sewers by pipe bursting/crushing method. The pipe bursting/crushing process is defined as the reconstruction of existing sanitary sewers by the simultaneous insertion (breaking and expanding the old pipe) of liner pipe within the bore of the existing pipe. Also covered in this specification is pipe, pipe joining, manhole connections, connection of service laterals and stubs, point repairs, obstruction removals, television requirements, testing requirements, bypass pumping criteria, site restoration, erosion control requirements, and warranty requirements.

The pipe bursting/crushing process involves the rehabilitation of deteriorated gravity sewer pipe by installing new pipe material within the enlarged bore created by the use of using a static, hydraulic, or pneumatic hammer "moling" device, suitably sized to break the existing pipe or by using a modified boring "knife" with a flared plug that crushes the existing sewer pipe. Forward progress of the "mole" or the "knife" may be aided by hydraulic equipment or other apparatus. Replacement pipe is either pulled or pushed into the bore. Sewer services are reconnected to the new pipe through small excavations from the surface. Sewage flows from the upstream line and from the services are pumped as required to prevent overflows and provide continual service. 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.

900.2 MATERIALS

1. High density polyethylene pipe (HDPE) related to pipe bursting or pipe crushing for a sanitary sewer or related pipe line habilitation:
 - a. Solid wall HDPE pipe referred to as Drisco 1000, Drisco 8600, Quail Pipe, Poly Pipe, and Plexco Pipe that is in conformance with ASTM F714 and ASTM requirements stated herein are considered approved for this project. HDPE pipe on this project will further be required to have a minimum pipe stiffness of 46 psi for 12" to 48" diameter pipe and 115 psi for 8" to 10" diameters as required by SAWS and TCEQ.

Pipe Manufacturer: All pipe and fittings will be high density polyethylene

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pipe and made of virgin material. No rework except that obtained from the manufacturer's own production of the same formulation will be used. The liner material will be manufactured from a high density high molecular weight polyethylene compound which conforms to ASTM D 1248 and meets the requirements for Type III, Class C, Grade P-34, Category 5, and has a PPI rating of PE 3408.

- b. The pipe produced from this resin will have a minimum cell Classification of 345434C (Inner wall will be light in color) under ASTM D 3350. A higher number cell classification limit which gives a desirable higher primary property, per ASTM D 3350 may also be accepted by the Engineer at no extra cost to SAWS. The value for the Hydrostatic Design basis will not be less than 1600 PSI (11.03 MPA) per ASTM D 2837. Pipe will have ultraviolet protection.
- c. Pipe Color and Quality: For television inspection purposes, the polyethylene pipe will have light-colored interior achieved with a homogenous, light-colored material throughout or with a fully bonded light-colored interior liner meeting specifications above indicated. All pipes shall be free of visible cracks, holes, foreign material, foreign inclusions, blisters, or other deleterious or injurious faults or defects. Pipe and fittings shall be as uniform as commercially practical in color, opacity, density, and other physical properties.

For interior lined pipe, the liner will be a minimum of 10 mils thick and co-extruded. The bond between the layers will be strong and uniform. It will not be possible to separate the two layers with a probe or point of a knife blade so that the layers separate cleanly at any point, nor will separation of the bond occur, between layers, during testing performed under the requirements of this specification.

- d. Pipe Diameter: Polyethylene plastic pipe will meet the applicable requirements of ASTM F 714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, ASTM D 1248, and ASTM D 3550. Internal diameter of the pipe indicated on the plans will be the minimum allowable pipe size.

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- e. Pipe Dimension Ratios: The minimum wall thickness of the polyethylene pipe will meet the following, as based on the deepest portion of a particular pipe pull, typically between manholes:

<u>Depth of Cover (Feet)</u>	<u>Minimum SDR of Pipe</u>
0 - 16.0	19
>16.1	17

Wall thickness shall be as indicated on the plans and will be in accordance with Chevron Plexco Industrial Piping System Pipe Data and Pressure Ratings Bulletin 301, or approved equal.

- f. Pipe Joining: Solid wall pipe shall be produced with plain end construction for heat-joining (butt fusion) conforming to ASTM D 2657.

The polyethylene pipe will be assembled and joined at the site using the thermal butt-fusion method to provide a leak proof and structurally sound joint. Threaded or solvent-cement joints and connections are not permitted.

All equipment and procedures used will be used in strict compliance with the manufacturer's recommendations. Fusing will be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.

The butt-fused joint will be true alignment and will have uniform roll back beads resulting from the use of proper temperature and pressure. The joint surfaces will be smooth. The fused joint will be watertight and will have tensile strength equal to that of the pipe. All joints will be subject to acceptance by the Engineers and/or his representative prior to insertion. All defective joints will be cut out and replaced at no cost to SAWS. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than 10% of the wall thickness, will not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, if in the opinion of the Engineers and/or his representative any section of pipe has other defects, including those hereinafter listed, that may indicate damaged, improperly manufactured, faulty, or substandard pipe, said pipe will be discarded and not used. Defects warranting pipe rejection include the following: concentrated ridges, discoloration, excessive spot roughness, and pitting; insufficient or variable wall thickness; pipe damage from bending, crushing, stretching or

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other stress; pipe damage that impacts the pipe strength, the intended use, the internal diameter of the pipe, internal roughness characteristics; or any other defect of manufacturing or handling.

Clamps and Gaskets: Clamps shall be stainless steel, including bolts and lugs as manufactured by JCM Industries Type 108 or equal. Furnish full circle, universal clamp couplings with a minimum 3/16 inch thick neoprene, grid-type gasket. Select clamps to fit outside diameter of pipe. Use minimum clamp length of 30 inches for replacement pipes O.D. of 10.75" (10" nominal) or greater and 18 inches for replacement pipe O.D. less than 10.75".

Terminal sections pipe that are joined within the insertion pit will be connected with a full circle pipe repair clamp. The butt gap between pipe ends will not exceed ½ inch.

- g. Force Mains: Where applicable, solid wall pipe for sanitary sewer force mains shall have a minimum working pressure rating of 150 psi, and an inside diameter equal to or greater than the nominal pipe size indicated on the Drawings.
- h. Augering Pipe: HDPE pipe is not approved in applications requiring augering of sewer pipe.
- i. Pipe Marking: Each standard and non-standard length of pipe or fitting shall be clearly marked with pipe size, pipe class, production code, material designation and other relevant identifying information.
- j. Pipe Inspections: The Engineer reserves the right to inspect pipes or witness pipe manufacturing. Such inspection shall in no way relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications. Should the Engineer wish to witness the manufacture of specific pipes, the manufacturer shall provide the Engineer with adequate advance notice of when and where the production of those specific pipes will take place. Approval of the products or tests is not implied by the Engineer's decision not to inspect the manufacturing, testing, or finished pipes.

900.3 CONSTRUCTION

1. Pit Location: Location and number of insertion or launching pits will be chosen

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by the contractor, and will typically be located near existing or proposed manholes, P.I.'s in the line, at logical breaks in the construction phasing, or at locations to comply with access or maintenance requirements.

Pits shall be placed and located to minimize the total number of pulls and maximize the length of pipe replaced per pull, within the constraints of maintaining service and access and other requirements. Use excavations at point repair locations for insertion pits where possible.

2. Operations: The contractor shall provide equipment, planning, and job execution necessary to accomplish the work in an efficient manner and consistent with the objectives of this specifications, including preventing damage to existing infrastructure, maintaining pedestrian and vehicle access, and providing continual sewer service to customers.

Pipe shall be assembled and fused on the ground in sections equivalent to the length of the anticipated pull. During installation, all bending and loading the pipe shall be in conformance with manufacturers recommendations and shall not damage pipe.

Manholes shall be prepared so as to provide pipe installation at the lines and grades indicated on the plans. The invert in the manholes shall be removed as required to allow for pipe installation activities and to accommodate invert replacement. Manhole inverts shall be restored upon completion with 3000 psi grout so as to establish a minimum 4 inch thick bottom on the manhole after shaping per drawings.

3. Equipment: The Contractor shall utilize pipe bursting/crushing equipment with adequate pulling/pushing force to complete pulls in a timely manner. The contractor shall provide equipment on the pulling mechanism to verify the pulling/pushing force exerted on the pipe does not exceed the manufacturer's recommendation for allowable pulling force to prevent damage to the pipe. The pulling force may not exceed the following: 6 tons for 8.625" O.D.; 10 tons for 10.75" O.D.; 17 tons for 14" O.D.; 23 tons for 16" O.D.; 28 tons for 18" O.D. Allowable pulling force for all diameters shall be determined by the contractor depending on the pipe size, wall thickness, manufacturer, field conditions, pull distance, manhole integrity, bearing capacity of soils, adjacent infrastructure, related equipment and cable strength, and related considerations.
4. Equipment shall be configured with adequate knives or other appropriate

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devices to minimize interruptions in the installation process due to obstruction removal and other problems. Pipe shall be secured to the pulling/pushing device in accordance with standard practice. The diameter of the pulling/pushing head shall be equal or slightly greater than the pipe OD.

5. Minimize Noise Impact: Equipment used to perform the work will be located away from buildings so as not to create a noise impact. Provide silencers or other devices to reduce machine noise as required to meet requirements.
6. Protection: The Contractor shall provide for the general safety of workers, pedestrians and traveling public throughout this project. Existing surface improvements and underground facilities and utilities shall also be protected. Damage caused by the Contractor shall be repaired at his own expense. Protection to be provided includes:
 - a. Provide barricades, warning lights and signs for excavations created by point repairs. Conform to requirements of TxDOT, City of San Antonio, and of contract documents.
 - b. Protection of Manholes: The Contractor will install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances will the pipes be stressed beyond their elastic limit.
 - c. Do not allow sand, debris, or runoff to enter sewer system.
 - d. Verify location of all underground utilities and facilities potentially impacted by rehabilitation related or other project activities and take necessary precautions to provide protection from damage. Damage caused by the Contractor shall be at his cost and responsibility.
 - e. Protect the new pipe and components during all phases of work, including hauling, installation, entry into the entry pit, and prevention of scarring or gouging of the pipe or components.

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7. Sealing Liner In Manhole:

- a. Allow liner pipe to normalize to ambient temperatures as well as recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and manhole invert shaping. Normalization usually takes at least 12 hours for polyethylene.
- b. Cut liner so that it extends four inches into manhole. Make a smooth, vertical cut and slope area over top of exposed liner using non-shrink grout.
- c. Seal the annular space between liner and sanitary sewer main at each manhole with a chemical seal and non-shrink grout. Place strips of oakum soaked in sealer (Scotchseal 5600 as manufactured by 3M Corporation, or equal) in a band to form an effective water-tight gasket in the annular space between liner and existing opening in manhole. Make width of the sealing band a minimum of eight inches or the thickness of the manhole wall, whichever is greater.
- d. Finish seal with a non-shrink grout placed around annular space from inside manhole. Apply grout in a band not less than six inches wide.
- e. Reshape and smooth the manhole invert. Form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new liner.

8. Field 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 to be free from visual defects.
- b. Defects which may affect the integrity or strength of the pipe in the opinion of the Engineer will be repaired or the pipe replaced at the Contractor's expense.
- c. The Contractor shall smoke test to verify all sewer service connections.

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- d. The following items are excerpted from TCEQ Chapter 317 requirements for gravity sewer construction testing (§317.a.4). Compliance with these requirements is required unless the contractor obtains and provides written authorization from the TCEQ authorizing alternative testing and compliance procedures:
1. **Testing of Installed Pipe:** An infiltration, exfiltration or low-pressure air test shall be specified. Copies of all test results shall be made available to the executive director (TCEQ) upon request. Tests shall conform to the following requirements:
 2. **Infiltration or Exfiltration Tests:** The total exfiltration as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of two feet above the crown of the pipe at the upstream manhole. When pipes are installed below the groundwater level an infiltration test shall be used in lieu of the exfiltration test. The total infiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of two feet above the crown of the pipe at the upstream manhole, or at least two feet above existing groundwater level, whichever is greater. For construction within the 25 year flood plain, the infiltration or exfiltration shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head. If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, remedial action shall be undertaken in order to reduce the infiltration or exfiltration to an amount within the limits specified.
 3. **Low Pressure Air Test:** The procedure for the low pressure air test shall conform to the procedures described in ASTM C-828, ASTM C-924, ASTM F-1417 or other appropriate procedures, except for testing times. The test times shall be as outlined in this section. For sections of pipe less than 36 inch average inside diameter, the following procedure shall apply unless the pipe is to be joint tested. The pipe shall be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be computed from the following equation:

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- T = time for pressure to drop 1.0 pound per square inch gauge in seconds
- K = $0.000419 \times D \times L$, but not less than 1.0
- D = average inside pipe diameter in inches
- L = length of line of same pipe size being tested, in feet
- Q = rate of loss, 0.0015 cubic feet per minute per square foot internal surface shall be used

Since a K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as follows:

4.	Pipe Diameter (Inches)	Minimum Time (Seconds)	Length for Minimum Time (Feet)	Time for Longer Length (seconds)
	6	340	398	0.855(L)
	8	454	298	1.520(L)
	10	567	239	2.374(L)
	12	680	199	3.419(L)
	15	850	159	5.342(L)
	18	1020	133	7.693(L)
	21	1190	114	10.471(L)
	24	1360	100	13.676(L)
	27	1530	88	17.309(L)
	30	1700	80	21.369(L)
	33	1870	72	25.856(L)

- 5. The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined above or until failure. Lines with a 27 inch average inside diameter and larger may be air tested at each joint. Pipe greater than 36" diameter must be tested for leakage at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

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6. Deflection Testing: Deflection tests shall be performed on all flexible pipes. For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter 27" and greater, a method approved by the executive director shall be used to test for vertical deflections. Other methods shall provide a precision of \pm two tenths of one percent (0.2 %) deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of five percent. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices. The design engineer should recognize that this is a maximum deflection criterion for all pipes and a deflection test less than five percent may be more appropriate for specific types and sizes of pipe. Upon completion of construction, the design engineer or other Texas Registered Professional Engineer appointed by the owner shall certify, to the Executive Director, that the entire installation has passed the deflection test. This certification may be made in conjunction with the notice of completion required in §317.1(e) (1) of this title (relating to General Provisions). This certification shall be provided for the Commission to consider the requirements of the approval to have been met.
7. Mandrel Sizing: The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
8. Mandrel Design: The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.
9. Method Options: Adjustable or flexible mandrels are prohibited. A

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television inspection is not a substitute for the deflection test. A deflectometer may be approved for use on a case by case basis. Mandrels with removable legs or runners may be accepted on a case by case basis.

900.4 MEASUREMENT AND PAYMENT: Measurement and 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.

1. Installed Pipe: The inserted pipe will be paid for per linear foot of pipe installed using pipe-bursting/pipe crushing method for the pipe diameter, type, quantity, and depth specified and will include all pipe installation materials, all submittals, sealing materials at manholes and annulus (if required), launching pits, receiving pits, post testing, shoring, bedding, backfill, and all necessary, corresponding, and related work specified herein. (Item No. 900)
2. Services: Locating and reconstruction of services and all connections of services will be paid for per each connection made, including fittings and pipe. Payment for abandoned services will be on a per each connection made basis. (Item No. 900.1)
3. Point Repairs: Point repairs will be paid for on a per each basis, as needed. Extra length point repair will be paid based on the length of pipe replaced per repair beyond the length established for each single point repair item, as needed. Abandoned point repairs will be paid on a cubic yard basis, as needed. (Item No.900.5)
4. Obstruction Removal: Obstruction removal will be paid for on a per each basis, as needed. (Item No. 900.6)
5. Storm Water Pollution Prevention and Erosion Control Plan: Payment for this item will be based on the items and quantities of control measures included in the proposal on the basis indicated in the respective specification sections.
6. Site Restoration: Except as associated with point repairs and obstruction removals, site restoration for all impacts to surface improvements will be on a linear foot basis of the rehabilitated line segment. For point repairs and

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- obstruction removals, site repair will be on a per each basis.
7. Television Inspection: Payment will be made for television inspection of the sewer line prior to pipe rehabilitation in accordance with specifications Item No. 866 and cleaning will be in accordance with specification Item No. 868. There will be no additional or separate payment for “post-TV” video inspection, documentation, required submittals, and associated or related work.
 8. Bypass Pumping: The cost of any necessary bypass pumping will be considered subsidiary to the appropriate pay items for pipe installation, television inspection, repair, or related work and will not be a separate pay item.