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Standard Practice for Sealing Lateral Connections and lines from the mainline Sewer Systems by the Lateral Packer Method, Using Chemical Grouting[1]

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INTRODUCTION

The infiltration of water in sanitary sewer systems through the lateral service connection and the first few joints of the lateral below the groundwater table is a major problem for collection system owners. The combined length of the lateral services often exceeds the length of the mainline sewers. Often, the lateral services have been built with little or no supervision and little or no above-ground access for monitoring and inspection.

1. Scope

1.1 This practice covers the procedures for testing and sealing sewer lateral connections and lateral lines from the mainline sewer with appropriate chemical grouts using the lateral packer method. Chemical grouting is used to stop infiltration of ground water and exfiltration of sewage in gravity flow sewer systems that are structurally sound.

1.2 This practice applies to mainline sewer diameters of 6 in. to 24 in. with 4 in., 5 in., or 6 in. diameter laterals. Larger diameter pipes with lateral connections and lines can be grouted with special packers or man-entry methods. The mainline and lateral pipes must be structurally adequate to create an effective seal.

1.3 Worker safety training should include reviewing the biohazards and gases from sewage, confined spaces, pumping equipment, and related apparatus. Additional safety considerations including proper handling, mixing, and transporting of chemical grouts should be provided by the chemical grout manufacturer or supplier, or both. Their safe operating practices and procedures should describe in detail appropriate personal protective equipment (PPE) for the various grouting operations. Operations covered should include the proper storage, transportation, mixing, and disposal of chemical grouts, additives, and their associated containers.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and to determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F2304 Practice for Sealing of Sewers Using Chemical Grouting

2.2 *NASSCO Standard:*[3]

NASSCO Specification Guidelines Wastewater Collection System Maintenance and Rehabilitation, 2003

[1] This practice is under the jurisdiction of ASTM Committee F36 on Technology and Underground Utilities and is the direct responsibility of Subcommittee F36.20 on Inspection and Renewal of Water and Wastewater Infrastructure.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from National Association of Sewer Service Companies (NASSCO), Inc., 5285 Westview Drive, Suite 202, Frederick, MD 21703, http://www.nassco.org.

3. Significance and Use

3.1 The inspection, testing, and repair of lateral connections for sanitary sewers are regular practice necessary for the maintenance and optimal performance of the system. It is important to identify methods that use the most current compounds and technology to ensure the reduction of infiltration and exfiltration. It is important to minimize disruption to traffic and lessen the environmental impacts for both the municipal and private owners.

3.2 This practice serves as a means to inspect, test, and seal sewer lateral connections and a predetermined portion of the lateral lines from the mainline sewer, having selected the appropriate chemical grouts using the lateral packer method. Television (or optical) inspection and sewer lateral connection testing are used to assess the condition and document any repairs.

3.3 This practice should not be used where mainline and lateral connections are found with longitudinally cracked pipe, structurally unsound pipe, or flattened or out of round pipe.

4. Contract Responsibilities

4.1 The lateral connection sealing contracts should define or affix responsibility for, or make provisions for, the following items:

4.1.1 *Notice of Client/Owner Requirements,* which are relevant to, and within the scope of, work to be performed under the contract.

4.1.2 *Municipal and Other Licenses and Permits,* (see Practice F2304) and assistance in obtaining approvals or consent from utilities or carriers or other persons or organizations upon whose property or authority might be impinged by the performance of work under the contract; or a written release from responsibility for the performance of work under the contract if and to the extent that such work is precluded by the inability to obtain approvals or consent. If working on private property permission from the owner's representative, the sewer line owner and the building department.

4.1.3 *Access to Site of Work,* to be provided to the extent that the owner is legally able to do so, if unable to, a written release from responsibility for the performance of work at sites where access cannot be made available.

4.1.4 *Clearances of Blockages or Obstructions,* in the sewer system, if any, if such clearance is required for performance of work under the contract and if such clearance is not otherwise provided for within the contract.

4.1.5 *Location and Exposure of All Manholes,* unless otherwise provided for in the technical specifications of the contract.

4.1.6 *A Manhole Numbering System,* for all areas of the project, and accurate manhole invert elevations when required for performance of the work.

4.1.7 *The Shutdown or Manual Operation of Certain Pump Stations,* if such becomes necessary for performance of the work.

4.1.8 *Water,* necessary for performance of work under the contract, with permission to use water from fire hydrants at the site of work, or other suitable designated sources within a reasonable distance from work areas.

4.1.9 *Disposal Area,* for all materials removed from the sewers during the performance of the work and the unencumbered right of the contractor to transport and expeditiously dispose of such materials at a location designated by the owner.

4.1.10 *A Secure Storage Area,* of a size adequate to accommodate the required vehicles, equipment, and materials for the period of the contract.

4.1.11 *Notice to Third Parties,* (such as utilities) of the contractor's intent to perform work in an area where such parties may have rights to underground property or facilities. Request for maps or other descriptive information as to the nature and location of such underground facilities or property and assurance of the contractor's ability to enter any public or private lands to which access is required for performance of the work under the contract.

4.1.12 *Information Pertinent to the Site,* including reports prepared under previously accomplished studies or surveys and other data relative to the project, such as, maps, drawings, construction specifications sewer system records, and so forth.

4.1.13 *Authorization,* to perform work that must be performed during nighttime hours, on weekends, or on holidays.

4.1.14 *Traffic Control,* by uniformed officers when the safety of workers or the public requires such protection, or as may be specified.

4.1.15 The contractor shall certify that backup equipment is available and can be delivered to the site within 48 h.

4.1.16 Submit equipment utilization schedule to the owner's representative for review and approval prior to commencement of the project.

4.1.17 Submit equipment operating procedures and systems to the owner's representative for review and approval prior to commencement of the project.

5. Chemical Grouts (Chemical Sealing Materials)

5.1 *Intent*—The intent of this section is to define the properties that a chemical sealing material must have to perform effectively in the intended application and under expected field conditions. The intended application is remotely sealing sewer lateral connections and a predetermined portion of the lateral from the connection to the mainline sewer with a lateral packer as specified in Section 12.

5.1.1 Generic chemical sealing materials currently in use are listed in 5.3 with the basic properties, performance standards, and mix ratios, which are known to give acceptable performance.

5.1.2 It is recognized that new and improved chemical sealing materials will become available from time to time. Sources, manufacturers, and product names of chemical sealing materials will thus change, and therefore; specific sources, manufacturers, and product names are not given.

5.1.3 In every case, mixing and handling of chemical sealing materials shall be in accordance with the manufacturer's or supplier's, or both, recommendations.

5.2 *General*—All chemical-sealing materials used in the performance of the work specified must have the following characteristics:

5.2.1 While being injected, the chemical sealant must be able to react/perform in the presence of water (groundwater).

5.2.2 The cured material must withstand submergence in water without degradation.

5.2.3 The resultant chemical grout formation must prevent the passage of groundwater (infiltration) through the surrounding soil ring, the sewer lateral connection, and the joints within the predetermined portion of the lateral from the lateral connection to the mainline sewer.

5.2.4 The sealant material, after curing, must be flexible as opposed to brittle.

5.2.5 The cured sealant must not be biodegradable.

5.2.6 The cured sealant should be chemically stable and resistant to the mild concentrations of acids, alkalis, and organics found in normal sewage.

5.2.7 Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and proper clean up procedures should spillage occur.

5.2.8 Measurement of the component materials being mixed must be compatible with field operations not requiring precise measurements of the ingredients by field personnel.

5.2.9 Cleanup must be done without inordinate use of flammable or hazardous chemicals.

5.2.10 Residual sealing materials must be easily removable from the sewer line to correct conditions that affect the sewage flow.

5.3 *Chemical Sealing Materials*—The following is a generic listing of chemical sealing materials currently in use and the basic requirements, properties, and characteristics of each:

5.3.1 *Acrylamide Base Gel:*

5.3.1.1 A minimum of 10 % acrylamide base material by weight in total sealant mix. A higher concentration of acrylamide base material may be used to increase strength or offset dilution during injection.

5.3.1.2 The ability to tolerate some dilution and react in moving water during injection.

5.3.1.3 A viscosity of approximately 2 centipoise, which can be increased with additives.

5.3.1.4 Maintains a constant viscosity during the reaction period.

5.3.1.5 A controllable reaction time from 10 s to 1 h.

5.3.1.6 A reaction (curing), which produces a homogeneous, chemically stable, non-biodegradable, firm, flexible gel.

5.3.1.7 The ability to increase mix viscosity, density, and gel strength by the use of additives.

5.3.2 *Acrylic Base Gel:*

5.3.2.1 A minimum of 10 % acrylic base material by weight in the total sealant mix. A higher concentration of acrylic base material may be used to increase strength or offset dilution during injection.

5.3.2.2 The ability to tolerate some dilution and react in moving water during injection.

5.3.2.3 A viscosity of approximately 2 centipoise, which can be increased with additives.

5.3.2.4 A constant viscosity during the reaction period.

5.3.2.5 A controllable reaction time from 10 s to 1 h.

5.3.2.6 A reaction (curing), which produces a homogenous, chemically stable, non-biodegradable, flexible gel.

5.3.2.7 The ability to increase mix viscosity, density and gel strength by the use of additives.

5.3.3 *Urethane Base Gel:*

5.3.3.1 One part urethane prepolymer thoroughly mixed with between 5 and 10 parts of water weight. The recommended mix ratio is 1 part urethane prepolymer to 8 parts of water (11 % prepolymer). When high flow rates from leaks are encountered, the ratio of water being pumped may be lowered.

5.3.3.2 A liquid prepolymer having a solids content of 75 % to 95 %, and a specific gravity of greater than 1.00.

5.3.3.3 A liquid prepolymer having a viscosity of between 100 centipoise and 1500 centipoise at 70 °F that can be pumped through 500 ft of ½ in. hose with a 1000 psi head at a flow rate of 1 oz⁄s.

5.3.3.4 The water used to react the prepolymer should have a pH of 5 to 9.

5.3.3.5 A cure time appropriate for the conditions encountered.

5.3.3.6 A relatively rapid viscosity increase of theprepolymer/water mix. Viscosity should increase rapidly in the first minute for 1 to 8 prepolymer/water ratio at 50 °F.

5.3.3.7 A reaction (curing) that produces a chemically stable and non-biodegradable, tough, flexible gel.

5.3.3.8 The ability to increase mix viscosity, density, gel strength, and resistance and shrinkage by the use of additives.

6. Optional Additives

6.1 Additives enhance the performance of the chemical sealing materials and can be used for specific applications. Owner's Representative should consult with grout manufacturers to determine appropriate additives.

7. Sewer Line Cleaning Procedures

7.1 The intent of sewer line cleaning is to remove foreign materials from the lines to obtain proper seating of the packer. Refer to NASSCO Specification Guidelines.

8. Sewer Flow Control

8.1 When sewer line depth of flow at the upstream manhole of the section being worked on is above the maximum allowable for television inspection, joint testing or sealing, or combination thereof, the flow shall be reduced to the level shown below by operation of pump stations, plugging, or blocking of the flow, or by pumping and bypassing of the flow as specified in Table 1.

8.2 Depth of flow shall not exceed that shown in Table 2 for the respective pipe sizes as measured in the manhole when performing television inspection, joint testing, or sealing, or combination thereof.

TABLE 1 Maximum Depth of Flow-Television (or Optical) Inspection

6 in. to 10 in. pipe	20 % of pipe diameter
12 in. to 24 in. pipe	25 % of pipe diameter

TABLE 2 Maximum Depth of Flow-Joint Testing/Sealing

6 in. to 10 in. pipe	25 % of pipe diameter
12 in. to 24 in. pipe	30 % of pipe diameter

8.3 *Plugging and Blocking*—When authorized by sewer owner/operator, a sewer line plug shall be inserted into the line upstream of the section being serviced. The plugging system shall be so designed that any or all portions of the sewage can be released. During television (or optical) inspection, testing, and sealing operations, flow shall be reduced to within the limits specified above. After the work has been completed, flow shall be restored to normal.

8.4 *Pumping and Bypassing*—When pumping and bypassing is required, the contractor shall supply the pumps, conduits, and other equipment to divert the flow of sewage from an upstream manhole to a downstream manhole, isolating the pipe run in which work is to be performed. The bypass system shall be of sufficient capacity to handle existing flow plus additional flow that may occur during a rainstorm. The contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. All engines shall be equipped to operate within environmental quality regulations in a manner to keep noise to a minimum.

8.5 *Flow Control Precautions*—When flow in a sewer line is plugged, blocked, or bypassed, sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to insure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

9. Television (or Optical) Inspection, Main Sewers

9.1 After cleaning, the mainline sewer sections shall be remotely inspected by means of color closed-circuit television "pan & tilt" or "pan & rotate" cameras or optical scans. The inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled as specified. The camera must be stopped and rotated at each lateral connection. The original recording of this inspection must be delivered to the sewer owner/operator. The recording must capture the date and time of the recording and use the agreed upon system to identify the pipe location being viewed.

9.2 Cleaning of the mainline sewer shall be performed by the contractor and is to be adequate for seating a lateral packer in the mainline and inserting and seating an inflatable sealing bladder in the lateral. The lateral shall be cleaned, if provided for in the contract, of obstructions and roots (that prevent the complete inversion of the lateral bladder or proper seating of the lateral bladder) over the predetermined portion to be sealed from the mainline sewer connection plus a distance of 1 ft (0.3 m).

9.2.1 Recorded (closed-circuit television) inspections shall be done in the mainline from manhole to manhole and in each lateral on the length to be sealed plus 1 ft (0.3 m). A pan and tilt camera, from the mainline, will normally be acceptable for inspecting the predetermined portion of the lateral from the mainline connection of up to 4 ft (1.2 m). For longer sealing portions of the lateral from the mainline connection or when the pan and tilt camera does not provide an acceptable view, a camera positioned from the mainline or positioned from an above ground access through the lateral shall be used if provided for in the contract. The recording must capture the date and time and use the agreed upon system to identify the lateral location being viewed. The original recording of this inspection must be delivered to the sewer owner/operator. A Lateral Connection Data Report shall be originated at the time of the inspection. A separate Lateral Connection Data Report form shall be filled out for each lateral with all the required information and submitted to the owner's representative.

9.2.2 Service laterals protruding more than ⅝ in. (1.6 cm) into the mainline shall be cut back or otherwise removed to avoid interference with the testing and sealing equipment, if provided for in the contract.

10. Lateral Sealing Packers

10.1 Lateral sealing packers are operated from the mainline sewer. The design accommodates the various sealing bladders for 4 in., 5 in., or 6 in. (10 cm, 13 cm, or 15 cm) diameter laterals and the different sealing lengths (up to 20 ft (6 m)). The lateral sealing bladder shall have an expandable end bulb. The void area or grout chamber of the packer shall be minimal to limit the amount of residual grout. A sensing device located within the void area shall accurately transmit the void pressure readouts to the control panel at the grouting truck or to a pressure gauge on the packer read and recorded by the closed-circuit television camera. The packer must have one connection for the test medium and two connections for the two-component grout. Each connection shall have its own port in the grouting chamber and be closed or opened by adjustable non-dripping check valves.

11. Testing of the Laterals

11.1 *Scope*—Lateral connection testing identifies those lateral sewer connections and the predetermined portion of the laterals that are defective (allowing groundwater to enter into the sewer system and sewage to exfiltrate from the sewer system) and that can be successfully sealed by the internal lateral connection sealing process. Testing will be performed on all lateral connections and predetermined portion of the laterals from the mainline connection in a section, unless visibly leaking, as this is a positive leak indicator. Testing each non-visibly leaking connection and predetermined portion of the lateral from the mainline connection, ensures that this portion of the lateral is watertight even if the groundwater table is below the invert of the pipe.

11.2 *Significance and Use*—Lateral connection testing is used to test the integrity of the individual lateral connections and predetermined portion of the lateral from the mainline connection. Testing will not be performed and will not be required on cracked or broken pipe.

11.3 *Apparatus*—The basic equipment used shall consist of a pan & tilt television (or optical) camera, a lateral connection testing device (known as a lateral test & seal packer) with inflatable mainline end elements and lateral bladder, and test monitoring equipment. The equipment shall be constructed in