

# Section 450—Pressure Grouting Portland Cement Concrete Pavement

## 450.1 General Description

This work includes pumping a slurry type grout mixture through holes drilled in the pavement into voids underneath the slabs to stabilize and underseal Portland cement concrete pavement.

Use a grout mixture that can form a hard and durable mass to fill voids under the pavement. Regrout unstable slabs after initial undersealing and stabilizing as directed by the Engineer.

### 450.1.01 Definitions

**Initial set:** 200 psi (1380 kPa) with a 0.25 in<sup>2</sup> (161 mm<sup>2</sup>) probe according to AASHTO T 197 (Proctor Needle Test).

### 450.1.02 Related References

#### A. Standard Specifications

[Section 452—Full Depth Slab Replacement](#)

[Section 609—Removal of Portland Cement Concrete Roadway Slabs](#)

[Section 801—Fine Aggregate](#)

[Section 830—Portland Cement](#)

[Section 831—Admixtures](#)

[Section 880—Water](#)

[Section 882—Lime](#)

[Section 883—Mineral Filler](#)

[Section 884—Chlorides](#)

#### B. Referenced Documents

[GDT 84](#)

AASHTO T 197 (Proctor Needle Test)

### 450.1.03 Submittals

General Provisions 101 through 150.

## 450.2 Materials

### A. Fine Aggregate

Ensure that fine aggregate meets the requirements of [Subsection 801.2.02](#), except mortar-making properties are not required.

### B. Grout Mixtures

The Bid Item designates the required undersealing grout mixture types. The mixture contains the proportions listed in the Table of Grout Mixtures, below.

Use enough mixing water with the dry ingredients to produce a grout consistency that makes the efflux time from the flow cone at least 14 seconds and no more than 20 seconds. Use [GDT 84](#) to determine the grout consistency.

Add cement, cement and limestone dust, cement and fly ash, or cement and fine aggregate in the proper proportions to a mixed batch to produce the required consistency.

Table of Grout Mixtures					
Mix Proportions, Percent by Weight of Dry Materials					
Grout Types Dry materials	1	2	3	4	5
Cement (min.)	25	25	25	25	25
Limestone dust	—	25	75	50	—

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Fly ash	25	—	—	25	75
Fine aggregate	50	50	—	—	—

Ensure that materials meet the requirements of these Specifications:

Material	Section
Portland Cement Types I or III	<a href="#">Section 830</a>
Mineral Filler (Limestone Dust)	<a href="#">Section 883</a>
Calcium Chloride, Type I	<a href="#">Section 884**</a>
Fly Ash, Type F	<a href="#">Section 831</a>
Water	<a href="#">Section 880</a>
Fine Aggregate Size No. 20	<a href="#">Subsection 801.2.02</a>
Agricultural Lime	<a href="#">Subsection 882.2.02*</a>
*Agricultural lime used for undersealing shall have at least 95% passing the No. 30 (600 µm) sieve and 30% passing the No. 200 (75 µm) sieve.	
**The Laboratory may approve other commercially available accelerators that may be substituted for calcium chloride.	

### 450.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

## 450.3 Construction Requirements

### 450.3.01 Personnel

Provide personnel to control the lifting on every slab that is undersealed.

Furnish a truck driver and sufficient workers to assist operating static load measuring gauges on the slab stabilization testing equipment.

### 450.3.02 Equipment

#### A. Batching Equipment

The batching equipment includes weight hoppers and scales for each dry material or calibrated volumetric batch hoppers.

Calibrate volumetric batch hoppers in increments equivalent to one 94 lb (42.6 kg) bag of cement. Use aggregate scales accurate to ± 1 percent and cement scales accurate to plus or minus 0.5 percent.

Equip conveyor belts with windproof covers if the belts convey the dry materials into the mixer.

#### B. Mixing Equipment

For mix types one through four, use a watertight, batch-type mixer or high-speed colloidal mixer capable of blending the materials into a homogenous mixture. Use a high-speed colloidal mixer for mix type five.

#### C. Grout Pumping Equipment

Use grout pumping equipment with a positive displacement plunger or piston-type pump or a screw-type worm pump.

- Ensure that the discharge line is equipped with the following:
  - Pressure gauge at the pump capable of measuring from 0 to 200 psi (0 to 1380 kPa)
  - Positive cut-off valve at the nozzle end
  - Bypass return line for recirculating the grout back into a holding tank or mixer
- Equip the end of the discharge line with a nozzle or device that remains secure in the drilled holes and is free of leaks.
- Furnish a blow pipe with enough air pressure to dislodge loose debris.
- Provide an auger of the proper size and length to open clogged holes.

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### D. Drilling Equipment

Provide the following drilling equipment:

- Air compressors—Provide air compressors with enough capacity to operate pneumatic hammers or drills.
- Pneumatic or hydraulic drills—Provide pneumatic or hydraulic drills equipped with bits that will cut 1.5 in (38 mm) or other approved diameter holes through the concrete pavement.

Operate the equipment so as to prevent damage to the pavement being drilled. Do not create excessive down pressure to force the bit through the concrete rapidly. The Engineer must approve the drilling procedure.

### E. Slab Stabilization Testing Equipment

Furnish a two axle truck with dual rear wheels. Load the rear axle to 18 kips (8000 kg) evenly distributed between the two sides.

### F. Slab Lift Measuring Equipment

Ensure that equipment used to measure the slab lift can simultaneously detect movement of the two outside slab corners adjacent to a joint and the adjoining shoulder. Ensure that the equipment can make these measurements to 0.001 in (0.025 mm).

### 450.3.03 Preparation

General Provisions 101 through 150.

### 450.3.04 Fabrication

General Provisions 101 through 150.

### 450.3.05 Construction

#### A. Observing Weather Limitations

Begin pressure grouting operations when the air temperature in the shade and away from artificial heat is at least 35 °F (2 °C) and rising. Stop pressure grouting if the temperature is 40 °F (4 °C) and falling or when the subgrade contains an abnormal amount of moisture.

#### B. Testing

Slab testing is performed to detect all slabs having a deflection greater than 0.030 in (0.76 mm).

Perform testing between 3:00 AM and 9:00 AM, unless otherwise directed by the Engineer. In hot weather, test between 3:00 AM and 7:00 AM if directed by the Engineer. Stop testing if slabs are beginning to “lock-up.”

##### 1. Preliminary Testing by the Department

Preliminary testing is not required on slabs that require grouting but have been previously tested and marked by the Department.

##### 2. Preliminary Testing by the Contractor

If the Department has not performed preliminary testing, use static methods to test each transverse joint and crack on the Project or within designated Project areas.

Do not test, however, transverse cracks in slabs that are to be replaced entirely. Test the joints and cracks as follows:

- a. Furnish four gauges on two gauge mounts (two gauges per mount) that can detect slab movement under the load to the nearest 0.001 in (0.025 mm).
- b. Maintain the gauges and mounts in operating order. Furnish the loaded truck, truck operator, and personnel to place and assist in operating the gauges.
- c. Position one set of gauges with one gauge referenced to the corner of each slab on both sides of the joint near the pavement edge. Zero in the gauges with no load on the slab on either side of the joint.
- d. Move the test truck into position and stop it with the center of the test axle about 1 ft (300 mm) behind the joint and the outside test wheel approximately 1 ft (300 mm) from the pavement edge.
- e. Read the back gauge and move the test truck across the joint to about 1 ft (300 mm) forward of the joint. Read the forward gauge.
- f. Repeat this operation for each joint to be tested. The Inspector will read and record the gauges.

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- g. When required, perform additional tests on slabs that move more than 0.030 in (0.76 mm) or as shown on the Plans. Perform additional tests as follows:
  - 1) Drill one hole in the corner of the slab where the movement was measured.
  - 2) Drill the holes the same diameter as the undersealing holes and place the holes 18 in (450 mm) from the transverse and shoulder joint.
  - 3) Fill the test holes with water and observe.
  - 4) If the Engineer believes the pavement system readily drains the water poured into the test hole, pressure grout the slab. Based on the results of testing, deflection measurements, and water drainage observations, the Engineer will determine which slabs require undersealing.
- h. After the designated slabs have been pressure grouted according to these Specifications, retest them according to [Subsection 450.3.05.B.2, “Testing.”](#)
- i. Regrout and retest slabs that deflect more than 0.030 in (0.76 mm) or deflect the amount shown on the Plans, as directed.

Slabs will be accepted that continue to show movement greater than specified after two properly performed groutings.

### C. Drilling Holes

The Plans show the location of holes to be drilled in each type of slab for undersealing. However, whenever possible, use the holes from previous undersealing work by redrilling.

To begin drilling:

- 1. Use the hole pattern and pumping sequence shown on the Plans with modifications to use as many holes from previous undersealing work as possible.

The Engineer may alter the hole pattern. Only the actual number of holes drilled will be considered for payment for the initial undersealing.
- 2. Drill the holes 1.5 in (38 mm) diameter or another size if approved by the Engineer. Ensure that the holes provide positive seal for the pumping nozzle.
- 3. For the first undersealing, drill the holes to approximately 8 in (200 mm) deep beneath the bottom of the concrete unless the Engineer approves an alternate depth.

The Engineer shall designate the number, depth, and location of holes for undersealing attempts after the initial attempt.
- 4. Be careful during operations to not break or crack the slabs.
- 5. Repair slabs that have cracks that extend through the drill hole at the Contractor’s expense. Make repairs according to [Section 609](#) and [Section 452](#).

### D. Cleaning Holes

After drilling the holes, and immediately before pumping the underseal grout, insert a pipe with enough air pressure in each hole to remove debris and to provide a passage for the grout, if necessary.

### E. Pumping Underseal Grout

Properly position the lift measuring device before pumping grout under a slab.

Fill the voids under a slab as follows:

- 1. Pump grout in holes designated by the Engineer.
- 2. Have the Engineer determine the time of day to perform pressure grouting. The Engineer may require pressure grouting during late night and early morning hours if the slabs cannot be stabilized with daytime grouting.
- 3. During pumping, watch the lift measuring device to prevent excessive pumping pressures, rapid lifting of slabs, or substantial rising of the adjacent shoulders.
- 4. Stop pumping in the hole when the cavities or voids are filled within the range of the hole being grouted. Grout flowing out of an adjacent hole or joint or the edge of the slab is sufficient evidence that the voids and cavities are filled and pumping should cease. Additional evidence is that the slab rises rapidly or the adjacent shoulder begins to rise.
  - a. Lift the slab slightly to move grout into the existing cavities and voids.

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- b. Do not lift more than 0.050 in (1.3 mm) for a slab measured at the outside joint corner unless approved by the Engineer.

**NOTE: Do not crack the slabs by differential lifting.**

5. Secure the discharge hose nozzle in the hole to provide a seal that will maintain the grout pressure underneath the slab.  
Ensure that the nozzle end does not extend below the bottom of the concrete.
6. Continue pumping in a hole until a clear flow of grout comes out other holes, joints, or cracks, or until the slab begins to lift excessively.
7. Repeat this procedure in other holes until the voids are filled. Do not plug the holes during grouting operations.
8. When edge drains are near the shoulder or pavement interface, take precautions to minimize the amount of grout that flows into the edge drain system.  
Use the following procedure or an alternate approved by the Engineer to monitor grout flow into the edge drain system:
  - a. Drill one or more “observation holes” in the asphaltic concrete shoulder as close as possible to the shoulder or pavement interface.
  - b. Time the grouting operation to prevent and stop excess grouting in a hole to ensure that grout does not flow into the edge drain system.
  - c. When grouting operations are complete, fill the “observation holes” with asphaltic concrete.
9. Prevent slabs from cracking during the undersealing operation. Remove and replace slabs cracked during this operation at the Contractor’s expense according to [Section 609](#) and [Section 452](#).

### F. Cleaning Up

Before permitting traffic on the section, remove grout deposits on the pavement or shoulders and clean the surface. Remove debris, bags, spillage, etc., from the Right-of-Way each day.

### G. Permanently Sealing Holes

Remove the grout from the holes and fill the holes with a stiff sand-cement mixture or an approved quick setting patching material.

Repair filled holes that ravel out or become damaged. Also, repair unsatisfactorily filled holes from previous undersealing work at the Contractor’s expense, as directed by the Engineer.

### H. Testing for Slab Stability

After pumping the grout under the designated slab and permitting traffic over the slabs for at least 12 hours, test the slabs for stability.

Conduct these tests by static loading as in [Subsection 450.3.05.B.2.h](#) and [Subsection 450.3.05.B.2.i](#). Based on the test results and criteria on the Plans, the slabs will be accepted or designated for further undersealing as directed by the Engineer.

### I. Opening to Traffic

Do not permit traffic on the grouted slabs until the grout has taken an initial set (normally 4 to 6 hours).

Schedule the operations so that the grout has initially set and the work area is cleared before traffic is allowed on the grouted slabs.

### 450.3.06 Quality Acceptance

General Provisions 101 through 150.

### 450.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

## 450.4 Measurement

Portland cement incorporated into the pressure grout slurry is measured by the 94 lb (42.6 kg) bag.

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### A. Holes

On an initial undersealing attempt, holes drilled through the existing concrete slabs at the locations and to the depths shown on the Plans or directed by the Engineer are measured per each.

If holes drilled for the first stabilizing attempt are used for the second stabilizing attempt, holes are not paid for again by the Department. If new holes are drilled they are measured per each.

### B. Preliminary Testing

Preliminary testing described in [Subsection 450.3.05.B.2.h](#) and [Subsection 450.3.05.B.2.i](#) is measured by the linear mile (linear kilometer), horizontal measure for each lane of each roadway tested, when required. Bridges are not included in the measurement.

### C. Stability Testing

Stability testing in [Subsection 450.3.05.H](#) is measured by the joint.

#### 450.4.01 Limits

General Provisions 101 through 150.

## 450.5 Payment

### A. Holes

Holes will be paid for at the Contract Unit Price per each. Payment is full compensation for drilling and sealing the hole.

If holes drilled for the first stabilizing attempt are used for the second stabilizing attempt, the Department does not pay for the holes again.

### B. Portland Cement Pressure Grout Slurry

Portland cement pressure grout slurry will be paid for at the Contract Unit Price bid per 94 lb (42.6 kg) bag of cement or fraction thereof. Payment is full compensation for furnishing materials to be incorporated into the grout slurry, hauling, mixing, pumping, and cleaning to stabilize the slabs.

### C. Preliminary Testing

Preliminary testing when shown on the Plans and in the Proposal as a payment Item will be paid for at the Contract Price bid per linear mile (kilometer), horizontal measure. Bridges will be excluded from the linear mile (kilometer) measurement.

### D. Stability Testing

Static testing of slabs performed according to [Subsection 450.3.05.B.2.h](#) and [Subsection 450.3.05.B.2.i](#) will be paid for each time the joint is tested. Payment is full compensation for furnishing the load test truck, driver, and personnel necessary to assist in the testing.

### E. Pumping Under Seal Grout

No separate payment will be made for this work. Include the cost in the bid submitted for Portland cement pressure grout slurry. The precautions used will require prior approval of the Engineer.

Payment will be made under:

Item No. 450	Holes	Per each
Item No. 450	Portland cement pressure grout slurry (grout type ____, ____, or ____)	Per bag 94 lb (42.6 kg)
Item No. 450	Preliminary testing	Per linear mile (kilometer )
Item No. 450	Stability testing	Per joint

#### 450.5.01 Adjustments

General Provisions 101 through 150.