SECTION 0000

PRESSURE TESTING AND GROUTING OF SEWER PIPE JOINTS

PART 1 - GENERAL

* 1. DESCRIPTION
1. The intent of joint testing is to identify those sewer joints that are not watertight and that can be successfully sealed by packer injection grouting. This document may be utilized for the following applications:
	1. Testing all joints in a mainline segment;
2. The Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to grout pipeline joints using a packer injection method.
	1. Requirements
3. The Contractor shall be trained in appropriate and satisfactory safety methods regarding the grouts used under this contract. These methods shall include handling, mixing, and transporting of chemical grouts.

1.03 Related Sections to be determined by engineer/owner

1.04 QUALIFICATIONS to be determined by engineer/owner

1.05 SUBMITTALS

1. Equipment operating procedures and systems.
2. Chemical Grout information:
	1. Description of chemical grout materials to be used per sections 2.03 & 2.04;
	2. MSDS sheets for all materials to be used.
3. Identification of the Manufacturers of the packers to be utilized on the project.
4. Upon completion of each pipe segment, the Contractor shall submit to the Engineer a report showing the following data for each joint tested, grouted or attempted to be grouted.
	1. Identification of the sewer pipe section tested;
	2. Type of pipe material, diameter and 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;
	6. Location stationing of each joint tested and location of any joints not tested with an explanation for not testing;
	7. Volume of grout material used on each joint;
	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 and temperature of the grout solution in tanks; and
	10. Video recordings that include:
		1. Testing and sealing operations for each joint (including
		 inflation and deflation over the joint) displaying the final
		 air test of joints; and
		2. An additional final recording, if specified, that includes inspection
		 of the pipe after all grouting work is complete.

1.06 REFERENCE STANDARDS

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

PART 2 – PRODUCTS

2.01 Testing and Grouting Equipment

1. The equipment shall be constructed in such a way as to provide a means for introducing air under pressure into the void area created by the expanded ends of the packer pushing against the host pipe. The equipment shall also provide a means for continuously measuring, viewing and recording the actual static pressure of the test medium and grout within the void area only
2. Void pressure data shall be transmitted from the void area directly to the monitoring equipment in the grouting truck or to the grouting truck via a 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.
3. Grouting equipment shall consist of the packer and appropriate pumping and hosing systems capable of supplying an uninterrupted flow of sealing materials to completely fill the voids. Grout pumping systems shall be sized to deliver a mixed volume of grout at a minimum of three gallons per minute (3 GPM) and thirty (30) gallons of uninterrupted flow within ten (10) minutes.
4. The volume of mixed grout pumped must be measured and recorded for each grouted joint.
5. The Contractor shall provide back-up bladders for pipe packers on-site any time grouting work is being conducted.

2.02 Grout(S) – GENERAL requirements

1. Grouting materials should be handled, mixed, and stored by the Contractor in accordance with the Manufacturers’ recommendations. The grouting materials shall be delivered to the site in unopened original Manufacturers’ containers.

2.03 GROUT(s) CHARACTERISTICS

1. Acrylamide and/or Acrylic based grouts shall be utilized and have the following characteristics:
2. A minimum of ten percent (10%) 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.
3. Product(s) and Manufacturer(s):

	1. Avanti AV-100;
	2. Avanti AV-118; or
	3. Approved equal(s).

2.04 ADDITIVES

1. At the Contractors discretion according to field conditions, additives may be selected and used within the Manufacturers’ recommended quantities.
2. Strengthening Agents
3. For joint grouting, a latex or diatomaceous earth additive may be added to increase compressive and tensile strength. The quantity of strengthening agent additive shall be as recommended by the Manufacturer and approved by the Engineer.
4. Product Manufacturer(s):
5. Avanti AV-257 Icoset;
6. Approved equal(s).
7. Root Inhibitor
	1. When roots are present, for joint grouting, 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 the Engineer.
	2. Product Manufacturer(s):
8. Avanti AC-50W; or
9. Approved equal(s).
10. Dye
11. A Manufacturer approved water soluble dye without trace metals may be added to the grout tank(s) for visual confirmation.
12. Gel Time Modifier
13. A gel time extending agent may be used in accordance with the Manufacturer(s)’ recommendations to extend gel time as necessary.
14. 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

3.01 CONTROL TESTS

1. Packer Tests – The Contractor shall demonstrate the acceptable performance of air test(s), including:
2. To insure the accuracy, integrity and performance capabilities of the testing equipment, a demonstration test (barrel test) shall be performed by the Contractor. The test procedures shall be as follows:
	1. After entering each pipeline segment with the test equipment, but prior to the commencement of joint testing, the Contractor shall position the test equipment on a section of sound sewer pipe between pipe joints, and perform a test as specified. The equipment shall hold a seven to ten PSI (7-10 PSI) test pressure for a period of fifteen (15) seconds with a pressure drop of less than one PSI (<1 PSI). In the event of a failed test, the Contractor shall repair any defective equipment and re-test to verify proper operation of all equipment.
3. Pump Tests - At the beginning of the contract, prior to application of grout, the Contractor shall perform a pump test. This test shall determine if proper ratios are being pumped from the grout component tanks at the proper rates and shall also measure pump rates. The Contractor shall 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 to confirm accuracy of the grout pump totalizer. The Contractor shall take corrective action if ratios or rates are not within the Manufacturers’ recommended standards.
4. Grout Tests – The Contractor shall perform and record a grout gel test in the presence of the Engineer. This test shall include the recording of the grout tank solution temperature, catalyst tank solution temperature,ambient air temperature in truck, and gel time of the sample. The test shall be performed whenever the following conditions occur:
5. At the beginning of each day. The material in the hoses shall be recycled to the tanks and a sample shall be taken;
6. Whenever new batches of grout are mixed; and
7. Whenever the temperature in the tanks or ambient temperature have changed by more than plus or minus ten degrees Fahrenheit (+/- 10°F) from the previous gel test.

3.02 PIPE PREPARATION

1. 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 including which shall inhibit proper seating of the packer.
2. The Owner shall have cleared the designated sewer line(s) of obstructions such as offset joints, protruding lateral connections, and broken pipe or crushed pipe which might otherwise prevent the use of the grouting equipment. If the CCTV inspection reveals such an obstruction, the Owner shall immediately make a point repair to remove the obstruction.

3.03 GROUT PREPARATION

1. The Contractor shall follow the manufacturers’ recommendations for mixing and safety procedures.
2. Gel time shall be adjusted 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 the resulting base material exceeds ten percent (10%) by weight for solution grouts.
3. Gel times shall be within the following formula calculations unless the Contractor’s experience and/or field conditions dictate otherwise.

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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 pack void space of .3 gallons would provide

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3.04 TESTING AND GROUTING DEFECTS

1. Testing and grouting shall not be required on pipe exhibiting the following conditions or characteristics:

	1. Cracked, fractured or broken pipe, as classified by PACP;
	2. Sections of the pipe with structural defects between joints; and
	3. Any sections of pipe or joints that are in such poor structural condition that in the judgment of the Engineer or the Contractor, significant structural damage of the pipe would occur as a result of the pressure test.
2. Any structurally undamaged joint that structurally fails or breaks during testing and grouting (said tests and grouting being documented on video to have been done under normal pressure conditions). Repairs necessary under this scenario shall be the Owner’s responsibility and cost to repair.

3.06 TESTING PROCEDURE FOR MAINLINES

1. Joint testing pressure shall be equal to one half (0.5) PSI per vertical foot (VF) plus two PSI (0.5 PSI per/VF + 2.0 PSI). However, test pressures shall not exceed ten (10.0) PSI without the approval of the Engineer.
2. The Contractor shall individually test each sewer pipe joint at the above-specified pressure (and retest after sealing) in accordance with the following air test procedure:
	1. The packer shall be positioned within the pipe in such a manner as to straddle the joint to be tested.
	2. The packer ends shall be expanded so as to isolate the joint from the remainder of the pipe and create a void area between the packer and the pipe joint. The ends of the testing device shall be expanded against the pipe as per manufacturers’ recommendations. If all attempts to isolate the joint fail, the Contractor shall pump grout in an attempt to seal the leak around the packer end. The Contractor shall be paid the unit price for grout to seal the packer unless the Engineer determines that the sewer was inadequately cleaned or the packer is not performing properly. The Contractor will not be paid the unit price for joint grouting for this activity.
	3. After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the void pressure decays by more than one PSI (1.0 PSI) within fifteen (15) seconds, the joint shall be determined to have failed the test and shall be sealed.
3. 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 a reading of zero point zero PSI, plus or minus zero point five PSI (0.0 PSI +/- 0.5 PSI), the Contractor shall clean the test equipment of residual grout material or make the necessary equipment repairs to provide for an accurate void pressure reading.

3.07 gROUTING – GENERAL REQUIREMENTS

1. The Contractor shall grout all joint and 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 pipeline utilizing the packer then in the sewer pipe.

3.08 JOINT SEALING FOR MAINLINES

1. The Contractor shall position the mainline packer over the joint to be sealed with the aid of a CCTV camera in the line.
2. The Contractor shall pneumatically expand the packer sleeves such that they seal against the inside periphery of the pipe. This shall form a void area at the joint that shall be completely isolated from the remainder of the pipe line.
3. The Contractor shall then pump grout materials into this isolated area. The pump shall be operated until “refusal”. The goal of this procedure is the applying of one quarter to one half (0.25 to 0.5) gallons of grout per inch of pipe diameter per pipe joint. Refusal shall mean the joint will not accept any more grout (because it has flowed throughout the void, through any joint failure and into the surrounding soil; or gelled or filled the available void space; and formed a cohesive seal stopping further grout flow). The Contractor shall record the amount of grout pumped on the sealing log.
4. Upon completion of the injection, the Contractor shall 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, the Contractor shall repeat the grouting procedure at no additional cost to the Owner, except for the additional grout injected. This sequence of air testing, grouting and subsequent air testing should be repeated until either the joint is sealed or it is determined that the grout consumption is too high (see section 3.09. E). The final determination to stop subsequent attempts to seal a joint shall be made jointly between the Engineer and the Contractor. Should the void pressure meter not read zero point zero PSI plus or minus zero point five PSI (0.0 PSI ± 0.5 PSI), the Contractor shall clean the equipment of residual grout or make the necessary equipment repairs/adjustments to produce accurate void pressure readings.
5. If a mainline joint requires more than one (1) gallon of grout per pipe diameter inch per pipe joint, the Contractor shall modify grouting procedures. This modification shall stage grouting by pumping additional grout in up to four (4) gallon increments, waiting one (1) gel set cycle time or one (1) full minute, whichever is greater between stages. The maximum number of stages shall not exceed two (2) stages of four (4) gallons each unless approved by Owner.

3.09 JOINT Connection SEALING VERIFICATION

1. The Contractor shall record grouting of joints. This shall include recording the void pressure drop continuously on video and in writing immediately before sealing, and immediately after grouting. After the packer is deflated and moved, the Contractor shall record on video the visual inspection of the joint.

3.10 DISPOSAL

1. The Contractor shall collect and properly dispose of cleaning materials used in the cleaning of the grouting equipment.

3.11 POST-Construction INSPECTION

1. After grouting is complete, all pipe sections shall be final inspected by means of a color CCTV system. The inspection shall be conducted as per the NASSCO Pipeline Assessment and Certification Program (PACP). One set of DVDs and reports shall be submitted by the Contractor to the Engineer and/or Owner.

3.12 Quality Control

1. The Contractor shall conduct warranty CCTV inspection of mainline sewers on all of the pipe sections which contain joint or lateral grouting. This work shall be completed during conditions of high ground water. This work shall commence a minimum of fifteen (15) months after final completion and be completed a maximum of twenty-four (24) months after final completion. Any joints or lateral connections which were originally sealed and are observed to be leaking shall be re-sealed by the Contractor at no cost to the Owner.

**PART 4 – DELIVERABLES AND PAYABLES**

* 1. PREPARATORY SEWER CLEANING
1. Measurement: The quantity for this Item shall be determined based on the entire length of the pipe segment in which pipe cleaning occurs. It shall be measured from center of manhole to center of manhole horizontally along the centerline of the pipe.
2. Payment: This payment shall only be made once for any given pipe segment, regardless of the number of preparatory cleanings required to complete the various inspections and rehabilitation work. The unit price for this Item shall be full compensation for providing all labor, materials, equipment, tools, and incidentals for all aspects of preparatory sewer cleaning as specified and shown.

* 1. REAMING OF MINERAL DEPOSITS
1. Measurement: The quantity for this Item shall be determined based on the entire length of the pipe segment in which pipe reaming occurs. It shall be measured from center of manhole to center of manhole horizontally along the centerline of the pipe.
2. Payment: This payment shall only be made once for any given pipe segment, regardless of the number of reaming passes required. The unit price for this Item shall be full compensation for providing all labor, materials, equipment, tools, and incidentals for all aspects of mineral deposit reaming as required.

	1. CUTTING OF PROTRUDING TAPS
3. Measurement: The quantity for this Item shall be determined based on the actual number of protruding taps cut.
4. Payment: The unit price for this Item shall be full compensation for providing all labor, materials, equipment, tools, and incidentals for all aspects of protruding tap cutting as required.

4.04 TESTING OF PIPE JOINTS

1. Measurement: The quantity for this Item shall be the number of joints tested.
2. Payment: The unit price for this Item shall be full compensation for providing all labor, materials, equipment, tools, and incidentals for all aspects of testing pipe joints as specified and shown. Visually leaking joints, whether tested or not, shall be paid under this Item. Payment for testing joints following chemical sealing is included under Packer Injection Grouting Item. Payment for Post Construction Inspection is under separate item.

4.05 PACKER INJECTION GROUTING OF PIPE JOINTS

1. Measurement: The quantity for this Item shall be the number of joints chemically sealed.
2. Payment: The unit price for this Item shall be full compensation for providing all labor, materials (except grout), equipment, tools, and incidentals for all aspects of chemically sealing and immediate re-testing of pipe joints as specified. Payment for grout is under separate item. Payment for Post Construction Inspection is under separate item.

4.09 POST CONSTRUCTION CCTV INSPECTION

1. Measurement and Payment: The lump sum payment for this Item shall be full compensation for all labor, materials, equipment, tools and incidentals required to complete post construction CCTV inspection of the pipe, including laterals. Payment shall be made upon receipt of acceptable Post Construction Inspection of all Work.

4.10 WARRANTY TESTING OF PIPE JOINTS

1. Measurement: The unit price payment for this Item shall be full compensation for providing all required warranty testing of pipe joints.
2. Payment: The unit price for this Item shall be full compensation for providing all labor, materials, equipment, tools, and incidentals for all aspects of CCTV inspection, re-testing and sealing pipe joints that fail the warranty testing as specified. No additional compensation shall be provided for repairs and post-repair inspections completed during the warranty period.

4.11 SUPPLEMENTAL GROUT UNIT PRICING

1. Measurement: The quantity for this Item shall be the number of gallons of grout used for sealing mainline sewer pipe joints.
2. Payment: The unit price for this Item shall be full compensation for providing all labor, materials, equipment, tools, and incidentals not included in Items C, D and F required for all aspects of sealing mainline sewer pipe joints. The payment per gallon of grout installed has been fixed by the Owner and is shown on the Schedule of Prices.
3. The Owner shall establish total gallons estimated for the bid with a stipulated unit price for each gallon. Acknowledging that all joints shall not fail the air test, using one quarter (.25) gallon/inch diameter times the total number of joints should give the owner an effective and realistic measure of units for grout at a pre-determined unit price. Consult with grout Manufacturer at time of bid for more information.

**END OF SECTION**

**Recommended Payment Schedule**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **Description** | **Qty.** | **Unit** | **Unit Price** | **Total Price** |
| 1 | Pre CCTV & cleaning of main lines including root removal  |  | Linear Foot |   |   |
| 2 | Reaming of Mineral Deposits in mainlines |  | Linear Foot |  |  |
| 3 | Cutting of Protruding Taps |  | Each |  |  |
| 4 | Testing of 8" pipe joints |  | Joint |   |   |
| 5 | Testing of 10" pipe joints |  | Joint |   |   |
| 6 | Testing of 12" pipe joints |  | Joint |   |   |
| 7 | Grouting 8" pipe joints |  | Joint |   |   |
| 8 | Grouting 10" pipe joints |  | Joint |   |   |
| 9 | Grouting 12" pipe joints |  | Joint |   |   |
| 10 | Post construction CCTV inspection |  | Linear Foot |   |   |
| 11 | Option A-Warranty testing of pipe joints |  | Linear Foot |   |   |
| 12 | Option B-Warranty CCTV Inspection of mainlines grouted. |  | Linear Foot |  |  |
|  |  |  |  |

**Supplementary Unit Prices**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item | Description | Quantity | Unit | Unit Price | Total Price |
| 1 | Chemical grout (Price to be determined by engineer) |  | Gallon |   |   |