



SECTION 625

UNDERSEALING PAVEMENT

SECTION 625.10 UNDERSEALING WITH CEMENTITIOUS GROUT

625.10.1 Description. This work shall consist of stabilizing Portland cement concrete pavement by furnishing, hauling and pumping a cementitious grout mixture under the concrete slab. This work shall be completed after any required pavement repair and prior to the placement of any new overlay material.

625.10.2 Material.

625.10.2.1 The material used in grouting shall consist of a mixture of Portland cement, fly ash and water proportioned as specified or as approved by the engineer. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Fly Ash	1018
Cement, Type I, II or III	1019
Water	1070

625.10.2.2 Cement and fly ash shall be kept dry and free from lumps.

625.10.3 Composition of Mixture Grout for filling voids beneath the pavement shall be composed of cement, fly ash, water and, if necessary, admixtures.

625.10.3.1 Grout shall meet the following minimum requirements:

(a) Flow cone efflux time shall be 10 to 16 seconds, as determined in accordance with ASTM C 939.

(b) The grout shall have a minimum design strength at minimum efflux time of 600 psi (4.1 MPa) at seven days, determined in accordance with ASTM C 942, with the exception that storage of compressive specimens after 24 hours shall be placed in a 100 percent humidity cabinet.

625.10.3.2 Preparation of grout for mix design purposes shall be performed in accordance with ASTM C 938 with the following exceptions:

(a) Mixing shall be performed with a commercial type blender operating at approximately 15,000 rpms.

(b) Molding of specimens shall be delayed by the amount of time stated in the contractor's mix design submittal.

625.10.3.3 At least three weeks prior to the beginning of this work, the contractor shall submit the proposed mixture to the engineer. The submittal shall include the mix design, source and type of all material test results of the grout showing one-day, three-day and seven-day compressive strengths, efflux time, time of initial and final set by the Gilmore needle in

accordance with ASTM C 266 and time delayed to molding specimens after mixing grout. The time delay between mixing and molding will be the maximum holding time permitted in the field. Sufficient quantities of all mixture components to permit laboratory verification of the grout properties listed herein shall accompany the mix design submittal. Approximately 10 pounds (5 kg) of Portland cement and 30 pounds (14 kg) of fly ash shall be furnished.

625.10.4 Construction Requirements.

625.10.4.1 Weather Limitations. Grouting shall not be performed when the air temperature is below 40 F (5 C), when the subgrade is frozen or when, in the judgment of the engineer, satisfactory results cannot be obtained.

625.10.4.2 Measurement of Material. The cement and fly ash for underseal grout shall be measured by weight (mass) or volume. The quantity of cement and fly ash to be used shall be calculated from the approved mix design. Batches not containing the proper quantities of material shall be wasted at the contractor's expense. Personnel, scales and equipment necessary for calibrating the proportioning devices and for verifying the accuracy of proportions shall be furnished by the contractor and shall be available at all times. The equipment shall include standard 50-pound (20 kg) test weights equivalent to 20 percent of the net load capacity of the scales, rounded up to the next 50-pound (20 kg) increment. All equipment shall be calibrated by the contractor in the presence of the engineer, and subject to approval from the engineer. Verification of the accuracy of the scales and other dispensing methods may be required at any time deemed necessary by the engineer, but will be performed at least once each day of operation.

625.10.4.2.1 Any admixtures used shall be incorporated in accordance with the manufacturer's recommendations. Admixtures may be added by hand methods. Admixtures shall be measured within a tolerance of plus or minus three percent of the required quantity.

625.10.4.2.2 Weight proportioning (mass determination) and volume proportioning equipment, accuracy, calibration and verification shall be in accordance with [Sec 501](#).

625.10.4.3 Grout Mixer. The grout plant shall produce a homogeneous mixture. Mixed material shall not be held for more than the period designated in the contractor's mix design submittal. Grout may be re-tempered with water. Prior to re-tempering the grout, the engineer shall be notified. Water used to wash the drum of the mixer may be used as mixing water if dry clumps of material do not fall into the bottom of the mixer drum when washed.

625.10.4.4 Deflection Testing. When required, deflection testing shall be performed in accordance with MoDOT Test Method TM 64.

625.10.4.4.1 No testing shall be performed if the slabs are beginning to lock-up. Tests shall not be performed during spring thaw conditions or when the subgrade is frozen.

625.10.4.4.2 The contractor shall furnish and maintain gauges with mounts capable of detecting vertical slab movement of 0.001 inch (0.025 mm) simultaneously on each side of the joint or crack and the pavement and shoulder or adjacent lane. The contractor shall furnish and maintain a vehicle having a dual-tire single axle with an 18,000-pound (8 Mg) single axle load. The contractor shall furnish a truck operator and necessary personnel to conduct the deflection testing.

625.10.4.5 Grouting Operations The hole pattern shall be as shown on the plans or as directed by the engineer. In no case shall there be less than two holes at any location. Drilled holes shall be a maximum of 1 1/2 inches (38 mm) in diameter, drilled vertically and round.

Holes drilled with a break out in excess of 1 1/2 inches (38 mm) outside the hole diameter will constitute a non-acceptable hole and will not be counted for payment.

625.10.4.5.1 A flow cone test shall be performed when directed by the engineer. The grout efflux time shall be between 10 and 16 seconds. The grout efflux time shall be measured by performing flow cone tests in accordance with ASTM C 939. At seven days, the grout material shall have a minimum compressive strength of 600 psi (4.1 MPa). Grout material failing to meet specifications will be rejected.

625.10.4.5.2 The contractor shall furnish equipment and personnel necessary to measure pavement lift during grouting. The equipment shall be capable of detecting and measuring the lift of the pavement edge relative to the adjoining shoulder or the adjacent slab to the nearest 0.001 inch (0.025 mm). The equipment shall measure lift relative to the reference points and shall be approved by the engineer prior to use. The lift gauge readings shall be recorded. Pavement raised in excess of 0.20 inch (5 mm) and cracked shall be replaced at the contractor's expense to such limits as directed by the engineer.

625.10.4.5.3 A positive action pump capable of forcing grout through a drilled hole into voids and cavities beneath the pavement slab or treated base shall be provided. The injection pump shall have pressure capability of 50 to 250 psi (345 to 1725 kPa) when pumping a grout slurry mixed to a 12-second flow cone time. The injection pump shall be capable of continuous pumping at rates as low as 1 1/2 gallons (6 L) per minute. This requirement may be waived if the system has a recirculating hose and by-pass valve at the discharge end of the system.

625.10.4.5.4 The grout shall be injected under the pavement progressively through the previously drilled holes by means of a pressure distributor. The distributor unit shall be equipped with the necessary hoses, fittings and valves, including a satisfactory nozzle for injecting the grout under the pavement without undue leakage at the point of injection.

625.10.4.5.5 Grouting shall begin at a low pumping rate and pressure. A short surge up to 200 psi (1380 kPa) will be permitted at the start, but the pressure shall quickly drop below 100 psi (690 kPa) to a range of 30 to 50 psi (205 to 345 kPa). Pumping shall be stopped at a location if any of the following occurs:

- (a) The initial pressure does not drop.
- (b) The pumping pressure increases.
- (c) Grout appears at any adjacent hole or longitudinal or transverse joint or crack.
- (d) The pavement is raised 0.125 inches (3 mm) or more.
- (e) When a negative reading occurs.

625.10.4.5.6 All drill tailings, spilled grout and other debris shall be cleaned up at the end of each working day or before the lane is opened to traffic. When adjacent lanes are open to traffic, provisions shall be made to prevent grout from encroaching onto the open lane or squirting onto passing vehicles. Grout shall not enter into gutters or closed drainage systems. Suitable means to restrict the infiltration of the residue into a closed drainage system shall be provided.

625.10.4.5.6.1 The contractor may disperse residue onto unpaved shoulders, adjacent roadside embankments or median ditch areas of divided highways where the residue runoff can percolate into the soil, unless specified otherwise in the contract. The spread rate shall not

generate surface runoff. If surface runoff occurs at a grinding location, the contractor shall remove the residue to an approved location at the contractor's expense.

625.10. 4.5.6.2 Residue shall not be spread within 100 feet (30 m) of any streams, lakes or other open bodies of water or within 15 feet (5 m) of a water filled ditch.

625.10. 4.5.6.3 Discharge of any residue runoff shall not flow into adjacent rivers, streams, lakes, ponds or other open bodies of water.

625.10. 4.5.6.4 The contractor shall use appropriate equipment and methods such that the discharging of the residue does not cause erosion of soil or damage to established vegetation along the roadway. The contractor shall repair and reseed any areas where the discharge of grinding residue causes damage to roadway slopes or vegetated areas, at the contractor's expense.

625.10.4.5.6.5 If the solids concentration of discharged residue at any particular area is determined to be excessive by the engineer, the contractor shall, at the contractor's expense, provide equipment and material to flush the areas with water as directed by the engineer.

625.10.4.6 Placement of Permanent Plugs. If the pavement is not to be resurfaced, the drill holes shall be filled flush with the surface of the pavement using a fast setting mortar or concrete approved by the engineer. The mortar for filling the holes may be composed of one part cement and two parts fine aggregate, by volume, with only enough water to permit placing and packing of the mortar in the holes or the material may be an approved commercial pre-mixed rapid set mortar or concrete. The mortar material shall not be placed until grout material injected beneath the pavement achieves initial set. If the pavement is to be resurfaced, the drill holes may be plugged with mortar as described above or by using an approved square or cylindrical wood plug, 4 to 5 inches (100 to 125 mm) in length, pointed at the lower end, with the top drive flush with the existing pavement surface. Wood plugs may be placed prior to the point at which the injected grout material achieves initial set.

625.10.4.7 Handling Traffic. The contractor may use one lane of the pavement for the equipment necessary to perform the work. At least one-way traffic shall be maintained at all times.

625.10.4.8 Opening to Traffic. No construction traffic shall be permitted on the undersealed pavement until three hours after the end of pumping operations and after all drill holes have been plugged. Grout ejection caused by construction traffic will be cause for further delay in opening to traffic.

625.10.5 Method of Measurement.

625.10.5.1 All properly filled holes authorized by the engineer will be counted.

625.10.5.2 Portland cement will be measured to the nearest 1/10 ton (0.1 Mg).

625.10.5.3 Fly ash will be measured to the nearest 1/10 ton (0.1 Mg).

625.10.5.4 Measurement of testing for deflection will be per joint, crack or pavement repair patch per traffic lane in which testing is performed. Testing prior to undersealing and testing after undersealing will be measured separately.

625.10.6 Basis of Payment. The accepted quantities of drilled holes, Portland cement, fly ash and deflection tests will be paid for at the contract unit price for each of the pay items

included in the contract. No direct payment will be made for water or any admixtures used in the grout.

SECTION 625.20 UNDERSEALING WITH POLYURETHANE MATERIAL

625.20.1 Description. This work shall consist of raising, filling voids and undersealing Portland cement concrete or bituminous pavements by furnishing, hauling and injecting polyurethane material under the pavement at locations shown on the plans or as directed by the engineer.

625.20.2 Material.

625.20.2.1 The material for raising and undersealing pavements shall be a water blown, closed cell, high density polyurethane system with the following physical characteristics and properties:

Property	Requirement
Density, min., per ASTM D 1622	3.0 psi (48 kg/m ³)
Compressive Strength, min., per ASTM D 1621	40 psi (276 kPa)
Volume Change, max.	+5.0 percent
Curing Rate	90 percent of compressive strength within 15 minutes after injection

625.20.2.2 The material shall be hydrophobic in the material's component reaction such that the injected product is not significantly compromised by soil moisture or free water under the pavement.

625.20.2.3 The material shall have a warranty against shrinkage and deterioration for a period of ten years. During the warranty period, the manufacturer shall replace by injection any failed material at the manufacturer's expense.

625.20.2.4 Acceptance of the polyurethane material will be based on certification and results from tests required by the engineer.

625.20.2.4.1 The contractor shall provide to the engineer certification from the manufacturer stating that the material provided is in accordance with [Sec 625.20.2](#). The MSDS for all pertinent production material shall be included with the certification.

625.20.2.4.2 When requested by the engineer, pumping units in service shall perform a product density test by injecting a sample of the unit's polyurethane material into a test cylinder of known volume. The sample's density shall be in accordance with [Sec 625.20.2.1](#).

625.20.2.4.3 The contractor, in the presence of the engineer, shall inject the polyurethane material into a container holding 40 gallons (150 L) of ambient temperature water at 70 F (21 C). The resulting product shall demonstrate consistent, closed cell polyurethane material.

625.20.2.5 All stored polyurethane material shall be sealed and protected from contamination of dust or any foreign material.

625.20.3 Contractor Pre-Qualification Requirements.

625.20.3.1 The contractor shall have a minimum of three years of experience in performing this type of work and a minimum of 50 projects on which the contractor has successfully done this type of work. Prior to beginning work, the contractor shall submit certification to the

engineer that the contractor meets the minimum required experience. The certification shall include a listing of previous clients with contact names and phone numbers.

625.20.3.2 Prior to being approved for performing this type of work, the following documents shall be supplied by the contractor to the engineer and found to be acceptable:

(a) A report from an industrial hygienist who has conducted a personnel, production vehicle and typical jobsite safety review of the contractor's implementation procedures involving the polyurethane material.

(b) A copy of the contractor's Employee Safety Manual specific to polyurethane pavement raising and undersealing work.

625.20.4 Equipment Requirements. The contractor shall provide at minimum, the following equipment:

(a) A truck-mounted pumping unit capable of injecting the high density polyurethane material beneath the pavement. The pumping unit shall be equipped with a dial gauge in increments of 1/10 pound (45 g) and shall be capable of controlling the rate of flow of material as well as the rate of rise of the pavement.

(b) Pressure and temperature control devices capable of maintaining proper temperature and proportionate mixing of the polyurethane component materials.

(c) Pneumatic or electric drills capable of efficiently drilling 9/16 to 3/4-inch (14 – 19 mm) diameter injection holes through the pavement without damaging the structural integrity of the existing pavement.

(d) Laser levels or dial indicator devices capable of monitoring and verifying that the pavement is raised to an even plane and to the required elevation.

(e) All necessary electric generators, compressors, heaters, hoses, containers, valves and gauges to efficiently conduct and control the work.

625.20.5 Construction Requirements.

625.20.5.1 The contractor shall provide a pavement profile from laser level readings or string lines of each area where the pavement needs to be raised. Each profile shall be accepted by the engineer prior to performing the work at that profile location.

625.20.5.2 At locations where the pavement is to be raised or undersealed, a series of 9/16 to 3/4-inch (14 – 19 mm) diameter holes shall be drilled through the pavement and underlying base at the appropriate locations and depths as determined by the contractor. The pavement surrounding each hole shall not be damaged.

625.20.5.3 The polyurethane material shall be injected through the drilled holes until all known or encountered voids under the pavement are filled. The rate and amount of material injection shall be determined by the contractor.

625.20.5.4 The pumping unit shall be calibrated daily or as directed by the engineer. If calibration results show inconsistencies from calibration to calibration, the work shall be stopped until the cause for the inconsistencies are corrected to the satisfaction of the engineer.

625.20.5.5 Injection nozzles shall prevent leakage during injection and shall be removed at completion of the injection or driven into the injection hole to a minimum depth of

1 1/4 inches (31 mm) below the pavement surface. Any excessive material on the pavement surface shall be removed from the area and the holes shall be sealed with polyurethane material or a non-expansive cementitious grout approved by the engineer.

625.20.5.6 All drill tailings, spilled polyurethane or cementitious grout material and other debris shall be cleaned up at the end of each working day or before the lane is opened to traffic. When adjacent lanes are open to traffic, provisions shall be made to prevent material from encroaching onto the open lane or squirting onto passing vehicles. Polyurethane or cementitious grout material shall not enter into gutters or closed drainage systems. Suitable means to restrict the infiltration of the residue into a closed drainage system shall be provided. Polyurethane or cementitious grout material shall be removed from the pavement surface before any residue is blown by traffic action or wind. All removed material shall be disposed of in an environmentally acceptable manner in accordance with all federal, state and local regulations.

625.20.5.7 Corrections to the grade of adjacent slabs, if necessary, or as determined by the engineer, shall be made in accordance with [Sec 625.20](#). All raised pavement shall match the existing grade of adjacent slabs to provide positive drainage. Final elevations of raised pavement areas shall be within 1/4 inch (6 mm) of the required elevations as determined by the profile or the engineer.

625.20.5.8 The contractor will be responsible for any pavement blowouts, excessive pavement lifting or pavement damage that may occur as a result of the contractor's work. The contractor shall repair any subject areas to the satisfaction of the engineer at the contractor's expense.

625.20.5.9 The roadway may be open to traffic when the polyurethane material has reached 90 percent of the material's designed compressive strength.

625.20.5.10 The contractor shall transfer all warranties on the polyurethane material to the Commission upon acceptance of the work by the engineer.

625.20.6 Method of Measurement. Polyurethane material will be measured to the nearest pound (kg).

625.20.7 Basis of Payment. The accepted quantities of polyurethane material injected beneath the pavement will be paid for at the contract unit price.