

## SFPUC SEWER LATERAL SPECIFICATION

### **PART 1 GENERAL**

#### 1.1 DESCRIPTION OF WORK

- A. The Contractor shall furnish all services related to locating, placing, and testing a sewer lateral.

#### 1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. City and County of San Francisco Department of Public Works Bureau of Engineering Subdivision Regulations (most recent edition) [the most recent edition was the 2000 edition when this document was approved].
- B. City and County of San Francisco Department of Public Works Bureau of Engineering Standard Specifications (most recent edition) [the most recent edition was the 1987 edition when this document was approved].
  - 1. Section 300 – General Requirements for Sewers and Related Work
  - 2. Section 301 – Handling and Disposal of Seepage, Storm Water, and Sewage
  - 3. Section 305 – Vitrified Clay Pipe Sewer
  - 4. Section 307 – Vitrified Clay Pipe Side Sewer
  - 5. Section 322 – Polyethylene Pipe Sewer
  - 6. Section 700 – Excavation, Backfill, and Embankment of the City and County
  - 7. Section 1009 – Restoration of Existing Lawn and other Planting
- C. City and County of San Francisco Department of Public Works Excavation Code
- D. San Francisco Plumbing Code (most recent edition [the most recent edition was the 2010 edition when this document was approved]).
- E. Section 01540 – Protection of Property
- F. Sewer Lateral Chemical Grouting Specification (see Appendix A)
- G. Cured-In-Place Sewer Lateral Lining Specification (see Appendix B)
- H. SFPUC CCTV System Operating Procedure
- I. ASTM C425 – Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
- J. ASTM C700 – Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
- K. ASTM C923 – Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

- L. ASTM C-924 – Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
- M. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test
- N. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- O. NASSCO and ICGA Suggested Standard Specification for Pressure Testing and Grouting of Sewer Pipe Joints, Laterals and Lateral Connections Using the Packer Method with Solution Grouts; April 2012

### 1.3 DEFINITIONS

- A. Sewer lateral: Pipe connecting a public or private building to the public sewer main, including portions that extend across public rights-of-way and the saddle, wye or other physical connection to the main. Sewer laterals shall not include internal building piping.
- B. Private sewer system: System of sewers, manholes, cleanouts that are owned, operated and maintained by an entity other than the San Francisco Public Utilities Commission (SFPUC) unless an interagency agreement has been approved by the SFPUC to provide maintenance and operation service to the private sewer system. All private sewer systems connect to SFPUC's sewer system.
- C. Lower sewer lateral: The portion of the sewer lateral within the City's street right-of-way, that is from the curb to the sewer main. When the sewer lateral connects to a sewer main in an easement or to a sewer main under public stairs (i.e. non-standard City Street), the lower lateral shall extend from the nearest property line of the benefitted property to the connection with the sewer main.
- D. Upper sewer lateral: The portion of the sewer lateral from a building or structure to the curb line in the street. The upper sewer lateral shall include the cleanout. When the sewer lateral connects to a sewer main in an easement or to a sewer main under the public stairs (i.e. non-standard City Street), the upper lateral shall extend from the building drain to the property line.
- E. Building drain: The wastewater piping which receives discharge from drainage pipes within the building or structure and conveys it to the upper sewer lateral. The point of connection of the building drain to the upper sewer lateral shall be within 2 feet of the outside of the building wall.
- F. Cleanout: A cleanout consists of a vent, riser and P-trap in combined and sanitary sewer systems or vent, riser and wye in storm sewer systems. A cleanout allows access from the ground surface to the sewer lateral. It provides access to the sewer lateral for inspection and maintenance including sewer lateral cleaning.
- G. P-trap: Fitting used to connect the lower sewer lateral (in combined and sanitary sewer systems) to the riser and to the upper sewer lateral. It prevents sewer gases from the sewer main and lower sewer lateral from migrating to the upper sewer lateral.
- H. Riser (or riser pipe): Segment of vertical pipe connected to a sewer lateral rising vertically to the ground surface. The riser is one component of the cleanout.

- I. Vent: A vent consists of a vent frame and perforated vent cover plate. A vent is put on the top of the riser pipe. A vent allows sewage (if required) to escape to the street thereby preventing sewage from backflowing into the building connected to the sewer lateral.
- J. Main or sewer main: A pipe that collects sewage from one or more sewer laterals.
- K. Backflow preventer: Check valve-type device in a pipeline that closes when flow begins to reverse. Required in cases where a property has plumbing fixtures (such as a shower, sink, or toilet) that are at an elevation that approaches or is below the elevation of the sewer main (in a basement for example).
- L. Combined sewer system: Portion of the sewer system in which the mains convey both sanitary sewage and storm water.
- M. Sanitary sewer system: Portion of the sewer system in which the mains convey sanitary sewage only and is separate from storm water.
- N. Storm sewer system: Portion of the sewer system in which the mains convey storm water only and is separately from sanitary sewage.

#### 1.4 CONTRACTOR SUBMITTALS

- A. Following the procedures specified in Section 307 – Vitrified Clay Pipe Side Sewer of the SFPUC Bureau of Engineering Standard Specifications, submit to the City six copies of the following:
  1. Certificate of compliance to ASTM C700 if sewer lateral pipe is VCP.
  2. Certificate of compliance to ASTM D3350 if sewer lateral pipe is HDPE.
  3. Catalog drawings and certificate of compliance to ASTM C425 for couplings if lateral pipe is VCP.
  4. Catalog drawings for the tap-tite when used for lateral connection to existing sewer main.

#### 1.5 LOCATION

- A. When a sewer collection system is constructed as part of new development, the sewer lateral shall be constructed to each lot perpendicular to the sewer main line.
- B. Sewer laterals shall be located at the lowest elevation of the frontage of the property.
- C. Consideration shall be given to trees, driveways, and other improvements, to minimize conflicts when the upper sewer lateral is extended to service the house.
- D. Points of access to the underground sewer lateral (i.e. cleanouts) shall remain unobstructed. Plantings adjacent to these points of access shall be kept a minimum of 6 inches clear on all sides. Within the 6-inch clear area, concrete shall be installed to keep plants from covering the point of access.
- E. Under public sidewalks, maintain a minimum amount of clearance between the edge of the sewer lateral and the centerline of a tree shall be 5 feet.
- F. The minimum amount of clearance between the edge of the sewer lateral and the centerline of a fire hydrant barrels shall be 3 feet.

- G. Sewer laterals shall not be located below permanent structures, and the minimum horizontal clearance between the edge of the sewer lateral and a permanent structure shall be 2 feet.
- H. The extent of the lower sewer lateral shall be as shown on Drawings 5 through 8 of the Sewer Lateral Standard Details.
- I. If a property could be served from both easement and a right-of-way, service shall be from the right-of-way. Clearance between sewer laterals and water supply lines shall comply with the California Department of Health Services separation requirements.

#### 1.6 DEPTH AND COVER

- A. The upstream end of the lower lateral shall have a minimum depth of 4 feet to crown of pipe, measured from existing ground surface or edge of adjacent roadway, whichever is lower.
- B. Whenever the depth exceeds this minimum depth, the design engineer shall label the invert elevation of the upstream end of the lower sewer lateral on the design drawings.
- C. At locations where gravity service is impossible or impractical, the design engineer shall clearly indicate on the plans which parcels will require a privately owned and maintained pump station.

#### 1.7 SLOPE

- A. The lower lateral shall have a minimum slope of  $\frac{1}{4}$  inch per foot (approximately 2%).
- B. For slope of the upper sewer lateral, refer to the most recent version of the San Francisco Plumbing Code.

### **PART 2 PRODUCTS**

#### 2.1 SIZE

- A. 6-inch diameter minimum for residential buildings (single family dwelling units).
- B. 8-inch diameter minimum for multi family dwelling units.
- C. 8-inch diameter minimum for non-residential (e.g. commercial or industrial) buildings.
- D. For sizing a sewer lateral, see Section XIV of the San Francisco Department of Public Works Bureau of Engineering Subdivision Regulations.

#### 2.2 MATERIALS

##### A. Pipe

1. Vitrified clay pipe (VCP), extra strength conforming to ASTM C-700; or
2. High Density Polyethylene Pipe (HDPE), SDR 17, 345434C, D, or E conforming to ASTM D3350. HDPE SDR 17 shall be purchased in longest length practicable in order to achieve the minimum amount of pipe joints during construction. A maximum of ten (10) joints per one hundred foot (100) length of laid pipe shall be achieved. HDPE pipe shall be black.

- B. Fittings –VCP fittings shall be extra strength conforming to the requirements of ASTM C700. VCP fittings shall be plain end or bell and spigot. HDPE fittings shall be plain end. HDPE fittings may be black or grey or green.
- C. Couplings – Rubber compression couplings, minimum 5-inch long, with stainless steel bands in accordance with the requirements of ASTM C425.
- D. P-trap – cast iron. P-trap shall be a one-piece fitting and shall not be fabricated in the field.
- E. Riser – Acrylonitrile Butadiene Styrene (ABS) Schedule 40 pipe conforming to ASTM D2661.
- F. Vent – Cast iron vent frame with malleable iron perforated vent cover plates. Cover shall be no less than 16 square inches with perforations not more than 3/8-inch in diameter per Section 1008 of the most recent San Francisco Plumbing Code.
- G. All pipe shall be clearly marked with type, class, date of manufacture, location of manufacturing plant, and/or thickness, as applicable. Marking shall be legible and permanent on the outside surface of the pipe, and shall be able to withstand normal wear due to handling and storage.
- H. Grout
  1. The grout materials shall consist of portland cement, portland cement and fly ash, and/or additives, providing materials are not biodegradable.
  2. Compressive Strength: The grout shall have a minimum penetration resistance of 100 psi in 24 hours when tested in accordance with ASTM C403 and a minimum compressive strength of 300 psi in 28 days when tested in accordance with ASTM C495 or C109.
  3. Shrinkage: The grout shall have less than one percent shrinkage by volume.
  4. Viscosity: The apparent viscosity shall not exceed 35 seconds in accordance with ASTM C939.
  5. The Contractor shall design a grout mix that has sufficient strength and durability to prevent movement of the carrier pipes.
  6. The Contractor shall use grouting procedures and design a grout mix that will prevent the floating of the carrier pipes.
  7. The maximum grouting pressure shall be 5 psig.
- I. Epoxy Mortar (also known as epoxy resin binder)
  1. Epoxy resin binder can be used “neat” or can be mixed with sand per manufacturer’s recommendations to create epoxy mortar.
  2. Epoxy mortar shall have the following characteristics:
    - a. 1,300 psi minimum 14-day tensile strength measured per ASTM C305.
    - b. 2,200 psi minimum 3-day compressive strength measured per ASTM C579 (73 degrees).
    - c. 6,000 psi minimum 28-day compressive strength measured per ASTM C579 (73 degrees).

## **PART 3 EXECUTION**

### **3.1 HANDLING AND DISPOSAL OF SEWAGE**

- A. When performing work on existing sewer laterals, the Contractor shall bypass wastewater around the work area in accordance with the requirements of Section 301 – Handling and Disposal of Seepage, Storm Water, and Sewage of the City and County of San Francisco Department of Public Works Bureau of Engineering Standard Specifications. Alternatively, the Contractor may coordinate with the Property Owner to temporarily shut down the sewer lateral. The Contractor shall ensure that no wastewater is discharged from the sewer lateral to the excavation site.

### **3.2 PROTECTION OF EXISTING PROPERTY**

- A. The Contractor shall protect the area affected by its sewer lateral installation operations in accordance with the requirements of Section 01540 – Protection of Property.

### **3.3 REMOVE AND REPLACE EXISTING SEWER LATERALS**

- A. When removing and replacing existing sewer laterals, only new pipe shall be used to replace the removed sewer lateral.

### **3.4 SEWER LATERAL REHABILITATION**

#### **A. CHEMICAL GROUTING**

- 1. Refer to technical specification Sewer Lateral Chemical Grouting. This specification section is located in the Appendix A.

#### **B. CURED-IN-PLACE PIPE LINING**

- 1. Refer to technical specification Cured-In-Place Sewer Lateral Lining. This specification section is located in Appendix B.

### **3.5 EXCAVATION, FOUNDATION PREPARATION, BEDDING, AND BACKFILL**

- A. Excavation, foundation preparation, bedding and backfill for sewer laterals shall conform to the requirements of Section 300 – General Requirements for Sewers and Related Work and Section 700 – Excavation, Backfill, and Embankment of the City and County of San Francisco Department of Public Works Bureau of Engineering Standard Specifications.
- B. The trench width shall be at least the full width of the pipe plus 6 inches on both sides of the pipe as shown in Detail 1 on Drawing 14 of the Sewer Lateral Standard Details.
- C. Trenching around all sewer laterals shall extend 4 inches below the bottom of the sewer pipe as shown as shown in Detail 1 on Drawing 14 of the Sewer Lateral Standard Details.
- D. Trenching around the P-trap shall extend 4 inches below the bottom of the P-trap.
- E. Backfill around and on top of all sewer laterals shall extend from the bottom of the trench to a height of 12 inches above the top of the pipe. Backfill material shall be as shown on the Sewer Lateral Standard Details.

- F. The Contractor shall give the City at least 2 working days advance notice for inspection and testing. The Contractor shall follow the inspection and testing procedure per paragraphs 3.11 (Inspection) and 3.12 (Testing) before covering the sewer lateral.

### 3.6 PIPE INSTALLATION AND JOINTING

- A. Installation of VCP sewer lateral pipe shall conform to the requirements of Section 305 – Vitrified Clay Pipe Sewer of the City and County of San Francisco Department of Public Works Bureau of Engineering Standard Specifications.
- B. All pipe installation shall start and proceed up grade from the point of connection at the main sewer line. Bell and spigot pipe shall be installed with the bell end facing up grade.
- C. VCP sewer laterals shall have bell and spigot joints with factory fabricated compression-type gasket joints conforming to ASTM C425. All joints shall be tight fitting, watertight, and without imperfections.
- D. Bell and spigot joints shall be used wherever possible for VCP pipe. If not possible, joints for VCP plain-end pipe sewers 12-inch or smaller in diameter may be rubber compression couplings, minimum 5-inches long, with stainless steel bands in accordance with the requirements of ASTM C425.
- E. HDPE sewers shall have the following joints:
  - 1. Butt fusion joints meeting the requirements of ASTM D2657 and ASTM D3261;
  - 2. Electro-fusion joints using electro-fusion couplings.
- F. Bell and spigot joints for HDPE pipe are not allowed.
- G. Between fittings, pipe shall be installed in a straight line at a uniform grade.
- H. Where joints cannot be made due to dissimilar pipe material or mismatched wall thickness, the Contractor shall use a rubber compression coupling, minimum 5-inches long, with stainless steel bands to make a watertight joint.
- I. When connecting a new sewer lateral to an existing sewer lateral, the new sewer lateral shall be laid on a straight grade from the main sewer connection to the point of junction with the existing sewer lateral. The deflection angle at the junction shall not exceed 45 degrees, using approved mitered joints.
- J. Horizontal and vertical bends in sewer laterals shall not exceed 45 degrees (1/8 bend), using approved cast or mitered joints. Normal joints shall not be deflected greater than that recommended by the manufacturer.

### 3.7 CONNECTION TO MAIN SEWER LINE

- A. Connections of sewer laterals to the main sewer shall depend on the material of the main sewer and the material of the sewer lateral.
- B. Tap connections must be a minimum of 2 feet apart and 2 feet from the bell of pipe. A maximum of 3 taps will be allowed per length of pipe.

### C. CONNECTION TO VCP MAIN SEWERS

1. See Sewer Lateral Standard Details for allowable connection configurations.
2. VCP fittings and sewer lateral pipe shall be vitrified clay conforming to ASTM C700 (Extra Strength Clay Pipe).
3. Connecting VCP sewer laterals to VCP sewer main using epoxy resin is not allowed.

### D. CONNECTION TO IRONSTONE PIPE (ISP)

1. See Sewer Lateral Standard Details for allowable connection configurations.
2. Approved saddles: Vassallo Industries or approved equal.

### E. CONNECTION TO CONCRETE SEWER MAINS

1. See Sewer Lateral Standard Details for allowable connection configurations.
2. To connect a VCP sewer lateral less than 10-inch in diameter, install a VCP stub with a bell end on the main line. The stub inlet shall be set with the back of the bell placed as close as possible to the outside surface of the sewer main. With a plain end VCP pipe, a coupler can be used. Per the Sewer Lateral Standard Details, this distance of the bell or coupler shall not exceed 6 inches.
3. To connect a VCP sewer lateral greater than or equal to 10-inch in diameter, core or chip the main line and connect the VCP pipe directly to the main with a concrete collar as shown in Sewer Lateral Standard Details.
4. To connect an HDPE sewer lateral to the sewer main, install a plain end VCP stub inlet and use an approved coupling. The stub inlet shall be set such that the distance between the end of the plain end of the VCP stub inlet and the outside wall of the main sewer line does not exceed six inches.
5. The VCP stub inlet shall be of such length that the inner spigot end shall be flush with the inside surface of the sewer main.
6. The holes in the existing concrete main sewer shall be cut in accordance with the plans and the requirements of Paragraph 8 (Cutting Pipe) of Section 304 – Precast Reinforced Concrete Pipe Sewer of the San Francisco Department of Public Works Bureau of Engineering Standard Specifications. Reinforcing bars within the hole shall be cut so as to clear the stub by not less than one inch.
7. The stub shall be mortared in place with an approved epoxy mortar. The clearance between the outside diameter of the stub and the drilled hole shall be such as to contain the epoxy mortar and produce a strong, watertight joint. The manufacturer's specifications for epoxy mortar shall be submitted in writing to the City for approval.

### F. CONNECTION TO BRICK SEWER MAINS

1. See Sewer Lateral Standard Details for allowable connection configurations.

2. To connect a VCP sewer lateral, install a VCP stub with a bell end on the main line. The stub inlet shall be set with the back of the bell placed as close as possible to the outside surface of the sewer main. With a plain end VCP pipe, a coupler can be used. Per the Sewer Lateral Standard Details, this distance of the bell or coupler shall not exceed 6 inches.
3. To connect an HDPE sewer lateral, install a plain end VCP stub inlet and use an approved coupling to connect it to the HDPE sewer lateral. The stub inlet shall be set such that the distance between the end of the plain end of the VCP stub inlet and the outside wall of the main sewer line does not exceed six inches.
4. The stub inlet shall be of such length that the inner spigot end shall be flush with the inside surface of the sewer main.
5. Contractor shall remove bricks on the existing brick sewer main as necessary to accommodate the sewer lateral connection. The clearance between the outside diameter of the stub and the drilled hole shall be such as to contain the epoxy mortar and produce a strong, watertight joint. The manufacturer's specifications for the epoxy mortar shall be submitted in writing to the City for approval.

#### G. CONNECTION TO HDPE SEWER MAINS

1. See Sewer Lateral Standard Details for allowable connection configurations.
2. Sewer laterals connecting to HDPE main sewers shall also be HDPE.
3. To connect an HDPE sewer lateral to the HDPE sewer main, use an HDPE electrofusion saddle.
4. The main shall be core drilled to conform to the opening of the saddle.

#### H. CONNECTION TO LINED MAIN SEWERS

1. See Sewer Lateral Standard Details for allowable connection configurations.
2. Use rubber sleeve, tap-tite fitting or approved equal to make the connection to tight fitting pipe liner or fiberglass sliplined pipe.
3. Use an HDPE electro-fusion saddle to make the connection to HDPE sliplined pipe.

#### I. CONNECTION TO SEWER MANHOLES

1. See standard details for allowable connection configurations.
2. To connect a VCP sewer lateral, install a VCP stub with a bell end on the manhole. The stub inlet shall be set with the back of the bell placed as close as possible to the outside surface of the manhole. Per the Sewer Lateral Standard Details, this distance shall not exceed 6 inches. The manhole shall be core-drilled to fit the VCP stub with bell end. The clearance between the outside diameter of the stub and the drilled hole shall be such as to allow one (1) inch of epoxy mortar.
3. To connect an HDPE sewer lateral, core-drill the manhole and install a flexible connector meeting the requirements of ASTM C923 (Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals). Installation of this connector shall be per the manufacturer's recommendations.

4. A maximum of three sewer lateral connections per manhole shall be allowed. Additional connections to the same manhole shall require approval by the City.
5. The minimum spacing between sewer laterals shall be nine inches (from outside diameter of lateral pipe to outside of lateral pipe).
6. Sewer lateral connections shall be a minimum of 8 inches from the precast manhole barrel section joints (from outside of lateral pipe to barrel joint).

### 3.8 FITTINGS

- A. All fittings shall be factory-produced and shall be designed for installation on the pipe to be used. If a factory-produced P-trap is not available, submit fabrication details for the fabricated P-trap to the City for approval.
- B. The maximum deflection permissible at any one fitting or joint shall not exceed the pipe manufacturer's recommendation, and in no case shall the deflection exceed 2 inches per foot at any joint or fitting. The maximum deflection of any combination of two adjacent fittings or joints shall not exceed 45 degrees (one-eight bend). Should greater than 45-degree deflection be needed between adjacent joints or fittings, a straight pipe of not less than 2-1/2 feet in length shall be installed between such adjacent fittings or joints, unless either one of such fittings is a wye branch with a cleanout provided on the straight leg or such a wye branch fitting is substituted for a joint.

### 3.9 CLEANOUTS IN COMBINED AND SANITARY SEWER SYSTEMS

- A. In combined and sanitary sewer systems, the Contractor shall furnish and install a cleanout including a P-trap, ABS riser, cast iron inlet frame with malleable iron gratings, fittings, connections, extensions, and appurtenances in accordance with Section 1008 of the latest San Francisco Plumbing Code.
- B. The riser shall be a minimum of 4 inches in diameter.
- C. The P-trap shall be of the same diameter as the lower sewer lateral.
- D. Per the Sewer Lateral Standard Details, the cleanout shall be installed within 2 feet from the face of curb.
- E. Fittings and pipe extensions on the house side of the P-trap connecting the P-trap to existing facilities shall be of the same type material as existing facilities or of VCP. Extensions connecting the sewer lateral to existing facilities shall not extend beyond the property line.
- F. Per the Sewer Lateral Standard Details, the P-trap shall have a bell end facing the upper sewer lateral and plain end facing the lower sewer lateral and riser. Or, the P-trap shall be connected via approved coupling. The riser and connection to the upper sewer lateral shall be made with rubber compression couplings with stainless steel bands.
- G. All damaged cleanouts due to grading or other construction activities shall be repaired or replaced at the Contractor's expense; no additional payments shall be made by the City.

### 3.10 CLEANOUTS IN STORM SEWER SYSTEMS

- A. In storm sewer systems, the Contractor shall furnish and install a cleanout including a wye, ABS riser, cast iron inlet frame with malleable iron gratings, fittings, connections, extensions, and appurtenances in accordance with Section 1008 of the latest San Francisco Plumbing Code.
- B. The riser shall be a minimum of 4 inches in diameter.
- C. The wye shall be of the same diameter as the lower sewer lateral.
- D. Per the Sewer Lateral Standard Details, the cleanout shall be installed within 2 feet from the face of curb.
- E. Fittings and pipe extensions on the house side of the wye connecting the wye to existing facilities shall be of the same type material as existing facilities or of VCP. Extensions connecting the sewer lateral to existing facilities shall not extend beyond the property line.
- F. Per the Sewer Lateral Standard Details, the wye shall have a bell end facing the upper sewer lateral and plain end facing the lower sewer lateral and riser. Or, the wye shall be connected via approved coupling. The riser and connection to the upper sewer lateral shall be made with rubber compression couplings with stainless steel bands.
- G. All damaged cleanouts due to grading or other construction activities shall be repaired or replaced at the Contractor's expense; no additional payments shall be made by the City.

### 3.11 CURB MARKINGS

- A. Where the street is to be paved before lot improvements are made, sewer laterals shall be constructed beyond the curb before the paving is started. The upper end of each sewer lateral not in service when the work is backfilled shall be closed with a water-tight, factory produced stopper, marked with a 2-inch by 2-inch redwood stake, and marked with the letter "S" on the curb and directly above the sewer lateral. In new concrete curbs the "S" shall be stamped in the fresh concrete. In the tops of existing curbs, it shall be neatly cut. The redwood stake shall run vertically from the bottom of the trench to a point one foot below the surface of walk or ground. Care shall be taken to maintain the stake in its correct position during backfilling. In addition to the redwood stake, the letter "Y" shall be stamped or neatly chipped on the curb opposite each stoppered bell from which a sewer lateral has not been constructed.
- B. Before making the "S" on the curb the Contractor shall verify the location of the sewer lateral by excavating to the top of the redwood stake. If for any reason the stake is not found, the Contractor shall excavate and expose the pipe. In no case shall probing with a bar, or other method, be permitted as a substitute for actual exposure of the stake or pipe.

### 3.12 INSPECTION

- A. The Contractor shall confirm that each property has been provided with a satisfactory connection for all its sewer laterals.
- B. The Contractor shall perform the following for all sewer laterals:
  - 1. Confirm connection points of active sewer laterals by dye-testing at sidewalk cleanouts.

2. Investigate, locate, and confirm active sewer laterals not identified by sidewalk cleanouts, by dye-testing at building fixtures and/or rodding.
    - a. Sewer laterals rodded to show lengths short of one (1) foot behind the curb shall be considered as inactive.
    - b. Sewer laterals rodded to show lengths beyond one (1) foot behind the curb are to be assumed as active and shall be connected to the new sewer main.
  3. Record locations of active sewer laterals and provide the City with a copy of the record.
- C. New sewer laterals and sewer lateral repairs shall also be CCTVed. All pipes shall be thoroughly cleaned prior to inspection, and inspections must be conducted in accordance with the latest version of National Association of Sewer Service Companies (NASSCO) Lateral Assessment & Certification Program (LACP). Personnel on the job are required to be trained and PACP certified. The video shall have the project name and limits of the sewer being televised superimposed on the beginning of each segment. The camera shall travel through the sewer at a speed of a half of a foot (0.5 feet) per second. A continuous tape counter in feet shall be superimposed at the bottom of the screen to show the distance from the starting reference point. The date of the video recording shall be superimposed on the screen. Lighting in the interior of the sewer shall be sufficient to produce a clear and well-focused video of the entire periphery of the pipe and correctly show the true color of the pipe.

CONTRACTOR shall submit database files, video files in MPEG format on DVDs, and digital inspection logs in PDF format. All inspection data will be standardized per PACP guidelines and later imported into City's comprehensive GIS system for proper identification, evaluation, sharing and management of asset. Therefore, CONTRACTOR must submit data in a format compatible to City's current database. DVD submitted shall have a typed label on the front of the DVD providing following information:

1. Sewer Job Order Number (J.O. #)
2. Contract Number (Contract #)
3. Street Names with Limits
4. Post Construction TV - Sewer Lateral
5. Contract Title
6. Date

### 3.13 MISCELLANEOUS REQUIREMENTS

- A. No roof drain, area drain, or subsurface drain shall be connected to a sewer lateral in sanitary sewer system.
- B. Private property roof drains or service drains in areas of combined sewer system shall be run in a separate pipe to the property line before connecting into the sewer lateral.

### 3.14 RESTORATION

- A. The Contractor shall restore the area affected by its sewer lateral installation operations in accordance with the requirements of Section 1009 – Restoration of Existing Lawn and other Planting of the City and County of San Francisco Department of Public Works Bureau of Engineering Standard Specifications.
- B. Upon completion of the work, and prior to final acceptance, the Contractor shall remove from the vicinity of the work all surplus material and equipment belonging to the Contractor or used under its direction during construction.
- C. In addition to general broom cleaning of paved surfaces and rake cleaning of other surfaces or grounds, the following shall be performed at completion of the work:
  - 1. Remove waste and debris from the entire site.
  - 2. Sweep paved areas.
  - 3. Clean/landscape areas.
  - 4. Clean storm drains.

END OF SECTION

**APPENDIX A  
SPECIFICATION FOR PRESSURE GROUTING AND TESTING OF SEWER LATERALS  
AND SEWER LATERAL CONNECTIONS USING THE PACKER METHOD WITH  
SOLUTION GROUTS**

**PART 1 GENERAL**

**1.1 DESCRIPTION OF WORK**

- A. Provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to grout joints in laterals connected to manholes and lateral connections to the mains using the packer injection method.
  - 1. Packer injection grouting is used to reduce the infiltration within the pipeline, seal annular space between liners and host pipes at lateral connections, seal pipe joints that have failed the joint test criteria, provide external pipe support, but not a structural rehabilitation, by stabilizing soils outside the pipe and prevent further loss of pipe bedding into the pipe.
  - 2. Packer injection grouting shall be accomplished by pressure injection of chemical grout into the soils encompassing the exterior of pipe joint. Chemical grouts shall be designed to be injected into the soil surrounding the pipe, which stabilizes the soil and forms a permanent impermeable seal called a grout/soil ring, and into the annular space between liners and host pipes. Adequate volumes of grout must be injected to form an effective seal. Adequate amounts of grout are based generally upon pipe size and field conditions. This application will be through structurally sound joints and lateral connections through penetrations from within the pipe by using the packer method in tandem with a closed circuit television (CCTV) inspection system.
- B. Provide all labor, materials, tools, equipment and incidentals as shown, specified, and required for testing sewer pipe joints by applying a positive air pressure to the joints, monitoring and recording the pressure in the void. The intent of joint & connection testing is to identify those lateral connections and laterals that are not watertight following sealing by packer injection grouting.

**1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS**

- A. National Association of Sewer Service Companies (NASSCO) prepared *Pipeline Assessment and Certification Program (PACP)*, TV inspection form and sewer condition codes
- B. ASTM F2304 Standard Practice for Rehabilitation of Sewers using Chemical Grouting (latest revision)
- C. ASTM F2454 Standard Practice for Sealing Lateral Connections and lines from the Mainline Sewer Systems by Lateral Packer Method, Using Chemical Grouting (latest revision)

**1.3 REQUIREMENTS**

- A. Contract requires work in active sewers. CONTRACTOR shall follow all federal, state and local requirements for safety in confined spaces and uniform traffic controls.
- B. Additional safety considerations including safely handling, mixing, and transporting of chemical grouts should be provided by the grout manufacturer/supplier, and should include safe operating practices and procedures, appropriate personal protective equipment (PPE) for the various grouting operations, and proper storage, transportation, mixing, and disposal of grouts,

additives, and their associated containers.

- C. Require completion of grout handling and mixing training certification from the grout manufacturer/supplier for personnel working with chemical grouts and additives.

#### 1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall provide a minimum 48-hour advance written notice of proposed testing schedules and testing procedures for review and concurrence of City.
- B. Equipment operating procedures and systems.
- C. Chemical Grout information:
  - 1. Description of chemical grout materials to be used per sections 2.3.
  - 2. Description of proposed additives to be used per sections 2.4.
  - 3. Manufacturers recommended procedures for storing, mixing, testing and handling of chemical grouts.
  - 4. MSDS sheets for all materials to be used.
- D. Identify the manufactures & models of the packers to be utilized on the project.
- E. Upon completion of each pipe segment, submit to ENGINEER a report showing the following data for each joint and/or lateral connection tested, grouted or attempted to be grouted as required by PACP.
  - 1. Identification of the sewer pipe section tested by assigned sewer ID (if available) and length.
  - 2. Type of pipe material, diameter & depth of pipe to the surface at manholes.
  - 3. Length of pipe sections between joints.
  - 4. Test pressure used and duration of test.
  - 5. Pass/fail results for each joint/connection tested.
  - 6. Location stationing of each joint/connection tested and location of any joints/connections not tested with an explanation for not testing.
  - 7. Volume of grout material used on each joint or connection.
  - 8. Gel set time used (cup test results from tanks)
  - 9. Grout mix record of the batches mixed including amount of grout and catalyst, additives, temperature of the grout solution in tanks.
  - 10. Operator conducting testing and sealing shall be noted on the reports.
  - 11. Video recordings
    - a. Video recording shall include testing and sealing operations for each joint/lateral (including inflation and deflation over the joint/lateral) displaying the final air test of joints or laterals.
    - b. Additional final recording, if specified, shall include inspection of the lateral after all grouting work is complete.

## PART 2 PRODUCTS

### 2.1 TESTING EQUIPMENT & GROUTING EQUIPMENT

- A. The device for testing lateral connections shall consist of inflatable mainline end elements and a lateral grouting plug that creates a void area extending beyond the main connection. Whenever possible, use a lateral grouting plug sized to match the diameter of the lateral being grouted with an effective sealing length from the sewer lateral connection to cleanout. Where the lateral is capped, utilize alternate sewer lateral grouting plug or equipment sized appropriately for the capped sewer lateral. In cases where the sewer lateral transitions from 6" to 4" in diameter, use a 4" lateral grouting plug. However, it is possible that due to physical restrictions the lateral plug may not launch and thus the service may not be able to be grouted.
- B. The basic equipment for 6-inch sewer laterals connected to manholes shall consist of a flexible push-type packer and mini-push camera. The device for testing sewer lateral pipe connected to the manhole shall be capable of testing the joints from the manhole to the cleanout. If the sewer lateral contains a transition, CONTRACTOR may change out diameters of push packer or grout sewer lateral using only a 4-inch push packer.
- C. Void pressure data shall be transmitted from the void area to the monitoring equipment or video picture of a pressure gauge mounted on the packer and connected to the void area. All test monitoring shall be above ground and in a location to allow for simultaneous and continuous observation of the televising monitor and test monitoring equipment.
- D. 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 gpm and 30 gallons of uninterrupted flow within 10 minutes.
- E. Volume of mixed grout pumped must be capable of being measured and recorded for each grouted joint/connection. Generally, the equipment shall be capable of performing the specified operations in sewers where flows do not exceed 25 percent of pipe diameter unless permitted by ENGINEER.
- F. Connection and sewer lateral service sealing shall be accomplished using the sewer lateral grouting plugs and push packers specified above. Provide back-up bladders for each packer on-site at all times during grouting procedures.
- G. Equipment for cleaning sewer lateral blockages shall be readily available while any sewer lateral grouting work is being performed.

### 2.2 GROUTS - GENERAL

- A. All grout materials must have the following characteristics:
  - 1. While being injected, the grout must be able to react /perform in the presence of water (groundwater).
  - 2. The ability to increase grout mix viscosity, density and gel strength by increased concentration of constituents or the use of approved additives.
  - 3. The cured grout must withstand submergence in water without degradation.
  - 4. The resultant grout formation must be homogeneous and prevent the passage of water (infiltration) through the pipe joint.

5. The grout must not be biodegradable.
  6. The cured grout should be chemically stable and resistant to organics found in sewage.
  7. Residual grout shall be easily removable from the sewer line to prevent blockage of the sewage flow.
- B. Handle, mix, and store grout in accordance with the manufacturer's recommendations. The materials shall be delivered to the site in unopened original manufacturer's containers.

## 2.3 CHEMICAL GROUTS

- A. Water based chemical grouts shall have the following characteristics:
1. A minimum of 12% acrylamide base material by weight in the total grout mix. A higher concentration of acrylamide base material is recommended to increase strength or offset dilution during injection.
  2. The ability to tolerate some dilution and react in moving water during injection.
  3. A viscosity of approximately 2 centipoise, which can be increased with approved additives.
  4. A controllable reaction time from 10 seconds to 1 hour.
  5. A reaction (curing) that produces a homogenous, chemically stable, non-biodegradable, firm, flexible gel.
  6. The ability to increase mix viscosity, density and gel strength by increased concentrations of the mix constituents or by the use of approved additives.
  7. Product Manufacturer:
    - a. Avanti AV-100, Avanti AV-118; or equal.
- B. Acrylate based grout shall have the following characteristics:
1. A minimum of 10% acrylate base material by weight in the total grout mix.
  2. The ability to tolerate some dilution and react in moving water during injection.
  3. A viscosity of approximately 1-3 centipoise, which can be increased with approved additives.
  4. A controllable reaction time from 10 seconds to 1 hour.
  5. A reaction (curing) that produces a homogenous, chemically stable, non-biodegradable, firm, flexible gel.
  6. The ability to increase mix viscosity, density and gel strength by the use of approved additives.
  7. Product Manufacturer: DeNeef AC-400, DeNeef Gelacryl SR, Avanti AV-160; or equal.

## 2.4 ADDITIVES

- A. A latex or "diatomaceous earth" additive shall be added for joint grouting to increase compressive and tensile strength. The quantity of strengthening agent additive shall be as recommended by the manufacturer and approved by ENGINEER.

1. Product Manufacturer: Avanti AV-257 Icoset, DeNeef Reinforcing Agent; or equal.
- B. A root deterrent chemical shall be added to control root re-growth. The quantity of inhibitor shall be as recommended by the manufacturer and approved by ENGINEER.
  1. Product Manufacturer: Avanti AC-50W; or equal.
- D. Ethylene glycol shall be used to prevent chemical grout cracking once set.
- E. At the CONTRACTOR and City's discretion and according to field conditions, additional additives may be selected and used within the manufacturers recommended quantities.
  1. Dye - A manufacturer approved water soluble dye without trace metals may be added to the grout tank(s) for visual confirmation.
  2. Gel Time Modifier - A gel time extending agent may be used in accordance with the manufacturer's recommendations to extend gel time as necessary.
- F. 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 and additive.

### **PART 3 EXECUTION**

#### **3.1 CONTROL TESTS**

- A. Packer Tests - Demonstrate the acceptable performance of air test.
  1. To insure the accuracy, integrity and performance capabilities of the testing equipment, a demonstration test will be performed in an above-ground 8" nominal diameter test cylinder suitable to contain the full length of the packer and sustain the void test pressure. The test cylinder shall be equipped with a void release valve to exercise a controlled release of pressurized air from the void area to test the packer under both sound and leaking conditions. The test cylinder shall also be equipped with a local pressure gauge (0-25 psi) within the void space.
    - a. With the void release valve sealed, inflate the packer and air test void at 7-10 psi. The observed void pressure at the test cylinder pressure gauge must be within  $\pm 1.0$  psi of the reading in the control center/studio void pressure gauge and follow both up and down pressure changes (allowing time for pressure equalization).
    - b. If above test is passed, crack the release valve to simulate a very small leak. The cylinder shall be equipped with a void release valve to exercise a controlled release of the test media with the associated pressure drop to be equally displayed  $\pm 1.0$  psi of the cylinder gauge and test monitoring equipment.
  2. Prior to the commencement of joint testing, position the packer on a section of sound sewer pipe between pipe joints, and perform a test as specified. The equipment shall hold a 7-10 psi test pressure for a period of 15 seconds with a pressure drop of less than 1 psi. In the event of a failed test, repair any defective equipment and re-test to verify proper operation of all equipment at no additional compensation to CONTRACTOR. Should it be found that the surface or porosity conditions of the barrel of the sewer pipe cannot meet the joint test requirements, then the performance testing shall be waived or modified as determined by City.
  3. If air testing cannot be performed successfully, repair or otherwise modify air test equipment and repeat the tests. This test may be required at any other time during the

performance of joint testing work if City suspects the testing equipment is not functioning properly.

- B. Pump Tests - At the beginning of the contract, prior to application of grout, perform a pump test to determine if proper ratios are being pumped from the grout component tanks at the proper rates and to measure pump rates. Use separate containers to capture the discharges from each of the grout component hoses, to simulate the actual volumes of each component through the interconnect hoses, hose reel and length of grout hose and confirm accuracy of grout pump totalizer. Take corrective action if ratios or rates are not within manufacturer's recommended standards.
- C. Grout Tests - Perform and record a grout gel test in the presence of City by recording the grout tank solution temperature, catalyst tank solution temperature, ambient air temperature in truck, and gel time of the sample whenever the following conditions occur:
  - 1. At the beginning of each day; the material in the hoses shall be recycled to the tanks and a sample shall be taken.
  - 2. When new batches of grout are mixed.
  - 3. Whenever the temperature in the tanks or ambient temperature have changed by more than +/- 10°F from the previous gel test.

### 3.2 PIPE PREPARATION

- A. Prior to the application of the chemical grouting materials, the CONTRACTOR shall thoroughly clean the sewer lateral designated to receive the chemical grouting. Cleaning shall constitute removal of all loose debris & solids which inhibit proper seating of the packer. If mineral deposits are present, they shall be removed and paid for per the applicable items on the Schedule of Prices. Removal of other hardened materials such as concrete shall be considered beyond the scope of this work.

### 3.3 ROOTS AND LOOSE DEBRIS IN SEWER LATERAL CONNECTIONS

- A. Remove all roots and loose debris from sewer laterals connected to manholes for the length of sewer lateral to be tested/grouted.

### 3.4 GROUT PREPARATION

- A. Follow the manufacturer's recommendations for the mixing and safety procedures.
- B. Adjust gel time as necessary to compensate for changes in temperature in grout component tanks or hoses. The addition of dilution water to extend gel times is not acceptable unless resulting base grout tank only material exceeds 20% by weight for solution grouts.
- C. During the grouting process, the Grouting Technician shall monitor the grout component tanks to make sure that proper ratios are being pumped. If unequal levels are noted in the tanks, repeat the pump test as described above and correct any defective equipment.
- D. Gel times shall be calculated using the following formula unless CONTRACTOR experience and/or field conditions dictate otherwise. Any alterations of the gel time formula shall be approved by City.

$$\text{Gel Time} = \left( \frac{\text{Volume of Pipe/Packer Void Space (gal)}}{\text{Pumping Rate (gpm)}} \right) \left( \frac{60 \text{ sec}}{1 \text{ min}} \right) + 20\text{sec}(+/- 5\text{sec})$$

Packer/Pipe void shall be defined as the volume between the inflated packer and the inside pipe wall when the packer is inflated per manufacturer recommendations.

For example: an 8" pipe with a packer void space of 0.3 gallons and a 3 gpm pumping rate would provide

$$\text{Gel Time} = \left( \frac{0.3 \text{ (gal)}}{3 \text{ (gpm)}} \right) \left( \frac{60 \text{ sec}}{1 \text{ min}} \right) + (20\text{sec}) = 26\text{sec}(+/- 5\text{sec})$$

### 3.5 TESTING AND GROUTING DEFECTS

- A. Testing and grouting will not be required on pipe exhibiting the following conditions or characteristics:
  - 1. Longitudinally cracked, fractured or broken pipe.
  - 2. Sections of the pipe with structural defects between joints.
- B. Any structurally undamaged joint that structurally fails (breaks) during grouting that are documented on video to have been done under normal pressure conditions shall be City's responsibility and cost to repair.
- C. Grout all circumferential cracks and fractures or other defects as specified or as directed by City. Do not test or grout any other pipe defects unless so specified or shown, or directed by City to do so. Testing or grouting not at the direction of City will be CONTRACTOR's cost. Any structurally failed pipe or joint that is grouted at City's direction that further fails/breaks during testing and grouting that are documented on video to have been done under normal pressure conditions shall be City's responsibility and cost to repair. Promptly repair any other sewer damage resulting from the CONTRACTOR's operations at no additional compensation.

### 3.6 JOINT TESTING PROCEDURE FOR SEWER LATERALS CONNECTED TO MANHOLES

- A. Joint testing pressure shall be equal to 0.5 psi per vertical foot of pipe depth plus 2 psi; however, test pressure shall not exceed 10 psi without the approval of City.
- B. Test joints in sewer laterals which are directly connected to manholes from sewer lateral connection to cleanout. Direct visual observation and measured cable lengths shall be used to position the sewer lateral packer for sewer laterals directly connected to manholes.
- C. Upon completing the testing of each individual joint, the packer shall be deflated with the void pressure meter continuing to display void pressure. Should the void pressure meter fail to drop to 0.0 +/- 0.5 psi, clean the test equipment of residual grout material or make the necessary equipment repairs to provide for an accurate void pressure reading.

### 3.7 GROUTING - GENERAL

- A. Grout all joint and sewer lateral connections that failed the pressure test by the injection method. This shall be accomplished by forcing grout through a system of pumps and hoses into and through the joints of the sewer from the packer within the sewer pipe.

Remove excess grout from pipe and sewer laterals. Excess grout shall be defined as a thickness of grout that given its location, size and geometry, could cause a blockage. Flush or push forward to the next downstream manhole, remove from the sewer system, and properly dispose of excess grout.

### 3.8 PIPE JOINT SEALING BY PACKER INJECTION GROUTING FOR SEWER LATERALS CONNECTED TO MANHOLES

- A. Position the mainline packer over the joint or defect to be sealed by means of a CCTV camera in

the line. Position the push/pull packer over the joint or defect to be sealed by a means of visual observation, marked push rod, or where a cleanout is available, through a CCTV camera in the sewer lateral. For push packers, start work at the most distant point to be grouted. Take an accurate measurement of the location of the defect to be sealed using a portion of the packer as a point of reference for positioning the injection area of packer over the defect.

- B. Pneumatically expand the packer sleeves such that they seal against the inside periphery of the pipe to form a void area at the joint now completely isolated from the remainder of the pipe line.
- C. Pump grout materials, in stages if needed, into this isolated area to refusal until and the void or surrounding soil has been filled or solidified with the goal of applying 0.25 to 0.5 gallons of grout per inch-diameter per pipe joint. Refusal is when the packer void pressure during grout pumping instantaneously rises or “spikes” by 4 to 5 psi or more above the normal void pressure experienced during grout pumping operation. Refusal may also be revealed when pumping void pressure exceeds the holding pressure of the packer end elements as evidenced by “blow-by” past the packer sealing end elements. Refusal shall mean, when the joint will not accept any more grout because it has flowed throughout the void, through any joint failure and into the surrounding soil; gelled or filled the available void space; and formed a cohesive seal stopping further grout flow, then the joint will have then been sealed. Record the amount of grout pumped on the sealing log. If sealing is not achieved refer to para.3.9.E
- D. Upon completion of the injection, deflate the packer to break away from the ring of gel formed by the packer void. The packer should then be re-inflated and the joint retested at a pressure equal to the initial test pressure. If the joint fails this air test, repeat the grouting procedure at no additional cost to City, except for the additional grout used. Repeat this sequence of air testing, grouting and subsequent air testing until either the joint is sealed or it is determined that the grout consumption is too high (see section 3.9.E). The final determination to stop subsequent attempts to seal a joint will be made jointly between City and the CONTRACTOR. Should the void pressure meter not read  $\pm 0.5$  psi, clean the equipment of residual grout or make the necessary equipment repairs/adjustments to produce accurate void pressure readings.
- E. If a mainline or sewer lateral joints require more than 0.5 gallon of grout per inch-diameter per pipe joint, modify grouting procedure to perform stage grouting by pumping additional grout in up to 4 gallon increments, waiting 1 gel set cycle time or 1 full minute, whichever is greater between stages. Maximum number of stages shall not exceed two stages of 4 gallons each unless approved by City.

### 3.9 SEWER LATERAL CONNECTION SEALING FROM THE MAINLINE BY PACKER INJECTION GROUTING

- A. The sewer lateral packer shall remain in position during the pressure test, thus maintaining the isolated void. Pressure inject grout through the sewer lateral packer into the annular space between the sewer lateral grouting plug and the sewer lateral pipe.
- B. When pumping grout, 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 about 2 to 4 psi, continue pumping until a point where there is a sudden increase in the void pressure. This increase from 2 to 4 psi to over 8 to 10 psi takes place in a matter of a few seconds. If the grout pumped exceeds 1 gallon per foot of sewer 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. Check that the packer is sealed properly. If it is, modify grouting procedure to stage grouting by pumping additional grout equivalent to 1 gallon plus 0.25 gallon per foot of sewer lateral bladder, waiting 1 full minute, and retesting. The maximum number of stages shall not exceed two stages unless authorized by City.

- C. Upon completion of the sewer lateral connection sealing procedure, deflate the sewer lateral bladder, re-inflate and air test the sewer lateral connection a second time to confirm the sealing of the connection in accordance with the air testing procedure. If the sewer lateral connection fails this air test, repeat the grouting procedure at no additional cost to City, except for the additional grout used. Air tests after grouting sewer laterals containing roots is not required.
- D. Confirm sewer lateral flow after sealing of each sewer lateral connection. If a grout blockage exists, the CONTRACTOR shall immediately clear the sewer lateral at no additional cost to City. Blockages in the sewer lateral that are not the result of grouting operations shall not be the responsibility of the CONTRACTOR.
- E. After grouting sewer lateral connections (with the appropriate size sewer lateral bladder), a thin residual grout film may be present inside the sewer lateral wall. The amount of residual grout film present is dependent on the sewer lateral bladder used, geometry of the sewer lateral and positioning of the packer. This thin layer of cured grout is normal and will eventually peel off the sidewall of the pipe. This residual chemical grout film is not considered excess grout. Removal of residual grout shall be requested by City and paid for under the unit price for post sewer lateral connection residual grout cleaning.

#### 3.10 JOINT SEALING VERIFICATION

- A. Record grouting of joints in conjunction with the testing of joints. Record the void pressure drop continuously on video and in writing immediately before sealing, and immediately after grouting. After the packer is deflated and moved, record on video the visual inspection of the joint.
- B. Use of standardized test and seal data sheets and PACP data codes is highly recommended.

#### 3.11 DISPOSAL

- A. Collect and properly dispose of cleaning materials used in the cleaning of the grouting equipment.

#### 3.12 POST-CONSTRUCTION INSPECTION

- A. After grouting is complete, all pipe sections shall have final inspection by means of a color CCTV system. All pipes shall be thoroughly cleaned prior to inspection, and inspections must be conducted in accordance with the latest version of NASSCO PACP. Personnel on the job are required to be trained and PACP certified. The video shall have the project name and limits of the sewer being televised superimposed on the beginning of each segment. The camera shall travel through the sewer at a speed of a half of a foot (0.5 feet) per second. A continuous tape counter in feet shall be superimposed at the bottom of the screen to show the distance from the starting reference point. The date of the video recording shall be superimposed on the screen. Lighting in the interior of the sewer shall be sufficient to produce a clear and well-focused video of the entire periphery of the pipe and correctly show the true color of the pipe.
- B. CONTRACTOR shall submit database files, video files in MPEG format on DVDs, and digital inspection logs in PDF format. All inspection data will be standardized per

PACP guidelines and later imported into City's comprehensive GIS system for proper identification, evaluation, sharing and management of asset. Therefore, CONTRACTOR must submit data in a format compatible to City's current database. DVD submitted shall have a typed label on the front of the DVD providing following information:

1. Sewer Job Order Number (J.O. #)
2. Contract Number (Contract #)
3. Street Names with Limits
4. Post Construction TV – Sewer Lateral
5. Contract Title
6. Date

### 3.13 QUALITY CONTROL

- A. SFPUC reserves the right to conduct warranty CCTV inspection of sewer lateral grouting up to 18 months after final completion. Any joints or sewer lateral connections which were originally sealed and are observed to be leaking shall be re-sealed at no cost to the City.

END OF SECTION

## APPENDIX B - SPECIFICATION FOR CURED-IN-PLACE SEWER LATERAL LINING

### PART 1 GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. Restoration of existing sewer laterals without excavation by installation of a resin impregnated flexible felt tube into the existing sewer lateral to produce a jointless, leak-free, hard, impermeable pipe from the mainline sewer to the cleanout.
- B. The construction documents shall divide the sewer laterals to be lined into two groups:
- C. Sewer laterals with either existing cleanouts or cleanouts that will be installed as part of this project will be lined from the mainline to the cleanout.
- D. Sewer laterals without cleanouts will only be lined from the mainline to three feet from the mainline.
- E. All sewer laterals in both groups will either have 18-inches of the mainline lined forming a “T shape” with the sewer lateral lining or will have the connection between the mainline and the lateral grouted. If a sewer lateral is connected directly to a manhole, grout the connection between the manhole and the sewer lateral.

#### 1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM) Standards:
  - 1. D638 Test Method for Tensile Properties of Plastics.
  - 2. D790 Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials.
  - 3. D2122 Determining Dimensions of Thermoplastic Pipe and Fittings.
  - 4. D2837 Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
  - 5. F1216 Rehabilitation of Existing Pipelines and Conduits by Inversion and Curing of a Resin-impregnated Tube.

#### 1.3 DEFINITIONS

- A. See Sewer Lateral Specifications for definitions.

#### 1.4 CONTRACTOR SUBMITTALS

- A. Submit six copies of the following:
  - 1. Certificate of compliance from the manufacturer certifying compliance with the applicable specifications and standards. The batch number of the resin to be used shall also be included in this submittal.
  - 2. Technical data sheets from resin manufacturer. Technical data sheets to include quality control values for viscosity and gel time. Technical data sheets also to include average values for flexural modulus, flexural strength.
  - 3. Certified copies of quality control resin batch test reports. Report to include measured values for viscosity and gel time.

4. Manufacturer's installation instructions and product data.
5. Contractor's procedures including the duration of service shutdown.
6. Data, measurements, assumptions and calculations for sizing liners.
7. Sampling procedures and locations for obtaining representative samples of the finished liner. This requirement is only applicable to sewer laterals that connect to manholes.
8. Traffic control information.
9. Door hanger and other public notification information.
10. Color video of sewer laterals prior to lining (1 copy).
11. Field Supervisor's and technician's resume/experience list to demonstrate that experience listed in paragraph 1.5 is met. Information to include project name, project location, date, contact name with organization, number of sewer laterals lined, and lateral lining product (T-Liner™ or other sewer lateral lining).
12. Submit the following after completing lining (see Paragraph 3.4):
13. Color video of sewer laterals after complete cure of the liner (2 copies).
14. Written log for each sewer lateral, including street address and field measurements (length, diameter, ovality, and depth).
15. Furnish an extended warranty for liner materials and liner installation from the Contractor for a total of 5 years from date of Final Acceptance. If grouting is used, furnish an extended warranty for liner materials and liner installation from the Contractor for a total of 5 years from date of Final Acceptance.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products. No products shall be shipped to the job site without the approval of the Engineer.
- B. Keep products safe from damage. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.
- C. Storage of materials and equipment shall be at a location approved by the Engineer.

#### 1.6 QUALIFICATIONS

- A. The Contractor shall have the following minimum qualifications:
- B. Field Supervisor Experience: The lining field supervisor (defined as the person who is supervising in the field during all phases of the sewer lateral lining) must have the following experience:
- C. Sewer Lateral Lining: Installed at least 100 sewer lateral linings as part of a lateral lining crew.
- D. Sewer Lateral Lining Supervision: As lining field supervisor, installed at least 20 sewer lateral linings (or at least 20 T-Liner™ lateral linings if T-Liner™ is used).
- E. Technician Experience: At least one of the crew members must have the following experience:
- F. Sewer Lateral Lining: Installed at least 50 lateral linings as part of a sewer lateral lining crew (or at least 50 T-Liner™ lateral linings if T-Liner™ is used).

#### 1.7 SEWER LATERALS TO BE LINED

The sewer laterals to be lined are shown on the construction drawings or listed in a table in the project specifications.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. The finished pipe liner shall be fabricated from materials which when complete are chemically resistant to and shall withstand internal exposure to domestic sewage. The finished pipe liner shall also be fabricated from materials which when complete are in compliance with regulations and ordinances of the State of California.
- B. Take all necessary field measurements of the existing sewers and sewer laterals (including diameter, ovality, depth and length) prior to manufacturing liners.
- C. Termination Location: The Contractor shall verify the lengths in the field before manufacturing.
- D. For sewer laterals without a cleanout, the termination location shall be no more than 24" downstream of the P-trap.
- E. For sewer laterals without a cleanout, the termination location of the lining shall be three feet from the mainline.
- F. Manholes: For sewer laterals that connect to manholes, the lining shall terminate at the inside face of the manhole wall (downstream termination point) and no more than 24" downstream of the P-trap (upstream termination point).
- G. Unless specified otherwise, the sewer lateral liner shall be structurally designed for a minimum service life of 50 years; fully deteriorated host pipe/direct bury condition; prism loading; soil loading of 120 pcf; factor of safety of 2.0; 2% ovality; maximum deflection of 5%; soil modulus of 1000 psi; lining enhancement factor of 7 maximum; H-20 live loading; 50% long-term modulus reduction factor; and hydrostatic load at 100% of depth to invert.
- H. Where applicable, the mainline portion of the liner may be designed for partially deteriorated conditions. All other design parameters shall remain as specified in this section.
- I. The installed liner shall be furnished to the following minimum thickness:

Nominal Diameter (in)	Depth at Mainline Sewer (ft)	Min. Liner Thickness (mm) <sup>1</sup>
4	0 to 20	3.0
4	20 to 30	4.0
8	0 to 25	5.0
8	25 to 30	6.0
10	0 to 25	6.0
10	25 to 30	7.0
12	0 to 20	6.0
12	20 to 25	7.0
12	25 to 30	8.0

<sup>1</sup>Based upon initial CIP modulus of 250,000 psi with 0.50 creep reduction factor.

## 2.2 CURED-IN-PLACE LINER

- A. All cured-in-place lining products shall comply with ASTM F-1216 or intent thereof as determined by the Engineer.
- B. Cured-in-place liners for sewer laterals shall be manufactured and installed to reconstruct a section of the mainline sewer and the adjacent sewer lateral without excavation. The tube liner shall consist of one or more layers of flexible needled felt or an equivalent non-woven material. The tube shall be continuous in length and the wall thickness shall be uniform. No overlapping sections shall be allowed in the circumference or the length of the sewer lateral liner, unless approved by the Engineer. The tube shall be capable of conforming to offset joints, bells, and disfigured pipe sections.
- C. Grouting products shall conform to the requirements of the Sewer Lateral Chemical Grouting specification located in Appendix A.
- D. The composite of the materials shall, upon installation and complete curing inside the host pipe, exceed the following minimum ASTM test standards:

FLEXURAL STRENGTH (ASTM D-790)	4,500 PSI
FLEXURAL MODULUS (ASTM D-790)	250,000 PSI

- E. The flexible tube shall be fabricated to a size that when installed shall neatly fit (minimum 99.75%) the internal circumference of the pipelines. Allowance shall be made for circumferential stretching during insertion so that the final cured product is snug against the wall of the host pipe.
- F. Unless otherwise specified, the Contractor shall furnish a general purpose, unsaturated, polyester or thermosetting vinyl ester resin and catalyst system compatible with the reconstruction process that provides the cured physical strengths specified herein.

### **PART 3 EXECUTION**

#### **3.1 SAFETY REQUIREMENTS**

- A. The Contractor shall carry out his operations in strict accordance with all applicable traffic, OSHA and manufacturer's safety requirements. Jobsite safety shall be exclusively the responsibility of the Contractor. Particular attention is drawn to confined space entry safety requirements.

#### **3.2 PREPARATION**

- A. Clean, inspect, and CCTV both the lateral line and the portion of the mainline on both sides of the sewer lateral connection immediately prior to lining, and remove all roots, debris, protruding service connections, etc. prior to the reconstruction process. The Contractor shall review the condition of the pipe and notify the Engineer if conditions are present that might preclude the successful lining of the sewer lateral.
- B. The Engineer will compare the condition of the pipe to the original design condition to verify that design parameters have not changed.
- C. When it is necessary to shutdown a private sewer lateral while work is in progress, the Contractor shall notify the residents at least 48-hours prior to the shutdown. No sewer or water service is to remain shutdown for more than four (4) hours unless the Contractor provides substitute services for the residents. Sewage from the services or main line shall not be discharged on the ground or in waterways. Holding pits or tanks are not allowed unless permitted by the Engineer.
- D. The Contractor shall provide for the flow of sewage around the section of pipe and services designated for lining. When required, the flows shall be by-pass pumped. The pumping system shall be sufficiently sized for normal to peak flow conditions. Monitor the upstream manhole at all times. An emergency deflate system shall be incorporated so that the plugs may be removed at any time without requiring confined space entry.
- E. Do not install lining if ground water temperatures and/or ambient temperatures are too high or too low for the product installation procedures, based on manufacturer's recommendations.
- F. The Contractor shall obtain all necessary permits to work in street right-of-way and is responsible for all necessary traffic control.

#### **3.3 INSTALLATION**

- A. Cured-in-place lateral lining shall be in accordance with ASTM F1216 and AWWA C-950 and the manufacturer's requirements, or intent thereof as approved by the Engineer.
- B. Designate a location where the liner tube shall be vacuum-impregnated prior to installation. The Contractor shall allow the Engineer to inspect the materials and "wet out" procedure. A

catalyst system compatible with the resin and liner tube shall be used. Sufficient excess resin shall be provided to insure a mechanical bond with the host pipe after curing.

- C. Document the placement of the lateral liner by internal video inspection with the camera being inserted from the lateral pipe down to the mainline pipe. Video documentation of the placement, prior to curing, shall be provided to the Engineer. Measuring from a CCTV counter or estimating shall not be allowed.
- D. Insert the sewer lateral liner from the mainline sewer or manhole by controlled air or water pressure.
- E. The mainline liner and the lateral tube shall be held tightly in place against the wall of the host pipe by controlled pressure until the cure is complete.
- F. When the curing process is complete, the pressure shall be released. The inversion bladder and launching device shall be removed from the host pipe. No barriers, coatings, or any material other than the cured tube/resin composite, specifically designed for desirable physical and chemical resistance properties, shall ever be left in the host pipe. Any materials used in the installation other than the cured tube/resin composite shall be removed from the pipe.

### 3.4 POST INSTALLATION

- A. Portions of any piece of liner material removed during installation shall be available for inspection and retention by the Engineer.
- B. Each lined lateral shall be CCTV inspected as soon as practical after installation to assure complete curing or reforming. CCTV will follow requirements in City CCTV specification. Segments not fully conforming to these Specifications must be immediately brought to the Engineer's attention with a proposed method of correction.
- C. In addition, each service shall be inspected with a 360° integral lighthouse camera from the mainline sewer. At each service, the camera shall come to a complete stop and the service shall be panned. Shut off sewage flow in the mainline sewer while videotaping.
- D. Submit a color videotape of the service inspection showing the lateral before and after relining, and the connection from the mainline sewer. Provide a log for each segment indicating the service location and address or parcel of each service renewed.

### 3.5 ACCEPTANCE

- A. It is the intent of these specifications that the completed liner shall be essentially equivalent in final quality and appearance to new sewer installation.
- B. The finished liner shall be continuous, jointless and homogeneous over the entire liner.
- C. The finished liner shall be fully rounded with no flat spots.
- D. The finished liner shall be free from visible defects, including but not limited to damage, deflection, holes, delamination, ridges, cracks, uncured resin, foreign inclusions or other objectionable defects.
- E. There shall be no visible infiltration through the liner, around the liner at manhole connections, at service connections, in services, or in cleanouts. Contractor shall repair any visible leaks, regardless of the results of leakage testing.
- F. Where a defect in the liner requires removal of a section of the liner, in the Engineer's opinion, the Contractor shall make all repairs as required by the Engineer and shall install a segmental liner, compatible with the liner, to accomplish a continuous finished liner. No separate payment shall be made for such defect repair or for the post-repair segmental liner.

### 3.6 CLEAN-UP AND RESTORATION

- A. The Contractor shall not allow the site of the work to become littered with trash and waste material, but shall maintain the site in a neat and orderly condition throughout the construction period.
- B. On or before completion, the Contractor shall clean and remove from the site of the work all surplus and discarded materials, temporary structures, and debris of any kind. He shall leave the site of work in a neat and orderly condition, equal or better to that prior to construction.
- C. Before final acceptance by the Engineer, the Contractor shall replace and/or restore any trees, shrubbery, fences, driveways, sidewalks, culverts, bridges, houses or buildings and all water, sewer, gas, telephone and electrical lines thereto, and all other private and public property along or adjacent to the work that may have been disturbed by construction operations.

### 3.7 PATENTS

- A. The Contractor shall warrant and save harmless the City and Engineer against all claims for patent infringement and any loss resulting therefrom.

END OF SECTION