

Section 02517

WATER LINE IN TUNNELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Handling, transporting, and installing water line in primary liner tunnels, including invert cleanup and blocking and water line in casings that will be backfilled with concrete or grout.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment of water line installed by tunneling is by linear foot along centerline of completed water line as designated on Drawings. No separate payment for tunnel shafts or other excavations.
2. Payment for installation of water line in tunnel constructed according to Section 02425 - Tunnel Excavation and Primary Liner will be authorized by City Engineer in three parts. Pay estimates for partial payments will be made as measured above according to following schedule:
 - a. 60 percent of installation will be authorized when excavation and primary liner installation is complete.
 - b. 95 percent of installation will be authorized when water line installation and grouting is complete.
 - c. 100 percent of installation will be authorized when section successfully hydrostatically tested.
3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work is in this Section is included in total Stipulated Price.

1.03 REFERENCE STANDARDS

- A. ASME B 40.1 - Pressure Gauge and Gauge Attachments.

1.04 SUBMITTALS

- A. Submit work plan including following information in accordance with Section 01330 - Submittals.
 - 1. Method of transporting pipes into tunnel
 - 2. Method of hoisting and positioning pipe in tunnel
 - 3. Method of jointing and aligning pipe
 - 4. Method of supporting and blocking pipe
 - 5. Tunnel ventilation while setting pipe and completing joints, when applicable
 - 6. Material, equipment and procedures for grout placement and other information required by Section 02431 - Tunnel Grout
- B. Submit results of tunnel primary liner survey in accordance with Paragraph 3.02, Tunnel Survey.
- C. Submit results of installed water line survey in accordance with Paragraph 3.10, As-built Survey and Installation Tolerances.

1.05 PROCEDURES

- A. Joints: Prepare joints as recommended by pipe manufacturer and in accordance with Section 02511 - Water Lines.
- B. Handling: Handle, store, and transport pipe in accordance with pipe manufacturer's recommendations and to prevent damage to pipe ends, pipe barrel, steel reinforcement, and pipe protective linings.
- C. Grouting: Perform grouting of annular space between water line and tunnel liner to fill voids with grout, without dislocating or damaging pipe.

PART 2 PRODUCTS

2.01 ANNULAR GROUT

- A. Specified in Section 02431 - Tunnel Grout

2.02 CONCRETE

- A.. Meeting requirement of Section 03315 - Concrete for Utility Construction, Class B concrete.

2.03 PIPE MATERIAL AND FITTINGS

- A. Manufacture and deliver pipe material and fittings as described in Section 02511 - Water Lines.

2.04 SPACERS

- A. Unless otherwise noted on Drawings, use casing spacers between water line and casing tunnel liner for water lines less than 36 inches in diameter. Refer to Paragraph 3.01 for exception. See Section 02447 - Augering Pipe for Water lines for spacer requirements and installation.

PART 3 EXECUTION

3.01 APPLICATION

- A. Grout in place tunnels for water lines with diameters of 36 inches or greater. When tunnel liner plate is used, grout water line in place regardless of water line diameter.

3.02 TUNNEL SURVEY

- A. Prior to installing water line in tunnel: Perform survey of tunnel in accordance with Paragraph 3.10B. Verify tunnel has been constructed within specified tolerances for line, grade, and roundness and water line to be placed in tunnel can be placed in conformance with tolerances specified. Should misalignment of tunnel preclude proper installation of water line, notify City Engineer of proposed correction method. City Engineer will make final decision on acceptability of correction.

3.03 PIPE TRANSPORT

- A. Transport pipe in tunnel for final placement so that no damage occurs to pipe ends or pipe barrel and interior lining or exterior coating. Repair pipe damaged during transport or final placement in tunnel in manner acceptable to City Engineer prior to joining. Remove damaged pipe from tunnel and replace, when directed by City Engineer, at no additional cost to City.

3.04 TUNNEL CLEANUP

- A. Remove temporary tunnel utilities, loose material, dirt, and debris prior to pipe placement. Broom clean concrete invert. Control seepage and remove standing water in invert.
- B. Temporary construction tracks or pipe skids may be left in place when they do not interfere with alignment of water line, short circuit cathodic protection system, or interfere with final placement of annular grout.

3.05 INVERT PIPE SUPPORT

- A. Construct invert pipe support of screeded concrete, steel beam, or other method, as approved, to final grade of outside of water line. Secure invert support to primary liner to prevent movement. Cure concrete support minimum of 48 hours prior to setting pipe. Maintain minimum of 4 inches clearance between outside of water line and steel beam or steel member.

3.06 JOINING PIPE IN TUNNELS

- A. Lay pipe in accordance with pipe manufacturer's recommendations, and as specified in this Section. Join pipe segments so as to properly compress gaskets and allow for correct final positioning of pipe for line and grade. Closely align pipe and bring loosely together by means of hydraulic jacks, locomotives, pipe mobiles, or winches. Once pipes have been loosely joined, pull home by means of hydraulic tugger or other similar methods suitably protecting pipe and joints against damage. Impact joining, such as ramming with locomotives or other mechanical equipment, is not permitted.

3.07 BLOCKING PIPE IN TUNNEL AND BULKHEADS

- A. Develop and submit pipe blocking system that will prevent water line from floating and deforming beyond specified limits. Loads imposed on pipe, primary liner and surrounding soil during grouting shall be determined by Registered Professional Engineer in State of Texas. Show essential details in plan for supporting system. Position water line in tunnel to allow minimum of 4 inches of grout to be placed between water line and tunnel primary liner or casing.
- B. Prevent pipe from floating during backfill operations by properly installed blocking. Remove and replace segment of pipe, which is distorted or moved from final line and grade.
- C. Secure blocking in place so that it cannot be dislodged during adjacent pipe laying and during grouting operations.
- D. Construct bulkheads of material, compatible with grout, to withstand imposed grout pressure without leakage. Provide bulkheads at frequency to allow completion of grouting in continuous operation and to permit timely removal of pipe and grout, which may be needed as result of pipe distortion or movement. Modifications to bulkhead spacing will be reviewed by City Engineer. Provide adequate venting for bulkheads.

3.08 ANNULAR GROUT

- A. Fill annular void between water line and tunnel primary liner or casing with grout, in accordance with Section 02431 - Tunnel Grout.
- B. Test annular grout material, equipment, and procedures in accordance with approved submittal. Perform test on first 200 feet of water line to be backfilled. When grout does not

totally fill annular space or other problems occur, correct defects in first test section and adjust method or mix and rerun test on next 200 feet. Repeat procedure as necessary.

C. Placement:

1. Placement Limits: Predetermine limits of each grout placement stage by size and capacity of batching equipment and initial set time of proposed grout. Under no circumstances shall placement at grout port continue longer than period of time for mix to take initial set. Locate grout hole spacing and locations according to number of stages necessary to backfill tunnel liner. Do not install another lift until proper set has been attained. Placement procedures shall be approved by admixture or additive manufacturers.
2. Equipment - Pumps: Pumping equipment must be of sufficient size and capacity to place grout to distances and volumes compatible with batching and mixing equipment. Maintain equipment and clean thoroughly each day. No hydrocarbons shall enter pumping chamber. Under no circumstances shall grout be pumped in excess of 1000 linear feet without prior approval by City Engineer. Pumping test and verification testing of resulting grout quality will be required for approval.
3. Slickline: Convey grout to point of placement in clean steel or rubber hoses designed to handle safely pump pressure and volumes during placement. Do not allow hardened grout or concrete to obstruct or coat steel pipe or hose internally.
4. Grout Connections: Grout connections shall be sized minimum of 2-inch inside diameter, consisting of grout hose attached immediately to pressure gauge. Gauged pumping pressure shall not exceed water line manufacturer's recommendations. Monitor grout pressure.
5. Gauges:
 - a. Type: Instrument oil-filled and attached to saddle-type diaphragm seal (gauge saver) to prevent clogging with grout.
 - b. Calibration: Certified and calibrated in accordance with ASME B 40.1.
 - c. Range: Not more than 100 percent greater than design grout pressure.
 - d. Accuracy: No more than one-half percent error over full range of gauge.
 - e. Fitting: Attach gauge to valve immediately attached to grout port in tunnel liner. Provide T-fitting in injection line for sampling.
6. Limit pressure on annular space to prevent damage to pipe or liner. Define limiting and estimated required pressure range. Provide and monitor open ended, high point tap or equivalent vent at bulkhead opposite point of grouting.

7. Pump grout until grout within 5 percent of specified density discharges from end opposite injection point to ensure grout is not diluted by extraneous water in annulus.
 8. Drilling of access holes from surface to facilitate grouting shall not be allowed.
 9. Communication: There shall be constant communications via telephone between headerman at point of injection and pump, batch plant, and supervisor. Under no circumstance shall grouting continue without continuity of communications.
 10. The headerman at point of placement shall advise batch plant of variations of density and make corrections as necessary. Record and submit to City Engineer for each days pour variations and corrections.
- D. Delay grouting until all significant differential movement has stopped as determined by monitoring.
 - E. Remove bulkheads unless constructed of masonry.
 - F. Repair or replace damage or distortion to waterline.

3.09 GROUTING JOINTS

- A. Materials and procedures for filling interior joint recesses shall conform to Section 02511 - Water Lines.

3.10 AS-BUILT SURVEY AND INSTALLATION TOLERANCES

- A. Perform as-built survey on installed water line. Determine horizontal and vertical location for invert of each pipe joint.
- B. Acceptable tolerances: Within plus or minus 3 inches of horizontal alignment, within plus or minus 2 inches of vertical alignment.
- C. Correct pipe section outside acceptable tolerances.

3.11 FINAL CLEANUP

- A. Clean interior to pipe after interior work is completed. Remove loose material, dirt, and debris from completed pipeline. After completion of work inside pipe, prevent dirt, water, and other debris from entering until water line work is completed.

END OF SECTION

