

**SECTION 03005
GROUT**

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. Mix design requirements, testing, furnishing and production of grout for:
 - 1. Pressure grouting of jacked-pipe.
 - 2. Annular grouting of cased or uncased sewer pipe.
 - 3. Grouting voids in ground resulting from caving, loss of ground or settlement.
- B. Compaction grouting is not part of this specification.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment shall be made for the Work performed under this Section. Include cost of such the Work in contract unit prices for the Work of which it is component part.
 - 2. Refer to Section 01270 - Measurement and Payment for Unit Price procedures.
- B. Stipulated Price (Lump Sum):
 - 1. If Contract is Stipulated Price Contract, payment for the Work in this Section is included in Total Stipulated Price.

1.3 DEFINITIONS

- A. Pressure Grouting: Filling void behind liner or pipe with grout under pressure sufficient to ensure void is properly filled but without overstressing temporary or permanent ground support or causing ground heave to occur.
- B. Annular Grouting: Filling annular space between carrier pipe and casing or ground, by pumping.
- C. Ground Stabilization Grouting: Filling of voids, fissures or under-slab settlement due to caving or loss of ground by injecting grout under gravity or pressure to fill void.

1.4 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials.
 - 1. ASTM C138 Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.
 - 2. ASTM C144 Standard Specification for Aggregate for Masonry Mortar.
 - 3. ASTM C150 Standard Specification for Portland Cement.
 - 4. ASTM C494 Standard Specification for Chemical Admixture for Concrete.
 - 5. ASTM C869 Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete.

6. ASTM C937 Standard Specification for Grout Fluidifier for Pre-placed Aggregate Concrete.
 7. ASTM C942 Standard Test Method for Compressive Strength of Grout for Pre-placed Aggregate Concrete into Laboratory.
 8. ASTM C1017 Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete.
- B. CFTS – City of Friendswood Technical Specifications.

1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit description of materials, grout mix, equipment and operational procedures to accomplish each grouting operation. Description may include sketches as appropriate, indicating type and location of mixing equipment, pumps, injection points, venting method, flow lines, pressure measurement, volume measurement, grouting sequence, schedule and stage volumes. Tests and certifications shall have been performed within last twelve months (12 Mos) prior to date of submittal.
- C. Submit grout mix design report, including:
 1. Grout type and designation.
 2. Grout mix constituents and proportions, including materials by weight and volume.
 3. Grout densities and viscosities, including wet density at point of placement.
 4. Initial set time of grout.
 5. Bleeding, shrinkage/expansion.
 6. Compressive strength.
- D. For cellular grout, also submit the following:
 1. Foam concentrate supplier's certification of dilution ratio for foam concentrate.
 2. A description of proposed cellular grout production procedures.
- E. Maintain and submit logs of grouting operations indicating pressure, density and volume for each grout placement.

PART II: PRODUCTS

2.1 MATERIALS

- A. Grouting materials: Conform to Section 03300 – Structural Concrete, except as modified in the following paragraphs.
- B. Grout Type Applications.
 1. Grout for pressure grouting, backfill grouting and annular grouting: Sand-cement mortar mix.
 2. Grout for annular grouting of sanitary sewer: Low density (cellular) grout, unless otherwise approved by the Project Manager.
 3. Grout for filling space in manholes: Sand-cement mortar mix.
 4. Ground stabilization: Sand-cement mortar mix.

- C. Do not include toxic or poisonous substances in grout mix or otherwise inject such substances underground.

2.2 GROUT

- A. Develop one (1) or more mixes based on following criteria as applicable:
 - 1. Size of annular void between sewer pipe and casing or size of void between casing and surrounding soil.
 - 2. Absence or presence of groundwater.
 - 3. Adequate retardation.
 - 4. Non-shrink characteristics.
 - 5. Pumping distances.
- B. Prepare mixes that satisfy required application. Provide materials conforming to the following standards:
 - 1. Cement: ASTM C150.
 - 2. Water: Potable.
 - 3. Foam: ASTM C869.
 - 4. Slurry: ASTM C138.
 - 5. Cellular Grout: ASTM C138.
 - 6. Sand for sand-cement mortar mix: ASTM C144.
- C. Provide grout meeting the following minimum requirements:
 - 1. Minimum twenty-eight day (28 D) unconfined compressive strength: one thousand five hundred pounds per square inch (1500 psi) for water lines, one thousand pounds per square inch (1000 psi) for other carrier pipes for mortar grout and three hundred pounds per square inch (300 psi) for cellular grout.
 - 2. Determine strength by ASTM C942.
 - 3. Maximum allowable density: Less than one hundred thirty pounds per cubic foot (130 pcf).
- D. Fluidifier: Provide fluidifier, meeting ASTM C937 that holds solid constituents of grout in colloidal suspension and is compatible with cement and water used in grouting operations.
- E. Admixtures.
 - 1. Use admixtures meeting ASTM C494 and ASTM C1017 as required, to improve pump ability, control time of set, hold sand in suspension and reduce segregation and bleeding.
 - 2. For cellular grout, do not use foam or admixtures that promote steel corrosion.
 - 3. Ensure that admixtures used in mix are compatible. Provide written confirmation from admixture manufacturers of their compatibility.

PART III: EXECUTION

3.1 PREPARATION

- A. Notify the Project Manager at least twenty-four hours (24 Hrs) in advance of grouting operations.

- B. Select and operate grouting equipment to avoid damage to new or existing underground utilities and structures.
- C. In selection of grouting placement consider pipe flotation, length of pipe, length of tunnel, depth from surface and type of sewer pipe, type of pipe blocking and bulkheading, grout volume and length of pipe to be grouted between bulkheads.
- D. Operate dewatering systems until grouting operations are complete and grout has reached initial set.

3.2 EQUIPMENT

- A. Batch and mix grout in equipment of sufficient size and capacity to provide necessary quality and quantity of grout for each placement stage.
- B. Use equipment for grouting of type and size generally used for the Work, capable of mixing grout to homogeneous consistency and providing means of accurately measuring grout component quantities and accurately measuring pumping pressures. Use pressure grout equipment which delivers grout to injection point at steady pressure.

3.3 ANNULAR GROUTING FOR SEWER/WATER LINE IN CASED OR UNCASED AUGERS

- A. Fill annular space between sewer pipe and casing or ground, with grout.
- B. 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 continue at grout port longer than that period of time for mix to take initial set. Locate grout hole spacing and locations according to number of stages necessary to grout tunnel liners. Stage or lift cannot be installed on another lift until proper set has been attained and placement procedures approved by admixture or additive manufacturer.
 - 2. Limit pressure on annular space to prevent damage or distortion to pipe. Define limiting and estimated required pressure range. Provide an open ended, high point tap or equivalent vent and monitor it at bulkhead opposite to point of grouting.
 - 3. Pump grout until material discharging is similar in consistency to that at point of injection.
- C. Remove temporary bulkheads installed for grouting.
- D. Batch and mix cellular grout mechanically to ensure consistency of mix. Wet solids thoroughly before introduction of foaming agent. Operate batching system to maintain slurry weight within three percent (3%) of design density. Introduce foam into slurry in accordance with manufacturer's recommendations.

3.4 PRESSURE GROUTING FOR JACKED PIPE

- A. For jacked pipe sixty inches (60 In) in diameter or greater, pressure grout annulus after installation, displacing bentonite lubrication. Jacked pipes

less than sixty inch (60 In) diameter may be left ungrouted unless excavated diameter exceeds external pipe diameter by more than one inch (1 In).

- B. Inject grout through grout holes in sewer pipe. Drilling holes from surface or through carrier pipe walls is not allowed. Perform grouting by injecting it at pipe invert with bentonite displacement occurring through high point tap or vent.
- C. Control ground water as necessary to permit completion of grouting without separation of grout materials.
- D. Limit pressures to prevent damage or distortion to pipe or to keep flexible pipe within acceptable tolerances.
- E. Pump grout until material discharging is similar in consistency to that at point of injection.

3.5 GROUND STABILIZATION GROUTING

- A. Completely fill voids outside limits of excavation caused by caving or collapse of ground. Fill with gravity or pressure injected sand-cement grout as necessary to fill void.
- B. Take care in grouting operations to prevent damage to adjacent utilities or public or private property. Grout at pressure that shall not distort or imperil portion of the Work or existing installations or structures.
- C. Verify that void has been filled by volumetric comparisons and visual inspection. In case of settlement under existing slabs, take cores as directed by the Project Manager, at no additional cost to the City, to demonstrate that void has been filled.

3.6 FIELD QUALITY CONTROL

- A. Annular Grouting for Sewer Line in Cased or Uncased Augers.
 - 1. Make one (1) set of four (4) compressive test specimens for every two hundred feet (200 Ft) of sewer pipe installed in primary lined tunnel.
 - 2. For cased or uncased augers, make one (1) set of four (4) compressive test specimens for each grouting operation or for each one hundred feet (100 Ft) of pipe installed, whichever is more frequent.
 - 3. For cellular grout, check slurry density both at point of batching and placement at least twice each hour in accordance with ASTM C138. Record density, time and temperature. Density must be within three percent (3%) of design density at point of batching and five percent (5%) of design density at point of placement.
- B. Pressure Grouting for Jacked Pipe. Make one (1) set of four (4) compressive test specimens for every four hundred feet (400 Ft) of jacked pipe pressure grouting.
- C. Ground Stabilization Grouting. Make one (1) set of four (4) compressive test specimens for every location where ground stabilization grouting is performed.

- D. All testing to be done in conformance with Section 01470 – Testing Laboratory Services and Section 01475 – Quality Control Testing Procedures.

END OF SECTION