

APPENDIX C – TECHNICAL SPECIFICATIONS FOR CHEMICALLY GROUTING PIPE JOINTS AND LATERAL CONNECTIONS

A. GENERAL REQUIREMENTS

1. Scope: The work covered by this section of the Specifications shall consist of grouting pipe joints and lateral connections using the packer injection-method. Packer injection grouting shall be accomplished by pressure injection of chemical grout into the soils encompassing the exterior pipe joint or lateral connection. Chemical grouts shall be injected into the soil surrounding the pipe and shall be designed to stabilize the soil and form a permanent impermeable grout/soil ring in the annular space between liners and host pipes. The Contractor shall provide all materials, labor, equipment, services, and incidentals necessary to complete the work including but not limited to bypass pumping and/or diversion of sanitary and stormwater flows, cleaning and television inspection of pipe to be grouted, all quality controls, final television inspection, and all other related work.
2. Reference Specifications, Codes, and Standards: The following ASTM references are part of this Specification. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Specification shall prevail. The last edition of the following references shall be used:

ASTM F2304	Standard Practice for Rehabilitation of Sewers using Chemical Grouting (latest version)
ASTM F2454	Standard Practice for Sealing Lateral Connections and lines from the Mainline Sewer Systems by Lateral Packer Method, Using Chemical Grouting (latest version)

B. CONTRACTOR SUBMITTALS

1. Data to be Submitted After Notice of Award:

The following data is to be submitted after the Notice of Award and a minimum of one week prior to the preconstruction meeting. The Contractor shall not start work until all submittals are turned in.

- a) Performance Work Statement (PWS): The Contractor shall submit a PWS that clearly defines the chemical grout product is in conformance with the requirements of these Contract Documents. The PWS shall, at a minimum, contain the following: a detailed installation plan describing all preparation work, cleaning operations, pre-CCTV inspections, bypass pumping, traffic control, installation and equipment operating procedures, quality control, final CCTV inspection, warranties furnished, and further requirements as listed below.
 - i. Chemical Grout Information: Contractor shall submit a description of the proposed chemical grout materials to be used including manufacturer's recommended procedures for storing, mixing, testing and handling of chemical grouts. Descriptions of any proposed additives to the chemical grout shall also be provided by the Contractor.
 - ii. Packer Information: Contractor shall submit a description of the packer equipment to be used on the project including its model and manufacturer information.
- b) Project Schedule: The Contractor shall submit a schedule identifying proposed work hours and dates for work on each sewer or storm pipe segment.
- c) Proof of Certification: The Contractor shall submit a training certification from the grout manufacturer/supplier stating that the personnel working with the chemical grouts and additives have completed the required training to handle and mix the specified materials.
- d) Bypass Pumping Plan: The Contractor shall submit a bypass-pumping plan for review by the Engineer. The plan shall include proposed methods and equipment for stormwater and sewage control in accordance with the Special Provisions. This submittal shall include methods of controlling main pipeline flow, including location where stormwater and sewage is to be diverted, type of pipe to be used for bypass, and the method of service lateral flow control. The plan shall include methods for

employing standby equipment when required during an emergency, including the use of a second pumping unit on standby or two pumps alternating.

C. PRODUCTS

1. Equipment: Grouting equipment shall consist of the packer, appropriate pumping and hosing systems capable of supplying an uninterrupted flow of sealing materials to completely fill the voids. Grout pumping system shall be sized to deliver a mixed volume of grout at a minimum of 3 gallons per minute and 30 gallons of uninterrupted flow within 10 minutes. Volume of mixed grout pumped must be capable of being measured and recorded for each grouted joint/connection. Contractor shall provide back-up bladders for each packer on-site at all times during grouting procedures. Equipment for cleaning lateral blockages shall be readily available while any lateral grouting work is being performed.
2. Grouts: Contractor shall handle, and store grout in accordance with the manufacturer's recommendations. The materials shall be delivered to the site in unopened original manufacturer's containers. All grouting materials shall have the following characteristics;
 - a) While being injected, the grout shall be able to react/perform in the presence of water (groundwater) and tolerate some dilution during the injection process.
 - b) The ability to increase grout mix viscosity, density and gel strength by increased concentration of constituents or the use of approved additives.
 - c) The cured grout shall withstand submergence in water without degradation.
 - d) The grout shall not be biodegradable.
 - e) A minimum of 10 percent acrylamide base material by weight in the total grout mix.
 - f) The cured grout shall be chemically stable and resistant to organics found in sewage.
 - g) The grout shall have a controllable reaction time between 10 seconds and 1 hour.
 - h) Water based chemical grouts shall have a viscosity of 2 centipoise. Acrylate base grouts shall have a viscosity between 1 and 3 centipoise.
 - i) The resultant grout formation shall be a homogeneous, chemically stable, firm, flexible gel prevents the passage of water (infiltration) through the pipe joint or lateral connection.
 - j) Residual grout shall be easily removable from the sewer line to prevent blockage of the sewage flow.
 - k) Acceptable water based chemical grouts are Avanti AV-100, Avanti AV-118, or approved equal.
 - l) Acceptable acrylate-based grouts are DeNeef AC-400, DeNeef Gelacryl SR, Avanti AV-160, or approved equal.
3. Additives: With Engineer approval, the Contractor may use additives to increase the performance of the chemical grouts. The additives shall be selected and used as recommended by the manufacturer. When using non soluble additives, the grout tanks must have mechanical mixing devices to keep the additives in suspension and maintain a uniform solution of grout additive.
 - a) Strengthening Agents: For joint grouting, a latex or "diatomaceous earth" additive may be added to increase compressive tensile strength. The quantity of strengthening agent additive shall be as recommended by the manufacturer and approved by the Engineer.
 - i. Acceptable strengthening agents are Avanti AV-257 Icoset, DeNeef Reinforcing Agent or approved equal.
 - b) Root Inhibitor: When roots are present, a root deterrent chemical shall be added to control root growth. The quantity of inhibitor shall be as recommended by the manufacturer and approved by the Engineer.
 - i. Acceptable root inhibitor is Avanti AC-50W or approved equal.
 - c) Dye: A manufacturer approved water soluble dye without trace metals may be added to the grout tank(s) for visual confirmation.
 - d) Gel Time Modifier: A gel time extending agent may be used in accordance with the manufacturer's recommendations to extend gel time as necessary to perform the work. Approval from the Engineer is required to use the gel time modifier.

D. INSTALLATION

1. Preparation:

a) Pipe Cleaning:

- i. Prior to the application of the chemical grouting materials, the Contractor shall thoroughly clean the sewer designated to receive the chemical grouting. Cleaning shall constitute removal of all loose debris and solids, which inhibit proper seating of the packer. If mineral deposits or protruding taps are present, they shall be removed ahead of grouting activities.
- ii. Contractor shall remove all roots and loose debris from pipe joints and lateral connections prior to lining activities.

2. Lateral Connection Sealing from the Mainline by Packer Injection Grouting:

- a) Contractor shall follow the manufacturer's recommendations for grout mixing and safe handling procedures.
- b) During the grouting process, the grouting technician shall monitor the grout component tanks to make sure that proper ratios are being pumped.
- c) Contractor shall grout all joints and lateral connections called out on the Construction drawings using the packer injection method. The grout shall be forced through a system of pumps and hoses into and through the joints of the sewer from the packer within the sewer pipe.
- d) Contractor shall operate the pumps until the mixed grout has flowed through any joint failure, through any annular space, and into the surrounding soil; gelled or filled the available void space; formed a cohesive seal stopping further grout flow; and minimum of 8 psi back pressure is achieved while pumping. As grout pumping continues, the void pressure will slowly rise to a range of approximately 2 to 4 psi. Contractor shall continue pumping until a point where there is a sudden increase in the void pressure. If the grout pumped exceeds 1 gallon per foot of lateral bladder plus 3 gallons, it will be suspected that there are significant voids on the outside of the pipe or that the packer is not properly sealed. Contractor shall verify that the packer is sealed properly. If it is, the Contractor shall modify the grouting procedure to stage grouting by pumping additional grout equivalent to 1 gallon plus 0.25 gallon per foot of lateral bladder, waiting 1 full minute, and retesting. The maximum number of stages shall not exceed two stages unless authorized by Engineer.
- e) Confirm lateral flow after sealing of each lateral connection. If a grout blockage exists, the Contractor shall immediately clear the lateral at no additional cost to the City. Blockages in the lateral that are not the result of grouting operations shall not be the responsibility of the Contractor.
- f) Contractor shall remove excess grout from pipe and laterals. Excess grout shall be defined as a thickness of grout that given its location, size, and geometry could cause blockage. The Contractor shall flush excess grout shall to the next downstream manhole, remove it from the sewer system and properly disposed of it.

E. TEMPORARY SEWAGE BYPASS

Unless specified otherwise in the Contract Documents, the work specified in this section includes all costs for labor, materials, accessories, equipment, and tools for performing all operations required to bypass pump sewage around a manhole or sewer section in which work is to be performed. This work shall be consistent with the temporary sewage bypass pumping guidelines as stated in the Special Provisions.

F. FINAL ACCEPTANCE AND QUALITY CONTROL

1. All connections and pipe joints called out on the Construction Drawings to be grouted shall be completed before final acceptance.
2. The City will conduct a wet-weather warranty CCTV inspection of the mainline sewers that contain joint or lateral grouting. The inspection will be conducted during the 1-year warranty period. Any joints or lateral connections originally sealed by the Contractor that are observed to be leaking shall be re-sealed at no cost to the City. After the Contractor has been notified of such leakage, the Contractor shall have 60 calendar days to re-seal the noted connections.