

# Special Specification 4179

## Compaction Grouting



### 1. DESCRIPTION

Furnish all supervision, labor, materials, transportation and plant; all grouting materials and other supplies; all operations and equipment to supply, transport, store, mix and pump grout materials for the purpose of achieving the grouting as presented in the plans and specifications or as amended by the Engineer during construction. Monitor the work to ensure that damage does not occur to any existing structure due to contractor processes. Keep complete grouting records that include records of volumes, pressures, time and refusal condition for each grout injection for review by the Engineer each working day.

### 2. MATERIALS

Determine the source, kind and quality of the water, cement, soil and chemical admixtures of the materials listed in this section. Submit this information to the Engineer for approval in advance of the scheduled construction start date.

Submit mix design and test results of grout mixture to the Engineer for approval two weeks before the commencement of the work. Submit, for approval by the Engineer, grout proportioning and strength data from prior experience.

- 2.1. **Cement.** Furnish cement conforming to DMS-4600, "Hydraulic Cement." Store cement in weather-tight enclosures or procure in weather-tight bags to protect against dampness and contamination. Do not use material that has been subjected to hydration.
- 2.2. **Supplementary Cementing Materials (SCM).**
- 2.2.1. **Fly Ash.** Furnish fly ash conforming to DMS-4600, "Fly Ash."
- 2.3. **Chemical Admixtures.** Furnish admixtures conforming to DMS-4640, "Chemical Admixtures for Concrete." Do not use Calcium Chloride. Do not use bentonite or other clay of medium to high plasticity. Add fly ash as approved by the Engineer.
- 2.4. **Soil.** Furnish natural soil that meets the following gradation requirements:
- Table 1**  
**Soil Gradation Requirements**
- | Sieve Size | Percent Passing by Weight |
|------------|---------------------------|
| 3/8"       | 100                       |
| No. 200    | 10-30                     |
- Soil fines must have a liquid limit of 25 or less and a plasticity index of 10 or less when tested according to AASHTO T89 and T90, respectively. Natural fines may be supplemented by fly ash to achieve the specified percent passing the No. 200 sieve. Fly ash must conform to the requirements of Section 2.B. except that the pozzolanic activity index is 75 as given in Table 2 of ASTM C618.
- Exact proportions of cement, water and soil are determined by site conditions. The grout mix generally consists of sandy soil with up to 12% cement by weight, and water to form a very stiff mortar-like mixture. Use no admixtures without the approval of the Engineer and previous testing
- 2.5. **Water.** Furnish water that conforms to Section 421.2.5 "Water."

- 2.6. **Equipment.**
- 2.6.1. **Compaction Grout Mixer.** Furnish a pugmill type grouting mixer to ensure complete mixing of the stiff grout, or a mixer approved by the Engineer. The compaction grout mixer must be of sufficient capacity to continuously deliver grout having a slump of less than 2 in. at pressures up to 1,000 psi, at flow rates ranging from 0.1 to 5.0 cu. ft. per minute.
- 2.6.2. **Riser.** Furnish a riser elbow having a minimum 1 ft. radius curve to minimize the potential for grout blockage.
- 2.6.3. **Gauges.** Provide gauges at the pump and the grout pipe head to measure pressure and rate of flow. The type and location of gauges must be approved by the Engineer. Provide a dial gauge or meter capable of measuring to 0.5 cu. ft. or less to measure the amount of grout pumped into the hole. Provide a pressure gauge graduated in 10-psi increments or less to measure the applied pressure. All gauges must be certified accurate to within 2%. Submit certification to the Engineer for review before any construction activities. Suitably protect gauges and flow meters to prevent grout clogging or damage from handling, vibration or shock.
- 2.6.4. **Grout Hose.** Furnish a compaction grout hose having a minimum inside diameter of 2 in. with non-restrictive full flow couplings and having sufficient strength for the pressures anticipated and being in good repair.
- 2.6.5. **Drilling Equipment.** Furnish drilling equipment capable of drilling through the reinforced approach slab, asphalt pavement and subsurface materials. The drilling equipment must be capable of installing the casing to be used. Provide flush joint steel casing with a minimum inside diameter of 2 in. The steel casing must have adequate strength to maintain the hole and to withstand the required jacking and pumping pressures.

---

### 3. DESCRIPTION

**Contractor.** The Contractor who does this compaction grouting work must have at least three years of experience in soil-cement grouting involving pressures above 200 psi. Submit the name of the firm that will do the compaction grouting at the preconstruction conference. Perform no work until the firm is approved by the Engineer.

Submit the items listed below with regards to qualification of the Contractor or intended subcontractor to perform the grouting program subject to approval by the Engineer:

- provide a list of major components to be used, such as pumps, hoses, pipes, fittings and drilling equipment, manufacturers' data on size, type, pressure rating, capacity, and other critical characteristics for each item before the commencement of work;
- provide a work schedule outlining mobilization, drilling (sequence and location), grouting, and demobilization;
- provide a description of the program for monitoring the work, including means of pressure measurement and movement detection;
- provide a listing of personnel to perform the work that includes the experience and qualification of key personnel;
- provide a list of similar work performed in the previous five years, using similar equipment and personnel. Include dates and project locations;
- submit copies of drilling and grouting report forms for approval by the Engineer; and
- submit certifications of grout gauges.

- 3.1. **Grout Pipe Installation.** Drill and grout primary holes prior to secondary holes.

Use a drilling method that is capable of simultaneously drilling the hole and advancing the casing to prevent collapsing the hole. Install the casing in such a way that there is intimate contact with the drilled hole wall to

prevent grout leakage and premature upward movement of the casing during injection of high pressure compaction grout. Furnish and use external packing or other means of assuring grout delivery to the bottom of the hole as approved by the Engineer.

Employ only air or air-injected foam to install grout pipes. No other drilling fluids may be used unless approved by the Engineer. Install all grout pipes to within 5° of vertical, or as directed by the Engineer.

- 3.2. **Grout Injection Procedures.** Continuously monitor grouting pressure and flow rate at the grout pipe head and at the pump by pressure gauges and flow meters.

Begin compaction grouting with the primary holes. Begin the secondary hole compaction grouting after the completion of the primary holes. Inject compaction grout in increments of 2 ft. under continuous pressure by the bottom-up method.

Controlled compaction grout pumping rates of 0.1 to 5.0 cu. ft. per minute are required. The acceptable rate of injection does not exceed 2.0 cu. ft. per minute.

- 3.3. **Criteria for Raising Grout Pipe.** Cut off criteria per grouting stage is as follows:

- the grout pressure at the gauge located at the grout pipe head exceeds 100 psi;
- more than 7 cu. ft. of grout is injected per 2 ft. interval; and
- retaining wall or abutment wall movement occurs, as determined by the Engineer.

Tertiary holes are ordered by the Engineer in the field if they are necessary. The drilling and grout quantities of tertiary holes must be no more than 20% of the primary holes. Replace any holes lost due to failure of grouting or drilling equipment at the sole expense of the Contractor.

- 3.4. **Testing and Quality Control.**

- 3.4.1. **Drilling Reports.** Prepare and provide drilling reports which contain at least the following information:

- name of driller;
- type of drill and method being used;
- date started;
- date completed;
- type of flushing;
- location of hole;
- depth of hole; and
- type and depth of material encountered.

- 3.4.2. **Grouting Reports.** Prepare grouting reports which contain at least the following information:

- name of grouting technician;
- constituents and proportions of grout;
- log of quantity injected per 5 ft. of hole;
- date;
- rate of pumping;
- grouting pressure at the hole;
- type of pump;
- grouting pressure at the pump;
- and depth of hole.

Make drilling reports and grouting reports available to the Engineer at the end of each working day.

---

**4. MEASUREMENT**

- 4.1. **Drilled Holes.** Drilled holes are measured by the foot to the bottom of the hole acceptably drilled and cased.
- 4.2. **Compaction Grouting.** Compaction grouting is measured by the cubic feet of grout used in acceptably completed locations.

---

**5. PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Drilled Holes" or "Compaction Grouting." The price bid for "Drilled Holes" is full compensation for drilling holes, furnishing and installing casing, disposal of the drill cuttings, equipment, labor, tools, and incidentals. The price bid for "Compaction Grouting" is full compensation for furnishing materials, hauling, mixing, pumping and installing compaction grouting, equipment, labor, tools, and incidentals.

Depending on the results of the planned grouting operation, it may be necessary to add grout holes to achieve adequate density of subsurface material. Any additional drilling and grouting work directed by the Engineer is paid for at the contract unit prices.