ITEM NO. 1101
SLIPLINING GROUT

1101.1 DESCRIPTION

Place grout in the annular space between the sliplining pipe and the host sewer. Completely fill the annular space without deflecting the pipe. Test grout equipment and procedures in accordance with approved submittals. Perform testing on the first pipeline segment to be grouted; testing must be performed under observation by the SAWS Engineer. If the grout does not totally fill the annular space, adjust the procedure or the mix, and rerun the test on the first pipeline segment.

1101.2 MATERIALS

1. MANUFACTURERS/APPLICATORS

   A. The applicator of the grout mix shall be certified by the grout mix manufacturer and approved by the SAWS Engineer. The certified applicator shall be regularly engaged in the placement of grout, including completion of pipeline grouting installations having at least 1000 cubic yards in the past 3 years.

2. MATERIALS

   A. Cement: Comply with ASTM C 150. Pozzolans and other cementitious materials are permitted.
   B. Fly Ash: Comply with ASTM C 618; either Type C or Type F shall be used.
   C. Sand, if provided, shall conform to ASTM C 144, except as modified below:

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<thead>
<tr>
<th>U.S. Standard Sieve Size</th>
<th>Percent Passing By Weight</th>
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<tbody>
<tr>
<td>No. 16</td>
<td>100</td>
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<tr>
<td>No. 30</td>
<td>60 – 85</td>
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<td>10 – 35</td>
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<tr>
<td>No. 100</td>
<td>5 – 25</td>
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<td>No. 200</td>
<td>- 10</td>
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   D. Water: Use potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the sliplining grout.

   E. Admixtures: Admixtures shall be selected by the sliplining grout manufacturer to meet performance requirements, improve pumpability, control set time and reduce segregation.

   1. Compressive Strength. The grout shall have a minimum penetration resistance of 100 psi in 24 hours when tested in accordance with
San Antonio Water System Standard Specifications for Construction

1. ASTM C 403 and a minimum compressive strength of 300 psi in 28 days when tested in accordance of ASTM C 495 or C 109.

2. Performance Requirements. The Contractor shall submit the proposed grout mixes, methods, plans and criteria of the grouting operations. The grouting system shall have sufficient gauges, monitoring devices, and test to determine the effectiveness of the grouting operation and to ensure compliance with the liner pipe specifications and design parameters.

3. Mix Designs. One or more mixes shall be developed to completely fill the annular space based, but not restricted to, the following requirements:
   a) Size of annular void
   b) Void(size) of the surround soil
   c) Absence or presence of groundwater
   d) Sufficient strength and durability to prevent movement of the liner pipe.
   e) Provide adequate retardation, and
   f) Provide less than 1 percent shrinkage by volume.

4. Density/Viscosity. The Contractor shall design a grout mix with a density to prevent floating of the liner pipe. The apparent viscosity shall not exceed 20 seconds in accordance with ASTM C 939 unless otherwise approved by the SAWS engineer.

1101.3 CONSTRUCTION

1. At least 7 days prior to grouting, submit information on equipment, grout mixes and procedures. Shop drawings and product data shall include but not be limited to the following:
   A. Detailed descriptions of equipment and operational procedures to accomplish the annular grouting operation, including mixing and pumping schedule, grouting pressures, rates of pumping, and methods for monitoring the effectiveness of the grouting.
   B. Detailed descriptions, and drawings indicating proposed locations, of surface mixing equipment, subsurface injection points, flowlines, waste grout recovery, grout pressure limiting equipment, bulkheads, and venting system. Show details of bulkhead design.
   C. Qualifications and experience of grout mix applicator.
   D. Grout mix design and trial mix tests, with set time, compressive strength, viscosity, and density test results.
   E. Initial set time of the grout.
F. The 24-hour and 28 day minimum grout compressive strengths.

G. The grout working time before a 15% change in density or viscosity occurs.

H. The proposed grouting method and resume of successful uses on previous projects

I. The maximum injection pressures

J. Proposed grout stage volumes

K. Bulkhead designs

L. Buoyant force calculations during grouting

M. Flow control

N. Provisions for service connections

O. Pressure gauge and recorder certifications

P. Vent location plans

Q. Written concurrence that the Contractor had coordinated this work with the grout installer and the liner pipe manufacturer.

R. For each different type of grout or variations on procedure of installation, a complete package shall be submitted. The submittal shall include each of the above items and the sewer locations of conditions to which it applies. The Contractor shall notify the SAWS engineer of any changes to be made in grout, mix, grouting procedures or installation.

2. PREPARATION

A. Notify SAWS Engineer at least 24 hours in advance of grouting operations.

B. Select and operate grouting equipment and carry out procedures with sufficient safety and care to avoid damage to existing underground utilities and structures.

3. EQUIPMENT

A. Mixers and Pumps: The materials shall be mixed in equipment of sufficient size and capacity to provide the desired amount of grout material for each stage in a single operation. The system shall mix the grout to a homogeneous consistency. Deliver grout to the injection point at a steady pressure with a nonpulsating centrifugal or triplex pump at the mix tank. Provide ways to
increase or decrease the water-cement ratio and accurately measure grout component quantities, pumping pressures, and volumes pumped.

B. Pressure Gauges:
1. Pressure gauges shall be equipped with diaphragm seals, have a working range between 1.5 to 2.0 times the design grout pressure, and have an accuracy within 0.5 percent of full range.
2. Provide one pressure gauge at the point of injection and one pressure gauge at the grout pump.
3. Grouting shall not proceed without appropriate gauges in place and in working order.
4. Grout pressure gauge and recorder shall be installed immediately adjacent to each injection port. During grouting operations, the recorder shall continuously record the actual grouting pressure versus time on paper with ink. The gauge shall conform to an accuracy of ± 0.5 psi. The range of the gauge should not be more than 100 percent greater than the design grout pressure. Pressure gauges shall be instrument oil filled and attached to a saddle-type diaphragm seal (gauge saver) to prevent clogging with grout. All gauges shall be certified and calibrated in accordance with ANSI B40, Grade 2A. The grout pressure recordings shall be identified as a minimum, with date, batch, and time of day grouting was performed and shall be submitted to the SAWS Engineer at the end of the work day that grouting was performed.

C. Procedure:
1. Place grout for a given pipeline segment between bulkheads. Place bulkheads at the ends of each pipeline segment to seal the annular space from sewer flow. Do not remove bulkheads until after grout has set.
2. Equip slipliner pipes with weirs to fill the pipes with water to prevent flotation during grouting operations.
3. Remove or control standing or running water in annular spaces to maintain the correct water ratio of the grout mixture. Grout the annular space by injecting grout from one end of the pipeline segment, allowing it to flow toward the other end. Vent the annular space to assure uniform filling of the void space.
4. Limit pressure on the annular space to prevent damage to the liner; do not exceed 5 psi. Regardless of the pressure, Contractor shall be solely responsible for any damage or distortion to slipliner pipe due to grouting. At the bulkhead opposite to the point of grouting, provide and monitor an open-ended high point tap or equivalent vent.
5. Pump grout until grout within 0.3 pounds per gallon of specified grout injection density discharges from the end opposite the injection point. This procedure is intended to ensure that the grout is not diluted by extraneous water in the annulus.

6. The drilling of additional injection holes from the surface to facilitate grouting may be allowed if approved by the SAWS Engineer.

7. Upon completion of sliplining but prior to grouting, bulkheading of the ends and appropriate venting shall required. This is to seal the annular space from sewer flow to permit the grout to set and withstand the loads imposed by the grout and groundwater. The Contractor shall test the integrity of the installed liner pipe and constructed bulkheads for any leaks by performing the following:

8. Dewater and inject dye water into the annular space (this will not be permitted if the crown or any portion of the host pipe is severely deteriorated to the point where water may escape through the host pipe.

9. Pressurize the annular space to the maximum permissible grouting pressure per manufacturer’s recommendation with approval of the SAWS engineer.

10. The Contractor shall submit a detailed plan to the SAWS engineer that shows how the liner pipe will be held on the invert for a period of time long enough to allow the grout to set when buoyant uplift is a factor.

D. Pumping

1. Design grout mix to be pumped through a 2-inch-diameter hose for a distance of 1000 feet, with a maximum allowable pressure at point of placement of 5 psi. The cast density shall be 55 pcf plus or minus 5 pcf. Minimum penetration resistance after 24 hours shall be 100 psi in accordance with ASTM C 403. The minimum compressive strength at 28 days shall be 300 psi in accordance with ASTM C 495. Grout mix shall have less than 1 percent shrinkage by volume.

2. The application system shall have sufficient gages, monitoring devices and tests to determine the efficiency and effectiveness of the grouting work and to provide a means of accurately determining the amount of grout injected. Contractor shall be prepared to modify the operation should grouting not perform as proposed. Such modifications and changes shall be done in a timely manner to avoid unnecessary delay in completion of the Project.
3. No deleterious amounts of toxic or other poisonous substances shall be included in the grout mix nor otherwise injected underground.

4. FINAL CLEANUP
   A. No hardened grout is permitted in the slipliner pipe invert after completion of grouting operations.

5. DEWATERING SYSTEM OPERATION
   A. Operate dewatering systems until the grouting of slipliner pipe is complete.

6. TESTING
   A. Density/Viscosity: During placement of grout, measure density in accordance with ASTM C 138 and C 939 at least twice per hour. Adjust the mix as required to obtain the specified cast density.
   B. Sampling:
      1. Take 4 test specimens for each 100 cubic yards of grout, or for each 4 hours of placing.
      2. Test in accordance with ASTM C 495 except:
         a. Specimens shall be 3-inch by 6-inch cylinders covered after casting to prevent damage and loss of moisture. Moist-cure specimens for at least the first 7 days; perform at least one compressive strength test of each set of samples at 28 days.
         b. Do not oven-dry specimens to be tested. Specimens may be tested at any age to monitor compressive strength. The material may require special handling and testing techniques.
         c. The Contractor shall be required to perform a test on each type of grout and grout system proposed to be used. The Test section to be grouted and the size of the annular space considered for each type of grout system shall be determined by the Contractor.
         d. The contractor shall engage the services of an approved, nationally accredited, independent testing laboratory to certify that the propose materials and methods comply with these requirements.

1101.4 MEASUREMENT AND PAYMENT

   A. Unit Prices: No separate payment will be made for work performed under this Section. Include the cost of such work in contract unit prices for sliplining sanitary sewers.

   B. Stipulated Price (Lump Sum): If the Contract is a Stipulated Price Contract, payment for work in this section is included in the total Stipulated Price.

No direct payment shall be made for incidental cost associated with the quality control testing of the grout, and all cost in connection therewith shall be included in the applicable contract price for the item to which the work pertains.
The Contractor shall submit monthly invoice from testing laboratory to testing services.

The Contractor shall be reimbursed the cost of the testing laboratory at cost plus ten percent (10%).

Any testing that fails shall be at the Contractor’s expense.