

# **200 Items**

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**Subgrade Treatments and Base**

# Item 204

## Sprinkling




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### 1. DESCRIPTION

Apply water for dust control, earthwork, or base construction.

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### 2. MATERIALS

Furnish water free of industrial wastes and other objectionable matter.

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### 3. EQUIPMENT

Use sprinklers and spray bars equipped with positive and rapidly working cut-off valves.

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### 4. CONSTRUCTION

Apply water at a uniform rate and in the required quantity, or as directed.

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### 5. MEASUREMENT

This Item will be measured by the 1,000 gal. (TGL) of water as applied.

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### 6. PAYMENT

Unless sprinkling is specified as a pay item, the work performed and materials furnished in accordance with this Item will not be measured or paid for directly, but will be subsidiary to pertinent Items.

When sprinkling is specified on the plans as a pay item, the work performed and water furnished will be paid for at the unit price bid for "Sprinkling (Base)," "Sprinkling (Earthwork)," or "Sprinkling (Dust Control)." This price is full compensation for furnishing and applying water; furnishing and operating sprinklers and measuring devices; and hauling, equipment, labor, fuel, materials, tools, and incidentals.

# Item 210

## Rolling



### 1. DESCRIPTION

Compact embankment, subgrade, base, surface treatments, broken concrete pavement, or asphalt pavement using rollers. Break up asphalt mats, pit run material, or base materials.

### 2. EQUIPMENT

Use any type of roller to meet the production rates and quality requirements of the Contract unless otherwise shown on the plans or directed. Use equipment that meets the requirements of this Item when specific types of equipment are required. The Engineer may allow the use of rollers that operate in one direction only when turning does not affect the quality of work or encroach on traffic.

**Table 1**  
**Roller Requirements<sup>1</sup>**

Roller Type	Materials to be Compacted	Load (ton)	Contact Pressure	Roller Speed (mph)
Steel wheel	Embankment, subgrade, base, asphalt concrete	≥10	≥325 lb. per inch of wheel width	2-3
Tamping	Embankment, subgrade	-	125-550 psi per tamping foot	2-3
Heavy tamping	Embankment, subgrade	-	≥550 psi per tamping foot	2-3
Vibratory	Embankment, subgrade, base, asphalt concrete	Type A < 6 Type B > 6 Type C as shown on the plans	Per equipment specification and as approved	As approved
Light pneumatic	Embankment, subgrade, surface treatment	4.5-9.0	≥45 psi	2-6
	Asphalt concrete			4-12
Medium pneumatic	Embankment, subgrade, base, surface treatment	12-25	≥80 psi, as directed	2-6
	Asphalt concrete			4-12
Heavy pneumatic	Embankment, subgrade, base, previously broken concrete pavement, other pavements	≥25	≤150 psi	2-6
Grid	Embankment, breaking up existing asphalt mats or base	5-13	-	2-3

1. Unless otherwise specified in the Contract.

- 2.1. **Static Steel Wheel Rollers.** Furnish single, double, or triple steel wheel, self-propelled power rollers weighing at least 10 ton capable of operating in a forward and backward motion. Ensure all wheels are flat. The Contractor may use vibratory rollers in the static mode when static steel wheel rollers are required.

For single steel wheel rollers, pneumatic rear wheels are allowed for embankment, subgrade, and base. Provide rear wheels for triple steel wheel rollers with a minimum diameter of 48 in., a minimum width of 20 in., and a minimum compression of 325 lb. per inch of wheel width.

- 2.2. **Tamping Rollers.** Furnish self-propelled rollers with at least one self-cleaning metal tamping drum capable of operating in a forward or backward motion with a minimum effective rolling width of 5 ft. Mount drums in a frame so that each drum moves independently of the other for rollers with more than one drum. Operate rollers in static or vibratory mode.
- 2.2.1. **Tamping Roller (Minimum Requirement).** Provide tamping feet that exert a static load of 125–550 psi and project at least 3 in. from the surface of the drum for all tamping rollers except for heavy tamping rollers.
- 2.2.2. **Heavy Tamping Roller.** Provide tamping rollers that have:
- two metal tamping drums, rolls, or shells, each with a 60-in. minimum diameter and a 5-ft. minimum width; or
  - one rear and two forward drums, each with a 60-in. minimum diameter. Arrange drums so that the rear drum compacts the space between the two forward drums and the minimum overall rolling width is 10 ft.

Equip drums with tamping feet that:

- project at least 7 in. from the drum surface,
- have an area of 7–21 sq. in.,
- are self-cleaning,
- exert a static load of at least 550 psi, and
- are spaced at 1 tamping foot per 0.65–0.70 sq. ft. of drum area.

- 2.3. **Vibratory Rollers.** Furnish self-propelled rollers with at least one drum equipped to vibrate. Select and maintain amplitude and frequency settings per manufacturer's specifications to deliver maximum compaction without material displacement or shoving, as approved. Furnish the equipment manufacturer's specifications concerning settings and controls for amplitude and frequency. Operate rollers at speeds that will produce at least 10 blows per foot unless otherwise shown on the plans or approved. Pneumatic rear wheels are allowed for embankment, subgrade, and base. Equip each vibrating drum with:
- separate frequency and amplitude controls,
  - controls to manually start and stop vibration, and
  - a mechanism to continuously clean the face of the drum.

For asphalt-stabilized base and asphalt concrete pavement, furnish a roller that also can:

- automatically reverse the direction of the rotating eccentric weight,
- stop vibration before the motion of the roller stops, and
- thoroughly moisten the drum with water or approved asphalt release agent.

- 2.3.1. **Drum (Type A).** Furnish a roller with a static weight less than 6 ton and a vibratory drum.
- 2.3.2. **Drum (Type B).** Furnish a roller with a minimum static weight of 6 ton and a vibratory drum.
- 2.3.3. **Drum (Type C).** Furnish a roller as shown on the plans.
- 2.4. **Pneumatic Tire Rollers.** Pneumatic tire rollers consist of rubber tire wheels on axles mounted in a frame with either a loading platform or body suitable for ballast loading. Arrange the rear tires to cover the gaps between adjacent tires of the forward group. Furnish rollers capable of forward and backward motion. Compact asphalt pavements and surface treatments using a roller equipped with smooth-tread tires. Compact without damaging the surface. Moisten the wheels with water or an approved asphalt release agent when necessary.

Select and maintain the operating load and tire air pressure within the range of the manufacturer's charts or tabulations to attain maximum compaction throughout the lift, as approved. Furnish the manufacturer's chart or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the tires furnished. Maintain individual tire inflation pressures within 5 psi of each other. Provide uniform compression under all tires.

2.4.1. **Light Pneumatic Tire.** Furnish a unit:

- with at least nine pneumatic tires,
- with an effective rolling width of approximately 5 ft.,
- capable of providing a total uniform load of 4.5–9 ton, and
- with tires capable of maintaining a minimum ground contact pressure of 45 psi.

2.4.2. **Medium Pneumatic Tire.** Furnish a unit:

- with at least seven pneumatic tires,
- with an effective rolling width of approximately 7 ft.,
- capable of providing a total uniform load of 12–25 ton, and
- with tires capable of maintaining a minimum ground contact pressure of 80 psi or 90 psi as directed.

2.4.3. **Heavy Pneumatic Tire.** Furnish a unit:

- with at least four pneumatic-tired wheels mounted on axles carrying no more than two wheels,
- with wheels arranged to carry approximately equal loads on uneven surfaces,
- with a width between 8 and 10 ft. that can turn 180° in the crown width,
- capable of providing a total uniform load of at least 25 ton,
- with tires capable of maintaining a maximum ground contact pressure of 150 psi, and
- with liquid-filled tires inflated to such a level that liquid will flow from the valve stem when the stem is in the uppermost position.

2.5. **Grid Rollers.** Furnish rollers that have two cylindrical cages with a minimum diameter of 66 in. and a minimum width of 32 in. Mount cages in a rigid frame with weight boxes. Use a cage surface of cast or welded steel fabric grid with bars 1-1/2 in. wide, spaced on 5-in. centers in each direction, that undulate approximately 1 in. between the high and low points.

Furnish rollers capable of providing a total load of 5–13 ton and capable of being operated in a forward or backward motion.

2.6. **Alternate Equipment.** The Contractor may use alternate compaction equipment that produces results equivalent to the specified equipment as approved. Discontinue the use of the alternate equipment and furnish the specified equipment if the desired results are not achieved.

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### 3. CONSTRUCTION

Perform this work in conformance with the applicable Items using equipment and roller speeds shown in Table 1. Use only rubber-tired equipment to push or pull compaction equipment on base courses. Use equipment that does not damage material being rolled.

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### 4. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to pertinent Items.

# Item 216

## Proof Rolling



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### 1. DESCRIPTION

Proof-roll earthwork, base, or both to locate unstable areas.

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### 2. EQUIPMENT

- 2.1. **Specified Equipment.** Furnish rollers that weigh at least 25 ton when loaded. The maximum acceptable load is 50 ton. Provide rollers that meet the requirements of Section 210.2.4., "Pneumatic Tire Rollers."
- 2.2. **Alternative Equipment.** The Contractor may use alternate compaction equipment that produces results equivalent to the specified equipment in the same period of time as approved. Discontinue the use of the alternative equipment and furnish the specified equipment if the desired results are not achieved.

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### 3. CONSTRUCTION

Perform proof rolling as directed. Adjust the load and tire inflation pressures within the range of the manufacturer's charts or tabulations, as directed. Make at least two coverages with the proof roller. Offset each trip of the roller by at most one tire width. Operate rollers at a speed between 2 and 6 mph, as directed. Correct unstable or nonuniform areas, if found, in conformance with the applicable Item.

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### 4. MEASUREMENT

Rolling will be measured by the hour operated on surfaces being tested.

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### 5. PAYMENT

The work performed and equipment furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Proof Rolling." This price is full compensation for furnishing and operating equipment and for labor, materials, tools, and incidentals.

# Item 247

## Flexible Base



### 1. DESCRIPTION

Construct a foundation course composed of flexible base.

### 2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. The Engineer may sample and test project materials at any time before compaction throughout the duration of the project to assure specification compliance.

- 2.1. **Aggregate.** Furnish aggregate of the type and grade shown on the plans and meeting the requirements shown in Table 1. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for the grade specified. Do not use additives, such as but not limited to lime, cement, or fly ash to modify aggregates to meet the requirements of Table 1, unless shown on the plans.

Unless otherwise shown on the plans, the unconfined compressive strength is waived when the flexible base material meets the #200 sieve requirement. When the #200 sieve requirement does not meet the specification in Table 1, the unconfined compressive strength is required.

**Table 1**  
**Material Requirements**

Property	Test Method	Grade 1-2 <sup>3</sup>	Grade 3	Grade 4	Grade 5
Master gradation sieve size (cumulative % retained)	Tex-110-E			As shown on the plans	
2-1/2"		0	0		0
1-3/4"		0-10	0-10		0-5
7/8"		10-35	-		10-35
3/8"		30-65	-		35-65
#4		45-75	45-75		45-75
#40		65-90	50-85		70-90
#200 <sup>1, 2</sup>		85-95	-		-
Liquid limit, % Max	Tex-104-E	40	40	35	
Plasticity index, Max	Tex-106-E	10	12	10	
Plasticity index, Min		As shown on the plans	As shown on the plans	As shown on the plans	
Wet ball mill, % Max	Tex-116-E	40	-	40	
Wet ball mill, % Max increase passing the #40 sieve		20	-	20	
Min compressive strength <sup>2</sup> , psi	Tex-117-E				
lateral pressure 0 psi		35	-	-	
lateral pressure 3 psi		-	-	90	
lateral pressure 15 psi		175	-	175	

- The #200 sieve test is only required to meet the waiver of the unconfined compressive strength requirement. The #200 sieve test requirement is only applicable to stockpile samples from Section 247.2.4.
- Compressive strength and #200 sieve requirements are waived when the flexible base is mixed with or without existing material and treated with cement, emulsion, foamed asphalt, or lime, unless otherwise shown on the plans.
- Grade 3 may be substituted for Grade 1-2 or Grade 5 when the flexible base is mixed with or without existing material and treated with cement, emulsion, foamed asphalt, or lime, as approved. The Grade 3 flexible base must meet the wet ball mill requirements of Grade 1-2 or Grade 5 as applicable.

- 2.1.1. **Material Tolerances.** The Engineer may accept material if no more than one of the five most recent gradation tests has an individual sieve outside the specified limits of the gradation. This allowance does not apply to the #200 sieve requirement.
- The Engineer may accept material if no more than one of the five most recent liquid limit or plasticity index tests is outside the specified limit. No single failing liquid limit or plasticity index test may exceed the allowable limit by more than 2 percentage points.
- 2.1.2. **Material Types.** Do not use fillers or binders unless approved. Furnish the type shown on the plans in accordance with the following.
- 2.1.2.1. **Type A.** Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Do not use gravel or multiple sources.
- 2.1.2.2. **Type B.** Crushed or uncrushed gravel. Blending of two or more sources is allowed.
- 2.1.2.3. **Type C.** Crushed gravel with a minimum of 60% of the particles retained on a No. 4 sieve with two or more crushed faces as determined in accordance with [Tex-460-A](#), Part I. Blending of two or more sources is allowed.
- 2.1.2.4. **Type D.** Type A material or crushed concrete. Crushed concrete containing gravel will be considered Type D material. Crushed concrete must meet the requirements of Section 247.2.1.2.6., "Recycled Material," and be managed in a way to provide for uniform quality. The Engineer may require separate dedicated stockpiles to verify compliance.
- 2.1.2.5. **Type E.** Caliche, iron ore, or as otherwise shown on the plans.
- 2.1.2.6. **Recycled Material.** Reclaimed asphalt pavement (RAP) and other recycled materials may be used when shown on the plans. Request approval to blend two or more sources of recycled materials. When RAP is allowed, do not exceed 20% RAP by weight, unless otherwise shown on the plans. The percentage limitations for other recycled materials will be as shown on the plans.
- Provide recycled materials, other than RAP, that have a maximum sulfate content of 3,000 ppm when tested in accordance with [Tex-145-E](#). Certify compliance with [DMS-11000](#), "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." In addition, recycled materials must be free of reinforcing steel and other objectionable material and have at most 1.5% deleterious material when tested in accordance with [Tex-413-A](#). The liquid limit, plasticity index, wet ball mill, and compressive strength for all recycled materials are waived. When using RAP, crush RAP so that 100% passes the 2-in. sieve and does not exceed a maximum percent loss from decantation of 5.0% when tested in accordance with [Tex-406-A](#). Test RAP without removing the asphalt. The final product must meet the requirements shown in Table 1 for the grade specified except when the Department requires a specific amount of Department-furnished RAP be added to the blend, unless otherwise shown on the plans.
- The Contractor is responsible for uniformly blending the recycled material with the flexible base material to build a stockpile to meet the percentages required. Any Contractor-furnished surplus of recycled materials will remain the property of the Contractor. Remove Contractor-owned recycled materials from the project and dispose of them in accordance with federal, state, and local regulations before project acceptance.
- 2.2. **Water.** Furnish water free of industrial wastes and other objectionable matter.
- 2.3. **Material Sources.** Expose the vertical faces of all strata of material proposed for use when non-commercial sources are used. Secure and process the material by successive vertical cuts extending through all exposed strata, when directed.
- 2.4. **Stockpile Approval.** Stockpile is approved when the Engineer's test results meet the material requirements shown in Table 1.



- 2.4.1. **Sampling.** The Contractor and the Engineer will sample flexible base from completed stockpiles in accordance with [Tex-100-E](#). Personnel conducting sampling must be certified by the Department-approved soils and base certification program.

Sampling stockpiles may be located at the production site or at the project location. The Contractor will witness the Engineer's sampling and sample the stockpile for their own testing, and label as deemed necessary.

Sample the stockpile for the Engineer when shown on the plans. When the Contractor samples the stockpile for the Engineer, the Engineer must witness the sampling of material designated for the Engineer and the Materials and Tests Division (MTD). The Engineer will label their sampling containers as "Engineer" and "MTD," or as deemed necessary.

The Engineer will take immediate possession of the sample containers for the Engineer and MTD. The Engineer will maintain custody of the samples until all testing and reporting are completed.

- 2.4.2. **Referee Testing.** Referee testing is applicable for stockpile testing only. MTD is the referee laboratory. MTD may designate a laboratory from the Department's MPL for Commercial Laboratories Approved for Flexible Base Referee Requests as the referee laboratory as deemed necessary. The designated laboratory cannot be performing any testing under this Item for the Engineer or Contractor.

The Contractor may request referee testing when the Engineer's test results fail to meet any of the material requirements shown in Table 1 and the Contractor's sample from Section 2.4.1., "Sampling," for the same failing Department test, passes. The tests must be performed by a laboratory listed on the Department's MPL for Commercial Laboratories Approved for Flexible Base Referee Requests. Submit the request by email within 5 working days after receiving failing test results from the Engineer. Include completed test reports passing the applicable requirements shown in Table 1 in the email.

Record and submit completed test reports electronically on Department-provided templates in their original format meeting the applicable material requirements shown in Table 1. Use Department-provided templates to record and calculate all test data. The Engineer and the Contractor will provide any available test results to the other party when requested.

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### 3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work.

- 3.1. **Rollers.** Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.
- 3.2. **Inertial Profiler.** When ride quality measurement is required, provide a high-speed or lightweight inertial profiler certified at the Texas A&M Transportation Institute. Provide equipment certification documentation. Display a current decal on the equipment indicating the certification expiration date.

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### 4. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

Stockpile base material temporarily at an approved location before delivery to the roadway. Build stockpiles in layers no greater than 2 ft. thick. Stockpiles must have a total height between 10 and 16 ft. unless otherwise approved. After construction and acceptance of the stockpile in accordance with Section 247.2.4., "Stockpile Approval," loading from the stockpile for delivery is allowed. Load by making successive vertical cuts through the entire depth of the stockpile.

Do not add or remove material from temporary stockpiles that require sampling and testing before delivery, unless otherwise approved. Charges for additional sampling and testing required as a result of adding or removing material will be deducted from the Contractor's estimates.

Haul approved flexible base in clean trucks. Deliver the required quantity to each 100-ft. station or designated stockpile site as shown on the plans. Prepare stockpile sites as directed. When delivery is to the 100-ft. station, manipulate in conformance with the applicable Items.

- 4.1. **Preparation of Subgrade or Existing Base.** Remove or scarify existing asphalt concrete pavement in accordance with Item 105, "Removing Treated and Untreated Base and Asphalt Pavement," when shown on the plans or as directed. Shape the subgrade or existing base to conform to the typical sections shown on the plans or as directed.

When new base is required to be mixed with existing base, deliver, place, and spread the new flexible base in the required amount per station. Manipulate and thoroughly mix the new base with existing material to provide a uniform mixture to the specified depth before shaping.

Proof roll the roadbed in accordance with Item 216 before pulverizing or scarifying when shown on the plans or directed. Correct soft spots as directed.

- 4.2. **Placing.** Spread and shape flexible base into a uniform layer using an approved spreader the same day as delivered unless otherwise approved. Construct layers to the thickness shown on the plans. Maintain the shape of the course. Control dust by sprinkling, as directed. Correct or replace segregated areas as directed at no additional expense to the Department.

Place successive base courses and finish courses using the same construction methods required for the first course.

- 4.3. **Compaction.** Compact using density control unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the material in accordance with Item 204, "Sprinkling." Maintain moisture during compaction within  $\pm 2.0\%$  of the optimum moisture content as determined in accordance with [Tex-113-E](#).

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least 1/2 the width of the roller unit. Begin rolling at the low side and progress toward the high side on superelevated curves. Offset alternating trips of the roller. Operate rollers at a speed between 2 and 6 mph as directed.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish requirements before the next course is placed or the project is accepted. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.

Before final acceptance, the Engineer will select the locations of tests and measure the flexible base depth in accordance with [Tex-140-E](#). Correct areas deficient by more than 1/2 in. in thickness by scarifying, adding material as required, reshaping, recompacting, and refinishing at the Contractor's expense.

- 4.3.1. **Ordinary Compaction.** Roll using approved compaction equipment as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing approved material as required, reshaping, and recompacting.

- 4.3.2. **Density and Moisture Control.** Compact to a minimum of 100% of the maximum dry density and within  $\pm 2.0\%$  of the optimum moisture content as determined in accordance with [Tex-113-E](#), unless otherwise shown on the plans. Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine roadway density and moisture content of completed sections in accordance with [Tex-115-E](#), Part I. The Engineer will determine random locations for testing in accordance with [Tex-115-E](#), Part IV. Do not achieve density by drying the material after compaction.

When the density is less than 100% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

- 4.3.3. **Miscellaneous and Small Areas.** Miscellaneous areas are those that typically involve handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed.
- 4.4. **Finishing.** After completing compaction, clip, skin, or tight-blade the surface using a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of it at an approved location. Seal the clipped surface immediately by rolling using a pneumatic tire roller until a smooth surface is attained. Add small increments of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades as shown on the plans or as directed.

Correct grade deviations greater than 1/4 in. in 16 ft. measured longitudinally. Correct grade deviations greater than 1/4 in. over the entire width of the cross-section in areas where surfacing is to be placed. Correct by loosening and adding or removing material. Reshape and recompact in accordance with Section 247.4.3., "Compaction."

- 4.5. **Curing.** Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat.
- 4.6. **Ride Quality.** Measurement of ride quality only applies to the final travel lanes that receive a one- or two-course surface treatment for the final riding surface, unless otherwise shown on the plans. Measure the ride quality of the base course either before or after the application of the prime coat, as directed, and before placement of the surface treatment. Use a certified profiler operator listed on the Department's MPL. When requested, furnish the Engineer with documentation for the person certified to operate the profiler.

Provide all profile data to the Engineer in electronic data files within 3 days of measuring the ride quality using the format specified in [Tex-1001-S](#). The Engineer will use Department software to evaluate longitudinal profiles to determine areas requiring corrective action. Correct 0.1-mi. sections with an average international roughness index (IRI) value greater than 100 in. per mile to an IRI value of 100 in. per mile or less, unless otherwise shown on the plans. Reprofile and correct sections that fail to maintain ride quality before the placement of the surface treatment, as directed. Unless ride deterioration is due to environmental impact, traffic, or other incidents outside the Contractor's control, perform this work at no additional expense to the Department, as approved.

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## 5. MEASUREMENT

Flexible base will be measured as follows.

- **Flexible Base (Complete in Place).** The ton, square yard, or any cubic yard method.
- **Flexible Base (Roadway Delivery).** The ton or any cubic yard method.
- **Flexible Base (Stockpile Delivery).** The ton, cubic yard in vehicle, or cubic yard in stockpile.

Measurement by the cubic yard in final position and square yard is a plans quantity measurement. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Measurement is further defined for payment as follows.

- 5.1. **Cubic Yard in Vehicle.** By the cubic yard in vehicles of uniform capacity at the point of delivery.

- 5.2. **Cubic Yard in Stockpile.** By the cubic yard in the final stockpile position, by the method of average end areas, or as shown on the plans.
- 5.3. **Cubic Yard in Final Position.** By the cubic yard in the completed and accepted final position. The volume of base course is computed in place by the method of average end areas between the original subgrade or existing base surfaces and the lines, grades, and slopes of the accepted base course, or as shown on the plans.
- 5.4. **Square Yard.** By the square yard of surface area in the completed and accepted final position. The surface area of the base course is based on the width of flexible base, or as shown on the plans.
- 5.5. **Ton.** By the ton of dry weight in vehicles as delivered. The dry weight is determined by deducting the weight of the moisture in the material at the time of weighing from the gross weight of the material. The Engineer will determine the moisture content in the material in accordance with [Tex-103-E](#) from samples taken at the time of weighing.

When material is measured in trucks, the weight of the material will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location. Scales must meet the requirements of Item 520, "Weighing and Measuring Equipment."

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## 6. 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 the types of work described below. No additional payment will be made for thickness or width exceeding that shown on the typical section or provided on the plans for cubic yard in the final position or square yard measurement.

Sprinkling and rolling, except proof rolling, will not be paid for directly, but will be subsidiary to this Item unless otherwise shown on the plans. When proof rolling is shown on the plans or directed, it will be paid for in accordance with Item 216.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade will be paid in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

- 6.1. **Flexible Base (Complete in Place).** Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle," "In Stockpile," or "In Final Position" will be specified. For square yard measurement, a depth will be specified. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, spreading, blading, mixing, shaping, placing, compacting, reworking, finishing, correcting locations where thickness is deficient, curing, furnishing scales and labor for weighing and measuring, equipment, labor, tools, and incidentals.
- 6.2. **Flexible Base (Roadway Delivery).** Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle," "In Stockpile," or "In Final Position" will be specified. The unit price bid will not include processing at the roadway. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, furnishing scales and labor for weighing and measuring, equipment, labor, tools, and incidentals.
- 6.3. **Flexible Base (Stockpile Delivery).** Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle" or "In Stockpile" will be specified. The unit price bid will not include processing at the roadway. This price is full compensation for furnishing and disposing of materials, preparing the stockpile area, temporary or permanent stockpiling, assistance provided in stockpile sampling and operations to level

stockpiles for measurement, loading, hauling, delivery of materials to the stockpile, furnishing scales and labor for weighing and measuring, equipment, labor, tools, and incidentals.

# Item 250

## Geogrid Base Reinforcement



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### 1. DESCRIPTION

Use geogrid to reinforce flexible base placed on embankment material. Geogrid consists of a synthetic planar structure formed by a regular network of integrally connected polymeric tensile elements with apertures designed to interlock with the base and the underlying material.

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### 2. MATERIALS

Furnish geogrid of the type shown on the plans meeting the requirements of [DMS-6240](#), "Geogrid for Base/Embankment Reinforcement." When directed, randomly select a roll from those delivered to the project and sample a piece of geogrid from the roll in accordance with [Tex-735-I](#). Do not sample from an area of the roll that is damaged or distorted. The Engineer must witness the sampling. The Materials and Tests Division (MTD) will test the geogrid sample to determine whether it meets the material requirements of [DMS-6240](#).

When test results fail to meet any of the minimum requirements, the Engineer may reject the roll and may randomly select an additional roll to sample and test. If the additional sample fails to meet any of the material requirements, the Engineer may reject the entire quantity of rolls represented by the samples tested.

- 2.1. **Packaging.** Package geogrid in rolls of the length and width shown on the plans or as approved. Package each roll in one continuous piece in a suitable sheath, wrapper, or container to protect the geogrid from damage due to ultraviolet light, moisture, storage, and handling.
- 2.2. **Identification.** Identify each roll with a tag or label securely affixed to the outside of one end of the roll. List the following information on the label:
- manufacturer's roll number,
  - manufacturer's lot or control number,
  - name of manufacturer and supplier,
  - style or catalog description of product, and
  - roll width and length.

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### 3. CONSTRUCTION

Install geogrid in accordance with the lines and grades as shown on the plans. Do not operate tracked construction equipment on the geogrid until a minimum cover of 6 in. of flexible base backfill material is placed on the geogrid. Install the geogrid to avoid any deformation or damage to the underlying, compacted material below the geogrid. When the underlying, compacted material below the geogrid is damaged during installation, correct all areas to the satisfaction of the Engineer.

- 3.1. **Geogrid Placement.** Orient the geogrid length as unrolled parallel to the direction of roadway. Overlap geogrid sections as shown on the plans or as directed. Use plastic zip-ties at overlap joints or as directed. When placing geogrid around corners, cutting and diagonal lapping may be required. Pin geogrid at the beginning of the backfill section as directed. Keep the geogrid taut and flat throughout backfilling, but not restrained from stretching or flattening. Use a track loader to place the flexible base material by cascading it onto the geogrid to a minimum depth of 6 in. Spread, shape, and use ordinary compaction to compact the flexible base material into a uniform layer.

Avoid direct contact by equipment with the geogrid. When approved, rubber-tired equipment may be operated directly on the geogrid. When approved, operate the rubber-tired equipment at a maximum of

5 mph, do not turn tires on the geogrid, do not make sudden stops and starts on the geogrid, and do not distort the geogrid to create excessive deformation waves. Correct areas with distorted and excessive deformation waves to the satisfaction of the Engineer. When directed by the Engineer, adjust the geogrid installation and construction methods to minimize any distortion and deformation waves.

- 3.1.1. **Longitudinal Joints.** Overlap longitudinal joints by a minimum of 1 ft. Space longitudinal zip-ties 10–20 ft. or as directed.
- 3.1.2. **Transverse Joints.** Overlap transverse joints by a minimum of 1 ft. Space transverse zip-ties 4–5 ft. or as directed.
- 3.2. **Damage Repair.** Remove and replace Contractor-damaged or excessively deformed areas as directed at no additional cost to the Department. Lap repair areas a minimum of 3 ft. in all directions. Tie each side of repair grid in at least three locations, but do not exceed normal construction spacing. The tie spacing for odd shapes will be as directed. Repair excessively deformed materials underlying the grid as directed.

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#### 4. MEASUREMENT

Geogrid base reinforcement will be measured by the square yard of roadway placement as shown on the plans with no allowance for overlapping at transverse and longitudinal joints.

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#### 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 bid price for "Geogrid Base Reinforcement" of the type specified. This price is full compensation for furnishing, preparing, hauling, and placing materials, including labor, materials, freight, tools, equipment, and incidentals.

# Item 251

## Reworking Base Courses



### 1. DESCRIPTION

Refinish or rework existing base material with or without asphaltic concrete pavement. Incorporate new base material when shown on the plans.

### 2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements shown on the plans and in conformance with specifications. Notify the Engineer of the proposed material sources and of changes to material sources. The Engineer will verify that the specification requirements are met before the sources may be used. The Engineer may sample and test project materials at any time before compaction. Use [Tex-100-E](#) for material definitions.

- 2.1. **Flexible Base.** Furnish new base material that meets the requirements of Item 247, "Flexible Base," for the type and grade shown on the plans.
- 2.2. **Water.** Furnish water free of industrial wastes and other objectionable matter.

### 3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work.

- 3.1. **Compaction Equipment.** Provide rollers in accordance with Item 210, "Rolling." Provide rollers in accordance with Item 216, "Proof Rolling," when required.
- 3.2. **Pulverization Equipment.** Provide pulverization equipment that:
- cuts and pulverizes material uniformly to the proper depth using cutters that plane to a uniform surface over the entire width of the cut,
  - provides a visible indication of the depth of cut at all times, and
  - uniformly mixes the materials.

### 4. CONSTRUCTION

Perform work to the width and depth shown on the typical sections for the type of work shown on the plans. Construct and shape exposed subgrade to conform to typical sections shown on the plans or as directed. Proof roll in accordance with Item 216 when shown on the plans. Correct soft spots as directed.

Before scarifying, clean the existing base of objectionable materials by blading, brooming, or other approved methods, unless otherwise shown on the plans. Perform this work in accordance with applicable Items.

- 4.1. **Types of Work.**
- 4.1.1. **Type A.** Scarifying only.
- 4.1.2. **Type B.** Scarifying, salvaging, and re-laying.



4.1.3. **Type C.** Scarifying and reshaping.

4.1.4. **Type D.** Refinishing.

4.2. **Performance of Work.**

4.2.1. **Scarifying.** Loosen and break existing base material, with or without existing asphaltic concrete pavement. Remove asphalt concrete pavement, surface treatment, plant mix seal, and micro-surfacing when shown on the plans and in conformance with applicable Items. Prevent contamination of asphalt material during and after removal. When the existing pavement consists of only a surface treatment, do not remove before scarifying. Scarify existing material for its full width and depth unless otherwise shown on the plans. Do not disturb the underlying subgrade. Break material into particles of not more than 2-1/2 in., unless otherwise shown on the plans.

4.2.2. **Salvaging.** Remove the existing base material and stockpile. Windrow if allowed. Perform salvage operations without interfering with traffic, proper drainage, or the general requirements of the work. Remove scarified material using an approved method. Keep material free of contamination.

4.2.3. **Re-Laying.** Prepare subgrade as shown on the plans or as directed before relaying salvaged material. Proof roll in accordance with Item 216, when shown on the plans. Correct soft spots as directed.

Return and rework salvaged base material, with or without additional new base material, on the prepared roadbed. Place salvaged material on the prepared subgrade and sprinkle, blade, and shape the base to conform to the typical sections shown on the plans or as directed. Place new base material and uniformly mix with salvaged material when shown on the plans. Correct, or remove and replace, segregated material with satisfactory material, as directed.

4.2.4. **Reshaping.** Rework scarified base material with or without additional new base material. Mix and shape scarified base to conform to the typical sections shown on the plans. When shown on the plans, furnish new base material and uniformly mix with scarified material before shaping. Do not disturb the underlying subgrade. Correct, or remove and replace, segregated material with satisfactory material as directed.

4.2.5. **Refinishing.** Blade existing base surface to remove irregularities. Cure before placing the pavement on the refinished base, as shown on the plans or as directed.

4.3. **Compaction.** Compact using ordinary compaction or density control as shown on the plans. Bring each layer to the moisture content directed. When necessary, sprinkle the material in accordance with Item 204, "Sprinkling." Maintain moisture during compaction within  $\pm 2\%$  of the optimum moisture content as determined in accordance with [Tex-113-E](#).

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half the width of the roller unit. On superelevated curves, begin rolling at the low side and progress toward the high side. Offset alternating trips of the roller. Operate rollers at a speed between 2 and 6 mph, as directed.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.

4.3.1. **Ordinary Compaction.** Roll using approved compaction equipment as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing approved material as required, reshaping, and recompacting.

4.3.2. **Density and Moisture Control.** Compact to a minimum of 98% of the maximum dry density and within  $\pm 2\%$  of the optimum moisture content as determined in accordance with [Tex-113-E](#), unless otherwise shown on the plans. Provide the Engineer with the beginning and ending station numbers of the area completed for

testing. The Engineer will determine roadway density and moisture content of completed sections in accordance with [Tex-115-E](#), Part I. The Engineer will determine random locations for testing in accordance with [Tex-115-E](#), Part IV. Do not achieve density by drying the material after compaction.

When the density is less than 98% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

- 4.4. **Miscellaneous and Small Areas.** Miscellaneous areas are those that typically involve handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed.
- 4.5. **Finishing.** Immediately after completing compaction, clip, skin, or tight-blade the surface using a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove and dispose of loosened material at an approved location. Seal the clipped surface immediately by rolling using a pneumatic tire roller until a smooth surface is attained. Add small amounts of water as needed during rolling. Shape and maintain the course and surface in conformance with the typical sections, lines, and grades shown on the plans or as directed.
- In areas where surfacing is to be placed, correct grade deviations in excess of 1/4 in. in 16 ft. measured longitudinally for the entire width of the cross-section. Correct by loosening, adding, or removing material. Reshape and recompact in accordance with Section 251.4.3., "Compaction."
- 4.6. **Curing.** Cure the finished section until the moisture content is at least 2% below optimum or as directed before applying the next successive course or prime coat.

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## 5. MEASUREMENT

This Item will be measured by the station, square yard, cubic yard, or ton.

Square yard and cubic yard in original position measurement will be established by the widths and depths shown on the plans and the lengths measured in the field.

When material is measured in trucks, the weight of the material will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at a location approved. Scales must meet the requirements of Item 520, "Weighing and Measuring Equipment."

Measurement is further defined for payment as follows.

- 5.1. **Station.** By the 100-ft. station measured along the centerline of each roadbed.
- 5.2. **Square Yard.** By the square yard of existing base or pavement in its original position. When square yard measurement is used, limits of measurement will be as shown on the plans.
- 5.3. **Cubic Yard in Vehicle.** By the cubic yard of salvaged material in vehicles as delivered at the stockpile.
- 5.4. **Cubic Yard in Stockpile.** By the cubic yard of salvaged material in the final stockpile position by the method of average end areas or as shown on the plans.
- 5.5. **Cubic Yard in Original Position.** By the cubic yard in its original position measured by the method of average end areas or as shown on the plans.
- 5.6. **Ton.** By the ton of dry weight in the trucks as delivered at the stockpile. The dry weight is determined by deducting the weight of the moisture in the material at the time of weighing from the gross weight of the

material. The Engineer will determine the moisture content in the material in accordance with [Tex-103-E](#) from samples taken at the time of truck weighing.

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## 6. 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 "Reworking Base Material" for the type, scarified depth, and compaction method shown on the plans. For cubic yard measurements, the measurement location (vehicle, stockpile, or original position) will be specified. No additional payment will be made for thickness or width exceeding that shown on the typical sections or provided on the plans for station, square yard, and cubic yard in the original position measurement. This price is full compensation for furnishing and disposing of materials, blading, brooming, scarifying, salvaging, replacing, stockpiling, reshaping, refinishing, compacting, finishing, curing, equipment, labor, tools, and incidentals.

Furnishing and delivering new base will be paid for in accordance with Section 247.6.2., "Flexible Base (Roadway Delivery)." Mixing, spreading, blading, shaping, compacting, and finishing new or existing base material will not be paid for directly, but will be subsidiary to this Item.

Sprinkling and rolling, except proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans. When proof rolling is shown on the plans or directed, it will be paid for in accordance with Item 216.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade or existing base will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade or existing base will be in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

Removal of existing asphalt concrete pavement will be paid for in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

Additional restrictions for measurement and payment are as follows.

- **Type A.** Work will be restricted to station and square yard measurement.
- **Type B.** Work will be restricted to station, square yard, and cubic yard in the original position measurement.
- **Type C.** Work will be restricted to station, square yard, and cubic yard in the original position measurement.
- **Type D.** Work will be restricted to station and square yard measurement.

# Item 260

## Lime Treatment (Road-Mixed)



### 1. DESCRIPTION

Mix and compact lime, water, and subgrade or base (with or without asphaltic concrete pavement) in the roadway.

### 2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. Obtain verification from the Engineer that the specification requirements are met before using the sources. The Engineer may sample and test project materials at any time before compaction. Use material definitions in accordance with [Tex-100-E](#).

- 2.1. **Lime.** Furnish lime that meets the requirements of [DMS-6350](#), "Lime and Lime Slurry." When dry lime is required, provide dry quicklime. When lime slurry is required, provide commercial lime slurry or quicklime slurry. Do not use dry quicklime when sulfates are present in quantities greater than 3,000 parts per million (ppm). When furnishing quicklime, provide it in bulk.
- 2.2. **Subgrade.** The Engineer will determine the sulfate content of the subgrade in accordance with [Tex-145-E](#) and organic content in accordance with [Tex-148-E](#) before lime treatment begins. Suspend operations when material to be treated has a sulfate content greater than 7,000 ppm or an organic content greater than 2.0%, unless otherwise directed.
- 2.3. **Flexible Base.** Unless otherwise shown on the plans, furnish base material that meets the requirements of Item 247, "Flexible Base," for the type and grade shown on the plans, before the addition of lime. Unless otherwise shown on the plans, the compressive strength of the flexible base is waived.
- 2.4. **Water.** Furnish water free of industrial wastes and other objectionable material.
- 2.5. **Asphalt.** When asphalt or emulsion is permitted for curing purposes, furnish materials that meet the requirements of Item 300, "Asphalts, Oils, and Emulsions," as shown on the plans or as directed.
- 2.6. **Mix Design.** The Engineer will determine the target lime content and optimum moisture content in accordance with [Tex-121-E](#) or prior experience with the project materials. The Contractor may propose a mix design developed in accordance with [Tex-121-E](#). The Engineer will use [Tex-121-E](#) to verify the Contractor's proposed mix design before acceptance. Reimburse the Department for subsequent mix designs or partial designs necessitated by changes in the material or requests by the Contractor. Limit the amount of recycled asphalt pavement to no more than 50% of the mix, unless otherwise shown on the plans or directed.

### 3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.

- 3.1. **Storage Facility.** Store quicklime in closed, weatherproof containers.

- 3.2. **Slurry Equipment.** Use slurry tanks equipped with agitation devices to slurry quicklime on the project or other approved location. The Engineer may approve other slurring methods.
- Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with a sampling device in accordance with [Tex-600-J](#), Part I, when using commercial lime slurry.
- 3.3. **Hydrated Lime Distribution Equipment.** Provide equipment to spread lime evenly across the area to be treated. Provide equipment with a rotary vane feeder to spread lime, when shown on the plans.
- 3.4. **Pulverization Equipment.** Provide pulverization equipment that:
- cuts and pulverizes material uniformly to the proper depth using cutters that plane to a uniform surface over the entire width of the cut,
  - provides a visible indication of the depth of cut at all times, and
  - uniformly mixes the materials.

#### 4. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

- 4.1. **Preparation of Subgrade or Existing Base for Treatment.** Before treating, remove existing asphalt concrete pavement in accordance with Item 105, "Removing Treated and Untreated Base and Asphalt Pavement," when shown on the plans or as directed. Shape existing material in conformance with applicable bid items to conform to typical sections shown on the plans and as directed.

Unless otherwise approved, proof roll the roadbed in accordance with Item 216 before pulverizing or scarifying existing material. Correct soft spots as directed.

When material is imported from a borrow source, notify the Engineer of the location of the borrow source well in advance to allow time for testing and approval to avoid delay to the project. Stockpile as directed. The Engineer will test the borrow source and determine the sulfate and organic contents. When the borrow source has a sulfate content greater than 3,000 ppm or an organic content greater than 2.0%, proceed as directed.

When new base material is required to be mixed with existing base, deliver, place, and spread the new material in the required amount per station. Manipulate and thoroughly mix new base with existing material to provide a uniform mixture to the specified depth before shaping.

- 4.2. **Pulverization.** Pulverize or scarify existing material after shaping. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to expose a secondary grade to achieve processing to plan depth.
- 4.3. **Application of Lime.** Uniformly apply lime using dry or slurry placement as shown on the plans or as directed. Add lime at the percentage determined in accordance with Section 260.2.6., "Mix Design." Apply lime only on an area where mixing can be completed during the same working day.

Start lime application only when the air temperature is at least 35°F and rising or is at least 40°F. The temperature will be taken in the shade and away from artificial heat. Suspend application when the Engineer determines that weather conditions are unsuitable.

Minimize dust and scattering of lime by wind. Do not apply lime when wind conditions, in the opinion of the Engineer, cause blowing lime to become dangerous to traffic or objectionable to adjacent property owners. When pebble grade quicklime is placed dry, mix the material and lime thoroughly at the time of lime

application. Use of quicklime can be dangerous. Inform users of the recommended precautions for handling and storage.

- 4.3.1. **Dry Placement.** Before applying lime, bring the prepared roadway to approximately two percentage points above optimum moisture content. When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of pebble grade quicklime using approved equipment.

- 4.3.2. **Slurry Placement.** Provide slurry free of objectionable materials, at or above the minimum dry solids content, and with a uniform consistency that will allow ease of handling and uniform application. Deliver commercial lime slurry to the jobsite or use quicklime to prepare lime slurry at the jobsite or other approved location, as specified. When dry quicklime is applied as slurry, use 80% of the amount shown on the plans.

Distribute slurry uniformly by making successive passes over a measured section of roadway until the specified lime content is reached. Uniformly spread the residue from quicklime slurry over the length of the roadway being processed, unless otherwise directed.

- 4.4. **Mixing.** Begin mixing within 6 hr. of application of lime. Lime exposed to the open air for 6 hr. or more between application and mixing, or that experiences excessive loss due to washing or blowing, will not be accepted for payment. Thoroughly mix the material and lime using approved equipment. When treating subgrade, bring the moisture content above the optimum moisture content to ensure adequate chemical reaction of the lime and subgrade materials.

Ensure 100% of the material passes a 2-1/2 in. sieve, except rock, before mellowing. Allow the mixture to mellow for 1–4 days, as directed. When pebble grade quicklime is used, allow the mixture to mellow for 2–4 days, as directed. Sprinkle the treated materials during the mixing and mellowing operation, as directed, to achieve adequate hydration and proper moisture content. When the material to be treated has a sulfate content greater than 3,000 ppm but less than or equal to 7,000 ppm, mellow for a minimum of 7 days. Maintain in a continuously moist condition by sprinkling in accordance with Item 204. After mellowing, resume mixing until a homogeneous, friable mixture is obtained. After mixing, the Engineer may sample the mixture at roadway moisture and test in accordance with [Tex-101-E](#), Part III, to determine compliance with the gradation requirements shown in Table 1.

**Table 1**  
**Gradation Requirements (Min % Passing)**

Sieve Size	Base	Subgrade
1-3/4"	100	100
3/4"	85	85
#4	–	60

- 4.5. **Strength Testing.** The Engineer will sample and test the lime-treated mixture for unconfined compressive strength in accordance with [Tex-117-E](#), Part II. The unconfined compressive strength must be greater than 50 psi for lime-treated subgrade and 150 psi for lime-treated flexible base or lime-treated flexible base with existing material, unless otherwise shown on the plans.

- 4.6. **Compaction.** Compact the mixture using density control, unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. Sprinkle the treated material in accordance with Item 204, or aerate the treated material to adjust the moisture content during compaction so that it is no more than 1.0% below optimum and 2.0% above optimum as determined in accordance with [Tex-121-E](#).

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half the width of the roller unit. On superelevated curves, begin rolling at the low side and progress toward the high side. Offset alternating trips of the roller. Operate rollers at a speed between 2 and 6 mph as directed.

Before final acceptance, the Engineer will select the locations of tests in each unit and measure the treated depth in accordance with [Tex-140-E](#). Correct areas deficient by more than 1/2 in. in thickness or more than

1/2% in target lime content by adding lime as required, reshaping, recompacting, and refinishing at the Contractor's expense.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met. Rework in accordance with Section 260.4.7., "Reworking a Section." Perform the work at no additional expense to the Department.

- 4.6.1. **Ordinary Compaction.** Roll using approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing treated material as required, reshaping, and recompacting.
- 4.6.2. **Density and Moisture Control.** Compact to at least 95% of the maximum density, and moisture content no more than 1.0% below optimum and 2.0% above optimum as determined in accordance with [Tex-121-E](#), unless otherwise shown on the plans. Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine roadway density and moisture content of completed sections in accordance with [Tex-115-E](#), Part I. The Engineer will determine random locations for testing in accordance with [Tex-115-E](#), Part IV.

When the density is less than 95% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

- 4.7. **Reworking a Section.** When a section is reworked within 72 hr. after completion of compaction, rework the section to provide the required density. When a section is reworked more than 72 hr. after completion of compaction, add additional lime at 25% of the percentage determined in accordance with Section 260.2.6., "Mix Design." Reworking includes loosening, adding material or removing unacceptable material if necessary, mixing as directed, compacting, and finishing. When density control is specified, determine a new maximum density of the reworked material in accordance with [Tex-121-E](#), and compact to at least 95% of this density.
- 4.8. **Finishing.** Immediately after completing compaction of the final course, clip, skin, or tight-blade the surface of the lime-treated material using a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of at an approved location. Roll the clipped surface immediately using a pneumatic tire roller until a smooth surface is attained. Add small amounts of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades shown on the plans or as directed.

Finish grade of constructed subgrade to within 0.1 ft. in the cross-section and 0.1 ft. in 16 ft. measured longitudinally.

Correct grade deviations of constructed base greater than 1/4 in. in 16 ft. measured longitudinally or greater than 1/4 in. over the entire width of the cross-section in areas where surfacing is to be placed. Remove excess material, reshape, and roll using a pneumatic-tire roller. Correct as directed if material is more than 1/4 in. low. Do not surface patch. The 72-hr. time limit required for completion of placement, compaction, and finishing does not apply to finishing required just before applying the surface course.

- 4.9. **Miscellaneous and Small Areas.** Miscellaneous areas are those that typically involve handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed.
- 4.10. **Curing.** Cure for the minimum number of days shown in Table 2 by sprinkling in accordance with Item 204, or by applying an asphalt material at a rate of 0.05–0.20 gal. per square yard, as shown on the plans or as directed. Maintain moisture during curing. Upon completion of curing, maintain the moisture content in

accordance with Section 132.3.5., "Maintenance of Moisture and Reworking," for subgrade and Section 247.4.5., "Curing," for bases before placing subsequent courses. Do not allow equipment on the finished course during curing except as required for sprinkling, unless otherwise approved. Apply seals or additional courses within 14 calendar days of final compaction.

**Table 2**  
**Min Curing Requirements before Placing Subsequent Courses<sup>1</sup>**

Untreated Material	Curing (Days)
PI ≤35	2
PI >35	5

1. Subject to approval. Proof rolling may be required as an indicator of adequate curing.

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## 5. MEASUREMENT

- 5.1. **Lime.** When lime is furnished in trucks, the weight of lime will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location approved. Scales must meet the requirements of Item 520, "Weighing and Measuring Equipment."
- 5.1.1. **Commercial Lime Slurry.** Lime slurry will be measured by the ton (dry weight) as calculated from the minimum percent dry solids content of the slurry, multiplied by the weight of the slurry in tons delivered.
- 5.1.2. **Quicklime.**
- 5.1.2.1. **Dry.** Lime will be measured by the ton (dry weight) of the quicklime.
- 5.1.2.2. **Slurry.** Lime slurry will be measured by the ton (dry weight) of the quicklime used to prepare the slurry multiplied by a conversion factor of 1.28 to determine the quantity of equivalent hydrated lime, which will be the basis of payment.
- 5.2. **Lime Treatment.** Lime treatment will be measured by the square yard of surface area. The dimensions for determining the surface areas are established by the widths shown on the plans and the lengths measured at placement.

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## 6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for in accordance with Section 260.6.1., "Lime," and Section 260.6.2., "Lime Treatment."

Furnishing and delivering new base will be paid for in accordance with Section 247.6.2., "Flexible Base (Roadway Delivery)." Mixing, spreading, blading, shaping, compacting, and finishing new or existing base material will be paid for under Section 260.6.2., "Lime Treatment." Removal and disposal of existing asphalt concrete pavement will be paid for in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

Sprinkling and rolling, except proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans. When proof rolling is shown on the plans or directed by the Engineer, it will be paid for in accordance with Item 216.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade or existing base will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade or existing base will be paid for in accordance with pertinent Items or Article 4.4., "Changes in the Work."



Where subgrade to be treated under this Contract has sulfates greater than 7,000 ppm, work will be paid for in accordance with Article 4.4., "Changes in the Work."

Asphalt used solely for curing will not be paid for directly, but will be subsidiary to this Item. Asphalt placed for curing and priming will be paid for under Item 310, "Prime Coat."

- 6.1. **Lime.** Lime will be paid for at the unit price bid for "Quicklime (Dry)" or "Commercial or Quicklime (Slurry)." This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.

Lime used for reworking a section in accordance with Section 260.4.7., "Reworking a Section," will not be paid for directly, but will be subsidiary to this Item.

- 6.2. **Lime Treatment.** Lime treatment will be paid for at the unit price bid for "Lime Treatment (Existing Material)," "Lime Treatment (New Base)," or "Lime Treatment (Mixing Existing Material and New Base)," for the depth specified. No payment will be made for thickness or width exceeding that shown on the plans. This price is full compensation for shaping existing material, loosening, mixing, pulverizing, spreading, applying lime, compacting, finishing, curing, curing materials, blading, shaping and maintaining shape, replacing mixture, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.

# Item 275

## Cement Treatment (Road-Mixed)



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### 1. DESCRIPTION

Mix and compact cement, water, and subgrade or base (with or without asphalt concrete pavement) in the roadway.

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### 2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. Obtain verification from the Engineer that the specification requirements are met before using the sources. The Engineer may sample and test project materials at any time before compaction. Use material definitions in accordance with [Tex-100-E](#).

2.1. **Cement.** Furnish hydraulic cement that meets the requirements of [DMS-4600](#), "Hydraulic Cement," and the Department's *Hydraulic Cement Quality Monitoring Program* (HCQMP). Sources not in the HCQMP will require testing and approval before use.

2.2. **Subgrade.** The Engineer will determine the sulfate content in accordance with [Tex-145-E](#) and organic content in accordance with [Tex-148-E](#) before cement treatment begins. Suspend operations when material to be treated has a sulfate content greater than 7,000 ppm or an organic content greater than 2.0% and proceed as directed.

2.3. **Flexible Base.** Unless otherwise shown on the plans, furnish base material that meets the requirements of Item 247, "Flexible Base," for the type and grade shown on the plans, before the addition of cement. Unless otherwise shown on the plans, the compressive strength of the flexible base is waived.

2.4. **Water.** Furnish water free of industrial waste and other objectionable material.

2.5. **Asphalt.** When asphalt or emulsion is permitted for curing purposes, furnish materials that meet the requirements of Item 300, "Asphalts, Oils, and Emulsions," as shown on the plans or directed.

2.6. **Mix Design.** The Engineer will determine the target cement content and optimum moisture content to produce a stabilized mixture that meets the strength requirements shown on the plans. The mix will be designed in accordance with [Tex-120-E](#) or will be based on prior experience with the project materials. The Contractor may propose a mix design developed in accordance with [Tex-120-E](#). Meet strength requirements when shown on the plans. The Engineer will use [Tex-120-E](#) to verify the Contractor's proposed mix design before acceptance. Reimburse the Department for subsequent mix designs or partial designs necessitated by changes in the material or requests by the Contractor. Limit the amount of recycled asphalt pavement to no more than 50% of the mix unless otherwise shown on the plans or directed.

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### 3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.

3.1. **Cement Storage Facility.** Store cement in closed, weatherproof containers.

- 3.2. **Cement Slurry Equipment.** Use slurry tanks equipped with agitation devices to slurry cement on the project or other approved location. The Engineer may approve other slurring methods.
- Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with an approved sampling device.
- 3.3. **Dry Cement Distribution Equipment.** Provide equipment to spread cement evenly across the area to be treated. Provide equipment with a rotary vane feeder to spread cement, when shown on the plans.
- 3.4. **Pulverization Equipment.** Provide pulverization equipment that:
- cuts and pulverizes material uniformly to the proper depth using cutters that plane to a uniform surface over the entire width of the cut,
  - provides a visible indication of the depth of cut at all times, and
  - uniformly mixes the materials.

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#### 4. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

- 4.1. **Preparation of Subgrade or Existing Base for Treatment.** Before treating, remove existing asphalt concrete pavement in conformance with pertinent Items and the plans or as directed. Shape existing material in conformance with applicable bid items to conform to the typical sections shown on the plans and as directed.

When shown on the plans or directed, proof roll the roadbed in accordance with Item 216 before pulverizing or scarifying existing material. Correct soft spots as directed.

When material is imported from a borrow source, notify the Engineer of the location of the borrow source well in advance to allow time for testing and approval to avoid delay to the project. Stockpile as directed. The Engineer will test the borrow source and determine the sulfate and organic contents. When the borrow source has a sulfate content greater than 3,000 ppm or an organic content greater than 2.0%, proceed as directed.

When new base material is required to be mixed with existing base, deliver, place, and spread the new material in the required amount per station. Manipulate and thoroughly mix new base with existing material to provide a uniform mixture to the specified depth before shaping.

- 4.2. **Pulverization.** Pulverize or scarify existing material after shaping. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to expose a secondary grade to achieve processing to plan depth.
- 4.3. **Application of Cement.** Uniformly apply cement using dry placement unless otherwise shown on the plans. Add cement at the percentage determined in accordance with Section 275.2.6., "Mix Design." Apply cement only on an area where mixing, compacting, and finishing can be completed during the same working day.

Start cement application only when the air temperature is at least 35°F and rising or is at least 40°F. The temperature will be taken in the shade and away from artificial heat. Suspend application when the Engineer determines that weather conditions are unsuitable.

- 4.3.1. **Dry Placement.** Before applying cement, bring the prepared roadway to approximately optimum moisture content. When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of dry cement using approved equipment. Minimize dust and scattering of cement by wind. Do not apply

cement when wind conditions, in the opinion of the Engineer, cause blowing cement to become dangerous to traffic or objectionable to adjacent property owners.

4.3.2. **Slurry Placement.** Mix the required quantity of cement with water, as approved. Provide slurry free of objectionable materials and with a uniform consistency that can be easily applied. Agitate the slurry continuously. Apply slurry within 2 hr. of adding water and when the roadway is at a moisture content drier than optimum. Distribute slurry uniformly by making successive passes over a measured section of roadway until the specified cement content is reached.

4.4. **Mixing.** Thoroughly mix the material and cement using approved equipment. Mix until a homogeneous mixture is obtained. Sprinkle the treated materials during the mixing operation, as directed, to maintain optimum mixing moisture. Spread and shape the completed mixture in a uniform layer.

After mixing, the Engineer may sample the mixture at roadway moisture and test in accordance with [Tex-101-E](#), Part III, to determine compliance with the gradation requirements shown in Table 1. When strength requirements are shown on the plans, the Engineer may sample the mixture to verify strength in accordance with [Tex-120-E](#) and adjust cement content to achieve the target strength for work going forward.

**Table 1**  
**Gradation Requirements (Min % Passing)**

Sieve Size	Base	Subgrade
1-3/4"	100	100
3/4"	85	85
#4	-	60

4.5. **Strength Testing.** The Engineer will sample and test the cement-treated mixture for unconfined compressive strength in accordance with [Tex-117-E](#), Part II. The unconfined compressive strength must be greater than 150 psi, unless otherwise shown on the plans.

4.6. **Compaction.** Compact the mixture in one lift using density control, unless otherwise shown on the plans. Complete compaction within 2 hr. after the application of water to the mixture of material and cement.

Sprinkle the treated material in accordance with Item 204, or aerate the treated material to adjust the moisture content during compaction so that it is within 2.0% of optimum as determined in accordance with [Tex-120-E](#). Adjust operations as required.

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half the width of the roller unit. On superelevated curves, begin rolling at the low side and progress toward the high side. Offset alternating trips of the roller. Operate rollers at a speed between 2 and 6 mph, as directed.

Before final acceptance, the Engineer will select the locations of tests in each unit and measure the treated depth in accordance with [Tex-140-E](#). Correct areas deficient by more than 1/2 in. in thickness or more than 1/2% in target cement content by adding cement as required, reshaping, recompacting, and refinishing at the Contractor's expense.

Remove or rework areas that lose required stability, compaction, or finish, as directed. When a section is reworked more than 4 hr. after completion of compaction, add additional cement as directed. Perform the work at no additional cost to the Department.

4.6.1. **Ordinary Compaction.** Roll using approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing treated material as required, reshaping, and recompacting.

4.6.2. **Density and Moisture Control.** Compact to at least 95% of the maximum density and within  $\pm 2.0\%$  of the optimum moisture content as determined in accordance with [Tex-120-E](#). Provide the Engineer with the

beginning and ending station numbers of the area completed for testing. The Engineer will determine roadway density and moisture content in accordance with [Tex-115-E](#), Part I within 4 hr. from the time compaction is completed. The Engineer will determine random locations for testing in accordance with [Tex-115-E](#), Part IV. The Engineer may verify strength in accordance with [Tex-120-E](#) and adjust cement content to achieve the target strength for work going forward. Remove material that does not meet density requirements, or rework by adding the target cement content, reshaping, recompacting, and refinishing, at the Contractor's expense.

When the density is less than 95% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

4.7. **Miscellaneous and Small Areas.** Miscellaneous areas are those that typically involve handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed.

4.8. **Finishing.** Immediately after completing compaction of the final course, clip, skin, or tight-blade the surface of the cement treated material using a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of at an approved location. Roll the clipped surface immediately using a pneumatic tire roller until a smooth surface is attained. Add small amounts of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades shown on the plans or as directed.

Finish grade of constructed subgrade to within 0.1 ft. in the cross-section and 0.1 ft. in 16 ft. measured longitudinally.

Correct grade deviations of constructed base greater than 1/4 in. in 16 ft. measured longitudinally or greater than 1/4 in. over the entire width of the cross-section in areas where surfacing is to be placed. Remove excess material, reshape, and roll using a pneumatic tire roller. Correct as directed if material is more than 1/4 in. low. Do not surface patch.

4.9. **Microcracking.** When shown on the plans, maintain moisture content of the finished cement-treated base for a period of 24–48 hr. During this time, but no sooner than 24 hr., roll the finished course using a vibratory roller to induce microcracking. The vibratory roller must be in accordance with Item 210, with a static weight equal to or more than 12 ton, and the vibratory drum must be no less than 20 in. wide. The roller must travel at a speed of 2 mph, vibrating at maximum amplitude, and make two–four passes with 100% coverage excluding the outside 1 ft. of the surface crown, unless otherwise directed by the Engineer. Additional passes may be required to achieve the desired crack pattern as directed. Notify the Engineer 24 hr. before the microcracking begins.

4.10. **Curing.** Cure for at least 3 days by sprinkling in accordance with Item 204 or by applying an asphalt material at the rate of 0.05–0.20 gal. per square yard, as shown on the plans or as directed. When a section is microcracked, cure section for an additional 2 days after microcracking. Maintain the moisture content during curing at no lower than 2 percentage points below optimum. Continue curing until placing another course.

4.11. **Ride Quality.** When shown on the plans, measurement of ride quality only applies to the final travel lanes that receive a one- or two-course surface treatment for the final riding surface. Measure the ride quality of the base course either before or after the application of the prime coat, as directed, and before placement of the surface treatment. Use a certified profiler operator on the Department's MPL. When requested, furnish the Engineer with documentation for the person certified to operate the profiler.

Provide all profile data to the Engineer in electronic data files within 3 days of measuring the ride quality using the format specified in [Tex-1001-S](#). The Engineer will use Department software to evaluate longitudinal profiles to determine areas requiring corrective action. Correct 0.1-mi. sections with an average international

roughness index (IRI) value greater than 100 in. per mile to an IRI value of 100 in. per mile or less, unless otherwise shown on the plans. Reprofile and correct sections that fail to maintain ride quality before the placement of the surface treatment, as directed and approved. Unless ride deterioration is due to environmental impact, traffic, or other incidents outside the Contractor's control, perform this work at no additional expense to the Department, as approved.

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## 5. MEASUREMENT

- 5.1. **Cement.** Cement will be measured by the ton (dry weight). When cement is furnished in trucks, the weight of cement will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location. Scales must meet the requirements of Item 520, "Weighing and Measuring Equipment."

When cement is furnished in bags, indicate the manufacturer's certified weight. Bags varying more than 5% from that weight may be rejected. The average weight of bags in any shipment, as determined by weighing 10 bags taken at random, must be at least the manufacturer's certified weight.

- 5.1.1. **Slurry.** Cement slurry will be measured by the ton (dry weight) of the cement used to prepare the slurry at the jobsite or from the minimum percent dry solids content of the slurry, multiplied by the weight of the slurry in tons delivered.
- 5.2. **Cement Treatment.** Cement treatment will be measured by the square yard of surface area. The dimensions for determining the surface areas are established by the widths shown on the plans and lengths measured at placement.

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## 6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for in accordance with Section 275.5.1., "Cement," and Section 275.5.2., "Cement Treatment."

Furnishing and delivering new base will be paid for in accordance with Section 247.6.2., "Flexible Base (Roadway Delivery)." Mixing, spreading, blading, shaping, compacting, and finishing new or existing base material will be paid for under Section 275.6.2., "Cement Treatment." Removal and disposal of existing asphalt concrete pavement will be paid for in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

Sprinkling and rolling, except proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans. When proof rolling is shown on the plans or directed by the Engineer, it will be paid for in accordance with Item 216.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade or existing base will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade or existing base will be in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

Where subgrade to be treated under this Contract has sulfates greater than 7,000 ppm, work will be paid for in accordance with Article 4.4., "Changes in the Work."

Asphalt used solely for curing will not be paid for directly, but will be subsidiary to this Item. Asphalt placed for curing and priming will be paid for under Item 310, "Prime Coat."

- 6.1. **Cement.** Cement will be paid for at the unit price bid for "Cement." This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.

- 6.2. **Cement Treatment.** Cement treatment will be paid for at the unit price bid for “Cement Treatment (Existing Material),” “Cement Treatment (New Base),” or “Cement Treatment (Mixing Existing Material and New Base),” for the depth specified. No payment will be made for thickness or width exceeding that shown on the plans. This price is full compensation for shaping existing material, loosening, mixing, pulverizing, spreading, applying cement, compacting, microcracking, finishing, curing, curing materials, blading, shaping and maintaining shape, replacing mixture, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.

# Item 276

## Cement Treatment (Plant-Mixed)



### 1. DESCRIPTION

Construct a base course composed of flexible base, hydraulic cement, and water, mixed in an approved plant.

### 2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of proposed sources of materials and of changes in material sources. The Engineer will verify that the specification requirements are met before the sources may be used. The Engineer may sample and test project materials at any time before compaction. Use material definitions in accordance with [Tex-100-E](#).

- 2.1. **Cement.** Furnish hydraulic cement that meets the requirements of [DMS-4600](#), "Hydraulic Cement," and the Department's *Hydraulic Cement Quality Monitoring Program* (HCQMP). Sources not in the HCQMP will require testing and approval before use.
- 2.2. **Flexible Base.** Furnish base material that meets the requirements of Item 247, "Flexible Base," for the type and grade shown on the plans, before the addition of cement. Unless otherwise shown on the plans, the compressive strength of the flexible base is waived.
- 2.3. **Water.** Furnish water that is free of industrial waste and other objectionable material.
- 2.4. **Asphalt.** Furnish asphalt or emulsion that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions," when permitted for curing purposes as shown on the plans or as directed.
- 2.5. **Mix Design.** Using the materials proposed for the project, the Engineer will determine the target cement content and optimum moisture content necessary to produce a stabilized mixture meeting the strength requirements shown in Table 1 for the class shown on the plans. The mix will be designed in accordance with [Tex-120-E](#). The Contractor may propose a mix design developed in accordance with [Tex-120-E](#). The Engineer will use [Tex-120-E](#) to verify the Contractor's proposed mix design before acceptance. The Engineer may use project materials sampled from the plant or the quarry, and sampled by the Engineer or the Contractor, as determined by the Engineer. Limit the amount of asphalt concrete pavement to no more than 50% of the mix unless otherwise shown on the plans or directed.

**Table 1**  
**Strength Requirements**

Class	7-Day Unconfined Compressive Strength, Min psi
L	500
M	300
N	As shown on the plans

### 3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.



- 3.1. **Cement Storage Facility.** Store cement in closed, weatherproof containers.
- 3.2. **Mixing Plant.** Provide a stationary pugmill, weigh-batch, or continuous mixing plant as approved that uniformly mixes cement, water, and base material in the specified proportions. Equip plants with automatic proportioning and metering devices, certified scales, and scale installations. Use belt scales for proportioning aggregate that are accurate to within 1.0% based on the average of three test runs, where no individual test run exceeds 2.0% from the average when checked in accordance with [Tex-920-K](#).
- Provide personnel, facilities, and equipment for checking the scales as approved. Check all weighing and measuring equipment after each move and at least once every 6 mo. or when requested.
- Calibrate all scales using weights certified by the Texas Department of Agriculture (TDA) or an equivalent agency as approved. Provide a written calibration report from a scale mechanic for all calibrations. Cease plant operations during the checking operation. Do not use inaccurate or inadequate scales.
- 3.3. **Spreader Equipment.** Provide equipment that will spread the cement-treated mixture in a uniform layer in one pass when shown on the plans. Equip spreaders with electronic grade controls when shown on the plans.

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#### 4. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or established by the Engineer. Start placement operations only when the air temperature is at least 35°F and rising or is at least 40°F. The temperature will be taken in the shade and away from artificial heat. Suspend operations when the Engineer determines that weather conditions are unsuitable.

- 4.1. **Mixing.** Thoroughly mix materials in the proportions designated on the mix design, in a mixing plant that meets the requirements of Section 276.3.2., "Mixing Plant." Mix at optimum moisture content, unless otherwise directed, until a homogeneous mixture is obtained. Do not add water to the mixture after mixing is completed unless directed. The Engineer may sample the mixture to verify strength in accordance with [Tex-120-E](#) and adjust cement content to achieve the target strength for work going forward.
- 4.2. **Placing.** Place the cement-treated base on a subgrade or base prepared as shown on the plans. Bring the prepared roadway to the moisture content directed. Haul cement-treated base to the roadway in clean trucks and begin placement immediately. Place cement-treated base only on an area where compacting and finishing can be completed during the same working day. Spread and shape in a uniform layer using an approved spreader. Construct individual layers to the thickness shown on the plans. Maintain the shape of the course by blading. Correct or replace segregated areas as directed at no additional expense to the Department.
- Construct vertical joints between new cement-treated base and cement-treated base that has been in place 4 hr. or longer. The vertical face may be created by using a header or by cutting back the face to approximately vertical. Place successive base courses using the same methods as the first course. Offset construction joints by at least 6 in.
- 4.3. **Compaction.** Compact each layer immediately after placing. Complete compaction within 2 hr. after plant-mixing water with dry material. Complete compaction of the final lift within 5 hr. after adding water to the treated base used in the first lift when multiple lifts are permitted.

Moisture content in the mixture at the plant may be adjusted so that during compaction it is within 2.0% of optimum as determined in accordance with [Tex-120-E](#). Maintain uniform moisture content by sprinkling the treated material in accordance with Item 204, "Sprinkling."

Begin rolling longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least one-half the width of the roller unit. Begin rolling at the low side and progress toward the high side on superelevated curves. Offset alternating trips of the roller. Operate rollers at a speed between 2 and 6 mph, as directed.

- 4.3.1. **Density and Moisture Control.** Compact to a minimum of 95% of the maximum density and within  $\pm 2.0\%$  of the optimum moisture content as determined in accordance with [Tex-120-E](#). Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine roadway density and moisture content in accordance with [Tex-115-E](#), Part I within 4 hr. from the time compaction is completed. The Engineer will determine random locations for testing in accordance with [Tex-115-E](#), Part IV. Remove material that does not meet density requirements. Remove areas that lose required stability, compaction, or finish. Replace with cement-treated mixture, compact, and test in conformance with density control methods.

When the density is less than 95% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

- 4.3.2. **Miscellaneous and Small Areas.** Miscellaneous areas are those that typically involve handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed.

- 4.4. **Finishing.** Clip, skin, or tight blade the surface of the cement-treated material using a maintainer or subgrade trimmer to a depth of approximately 1/4 in. immediately after completing compaction. Remove loosened material and dispose of at an approved location. Roll the clipped surface immediately using a pneumatic tire roller until a smooth surface is attained. Add small increments of water as needed during rolling. Shape and maintain the course and surface in conformance with the typical sections, lines, and grades shown on the plans or as directed.

Trim grade deviations greater than 1/4 in. in 16 ft. measured longitudinally or greater than 1/4 in. over the entire width of the cross-section in areas where surfacing is to be placed. Remove excess material, reshape, and then roll with a pneumatic tire roller. Correct as directed if material is more than 1/4 in. low. Do not surface patch.

- 4.5. **Microcracking.** When shown on the plans, maintain moisture content of the finished cement-treated base for a period of 24–48 hr. During this time, but no sooner than 24 hr., roll the finished course using a vibratory roller to induce microcracking. The vibratory roller must be in accordance with Item 210, with a static weight equal to or more than 12 ton, and the vibratory drum must be no less than 20 in. wide. The roller must travel at a speed of 2 mph, vibrating at maximum amplitude, and make two–four passes with 100% coverage excluding the outside 1 ft. of the surface crown, unless otherwise directed by the Engineer. Additional passes may be required to achieve the desired crack pattern as directed. Notify the Engineer 24 hr. before the microcracking begins.
- 4.6. **Curing.** Cure for at least 3 days by sprinkling in accordance with Item 204, or by applying an asphalt material at the rate of 0.05–0.20 gal. per square yard, as shown on the plans or directed. When a section is microcracked, cure section for an additional 2 days after microcracking. Maintain the moisture content during curing at no lower than 2 percentage points below optimum. Continue curing until placing another course.

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## 5. MEASUREMENT

Cement-treated base will be measured by the ton, cubic yard, or square yard as a composite mixture of cement, flexible base, and recycled materials.

Measurement by the cubic yard in final position and square yard is a plans quantity measurement. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Measurement is further defined for payment as follows.

- 5.1. **Cubic Yard in Vehicles.** Cement-treated base will be measured by the cubic yard in vehicles as delivered on the road.
- 5.2. **Cubic Yard in Final Position.** Cement-treated base will be measured by the cubic yard in its completed and accepted final position. The volume of each course will be computed in place between the original subgrade surfaces and the lines, grades, and slopes of the accepted base course as shown on the plans and calculated by the method of average end areas, or as shown on the plans.
- 5.3. **Square Yard.** Cement-treated base will be measured by the square yard of surface area. The dimensions for determining the surface area are established by the dimensions shown on the plans.
- 5.4. **Ton.** Cement-treated base will be measured by the ton (dry weight) in vehicles as delivered on the road. The dry weight is determined by deducting the weight of the moisture in the material at the time of weighing from the gross weight of the material. The Engineer will determine the moisture content in the material in accordance with [Tex-103-E](#) from samples taken at the time of weighing.

When material is measured in trucks, the weight of the material will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location. Scales must meet the requirements of Item 520, "Weighing and Measuring Equipment."

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## 6. 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 "Cement Treatment (Plant-Mix)" of the class (strength), flexible base type, grade, and thickness (for square yard measurement) specified. For cubic yard measurement, "In Vehicle" or "In Final Position" will be specified. This price is full compensation for furnishing and disposing of materials (including cement and base); storing, mixing, hauling, placing, sprinkling, compacting, microcracking, finishing, curing, and maintaining and reworking treated base; and equipment, labor, tools, and incidentals.

Sprinkling and rolling, except proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans. When proof rolling is shown on the plans or directed by the Engineer, it will be paid for in accordance with Item 216.

Where subgrade or base courses are constructed under this Contract, correction of soft spots will be at the Contractor's expense. Where subgrade or base is not constructed under this Contract, correction of soft spots will be paid for in conformance with pertinent Items and in accordance with Article 4.4., "Changes in the Work."

Asphalt used solely for curing will not be paid for directly, but will be subsidiary to this Item. Asphalt placed for curing and priming will be paid for under Item 310, "Prime Coat."

Removal and disposal of existing asphalt concrete pavement will be paid for in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

- 6.1. **Thickness Measurement for Cubic Yard in Final Position and Square Yard Payment Adjustment.** Before final acceptance, the Engineer will select the locations of tests within each unit and measure the treated base depths in accordance with [Tex-140-E](#).

6.1.1. **Units for Payment Adjustment.**

6.1.1.1. **Roadways and Shoulders.** Units for applying a payment adjustment for thickness to roadways and shoulders are defined as 1,000 ft. of treated base in each placement width. The last unit in each placement width will be 1,000 ft. plus the fractional part of 1,000 ft. remaining. Placement width is the width between longitudinal construction joints. For widening, the placement width is the average width placed of the widened section that is deficient in thickness.

6.1.1.2. **Ramps and Other Areas.** Units are defined as 2,000 sq. yd. or fraction thereof for establishing an adjusted unit price for ramps, intersections, irregular sections, crossovers, entrances, partially completed units, transitions to ramps, and other areas designated by the Engineer.

6.1.2. **Price Adjustments of Deficient Areas.**

6.1.2.1. **Thickness Deficiency  $\leq 1.0$  in.** Table 2 will govern the price adjustment for each unit with deficient areas  $\leq 1.0$  in.

**Table 2  
Measurements and Price Adjustment for Each Unit**

Thickness Deficiency (in.)	Additional Measurements	Average Thickness Deficiency of 3 Measurements (in.)		Price Adjustment
$\leq 0.5$	None	-		Full payment
$> 0.5$	2	$\leq 0.5$		Full payment
		$> 0.5$	$\leq 0.8$	75% payment
		$> 0.8$	$\leq 1.0$	50% payment
		$> 1.0$		In accordance with Section 276.6.1.2.2., "Thickness Deficiency $\geq 1.0$ in."

6.1.2.2. **Thickness Deficiency  $\geq 1.0$  in.** Remove and replace areas of treated base found deficient in thickness by more than 1.0 in., unless otherwise approved. Take exploratory measurements at 50-ft. intervals parallel to the centerline in each direction from the deficient measurement until a measurement is not deficient by more than 1.0 in. The minimum limit of non-pay will be 100 ft.

6.2. **Excess Thickness and Width.** For cubic yard in final position and square yard measurement, no additional payment will be made for thickness or width exceeding that shown on the plans.

# Item 290

## Emulsified Asphalt Treatment (Road-Mixed)



### 1. DESCRIPTION

Perform full-depth reclamation (FDR) using an in-place mixing process to obtain a homogenous mixture of the existing surface and the underlying base material (with or without new material and additive added) using an emulsified asphalt.

### 2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and, when necessary, changes to material sources. Obtain verification from the Engineer that the specification requirements are met before using the sources. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

- 2.1. **Emulsion.** Furnish cationic standard yield emulsified asphalt that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions," unless otherwise shown on the plans.
- 2.2. **Additional Material.** When shown on the plans, required by the mixture design, or directed, furnish base or reclaimed asphalt pavement (RAP) material that meets the requirements of Item 247, "Flexible Base," for the type and grade required. Unless otherwise shown on the plans, the compressive strength of the flexible base is waived.
- 2.3. **Additive.** When shown on the plans, required by the mixture design, or directed, use the type and amount of additive required. Do not exceed 1.0% by weight of material, unless otherwise shown on the plans.
- 2.3.1. **Lime.** When shown on the plans, required by the mixture design, or directed, furnish lime in accordance with [DMS-6350](#), "Lime and Lime Slurry." When dry lime is required, provide dry quicklime. When lime slurry is required, provide commercial lime slurry or quicklime slurry.
- 2.3.2. **Cement.** When shown on the plans, required by the mixture design, or directed, furnish hydraulic cement in accordance with [DMS-4600](#), "Hydraulic Cement," and the Department's Hydraulic Cement Quality Monitoring Program (HCQMP). Sources not in the HCQMP will require testing and approval before use.
- 2.4. **Mixture Design.** Provide a mixture design in accordance with [Tex-122-E](#), unless otherwise directed, before the start of any work pertinent to this Item. The Engineer will determine the location or locations to sample and witness the sampling to obtain materials. Design the mixture from each sampling location selected by the Engineer to meet the requirements shown in Table 1. Report the mixture design using the test template in accordance with Section 290.6.1., "Reporting and Responsibilities."

**Table 1  
Laboratory Mixture Design Properties**

Mixture Property	Min Requirement
Indirect tensile strength (IDT), psi	50
Moisture-conditioned IDT, psi	30

- 2.5. **Mixture Design Verification.** Provide the Engineer with representative samples of all materials that will be included in the treatment process at least 4 weeks before the start of production, unless otherwise directed. The Engineer will verify the target emulsion content that produces a mixture to meet the requirements shown in Table 1. When the mixture fails to meet the requirements of Table 1, provide a new mixture design.

- 2.6. **Water.** Furnish water free of industrial waste and other objectionable material.

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### 3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work.

- 3.1. **Storage Facility.** Store cement, quicklime, and dry hydrated lime in closed, weatherproof containers.
- 3.2. **Slurry Equipment.** Use slurry tanks equipped with agitation devices to slurry cement, hydrated lime, or quicklime at the project or another approved location. The Engineer may approve other slurry methods. Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with a sampling device in accordance with [Tex-600-J](#), Part I.
- 3.3. **Dry Distribution Equipment.** Provide equipment to spread the cement or lime evenly across the area to be treated. Provide equipment with a rotary vane feeder to spread the cement or lime, when shown on the plans.
- 3.4. **Rollers.** Provide rollers in accordance with Item 210, "Rolling," and Section 290.6.6., "Compaction."
- 3.5. **Proof Rollers.** Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.
- 3.6. **Asphalt Transports.** Provide asphalt transports with a pintle hitch on the rear bumper to allow the reclaimer to connect and push the transport during mixing.
- 3.7. **Reclaimer for Emulsion Treatment.** Use a reclaimer with the following equipment and capabilities:
- self-propelled mixer capable of fully mixing the existing road to the depth shown on the plans with emulsion, water, and when applicable, additives and additional material to produce a homogeneous material;
  - minimum power capability of 400 horsepower;
  - a pintle hitch on the rear bumper to allow the reclaimer to connect and push the transport during mixing;
  - ability to mix the roadway with the additive and additional materials, when applicable, in a single pass for the width and depth shown on the plans;
  - ability to add emulsion using a full-width spray bar consisting of a positive displacement pump interlocked to the machine speed such that the amount of emulsion added is automatically adjusted with changes of machine speed;
  - an emulsion injection system capable of accurately adding up to 8 gal. per square yard of emulsified asphalt; and
  - emulsion injection system spray bar equipped with individual valves that can be turned off to minimize emulsion overlap on subsequent passes.

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### 4. STAFFING REQUIREMENTS

Provide at least one staff member with at least 2 years' experience in supervising FDR projects using emulsion onsite to oversee the startup operations, unless otherwise approved. This staff member must be onsite for the first 3 days of production of the FDR process or as deemed necessary by the Engineer.

Provide Soils & Base 102 (SB102) Field Specialists certified by the Department-approved soils and base certification program to conduct daily sampling and testing for the duration of the project, in accordance with this Specification. Supply the Engineer with a list of certified personnel and copies of their current certifications, either hardcopy or electronic files, before beginning production and when personnel changes are made.

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## 5. CONTROL SECTION

Construct a control section at an approved location. Process material in the control section for an area within the typical section, minimum 300 ft. in length, and to the depth shown on the plans. Meet the requirements of Article 290.7., "Process Control," with the Engineer witnessing the sampling and testing, and provide test results and any pertinent information to the Engineer upon completion of the control section. Compact the control section in accordance with Section 290.6.6., "Compaction," and Section 290.6.6.2., "Density and Moisture Control," unless otherwise directed.

The Engineer will determine the moisture content of the reclaimed and treated material in accordance with [Tex-103-E](#). The Engineer will use this moisture content to determine a correction factor in accordance with Section 290.6.6.2., "Density and Moisture Control."

When directed, proof roll the control section in accordance with Item 216. Proceed to full construction when approved.

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## 6. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the materials, density, and moisture content as required by the approved mixture design. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans, or as directed.

- 6.1. **Reporting and Responsibilities.** Use Department-provided templates to record and calculate all test data and pertinent information for the mixture design and process control testing. Obtain the current version of the templates from the Department's website or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. Record and electronically submit all test results and pertinent information on Department-provided templates.
- 6.2. **Preparation of Existing Pavement for Treatment.** Before treating, remove existing asphalt pavement in accordance with Item 105, "Removing Treated and Untreated Base and Asphalt Pavement," when shown on the plans or as directed. Shape existing material in conformance with applicable bid items to conform to typical sections shown on the plans and as directed.
- 6.3. **Application of Additive.** Apply the required additive uniformly across the roadway in advance of the mixer, when required. Minimize dust and scattering of additives by wind. Do not apply additives when, in the opinion of the Engineer, wind conditions cause blowing additive to become dangerous to traffic or objectionable to adjacent property owners.
- 6.3.1. **Lime.** Uniformly apply lime using dry or slurry placement as shown on the plans or as directed. Add lime at the percentage determined in the mixture design. Apply lime only to the area to be reclaimed during the same working day.
- 6.3.1.1. **Dry Placement.** When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of hydrated lime using approved equipment. Do not use a motor grader to spread hydrated lime.
- 6.3.1.2. **Slurry Placement.** Provide slurry free of objectionable materials, at or above the approved minimum dry solids content, and with a uniform consistency that will allow ease of handling and uniform application. Inject slurry directly into mixing chamber using an independent metered spray system. Alternatively, distribute slurry uniformly by making successive passes over a measured section of roadway until the specified lime content is reached.

Deliver commercial lime slurry to the jobsite or prepare lime slurry at the jobsite or other approved location by using hydrated lime, as specified.

- 6.3.2. **Cement.** Uniformly apply cement as shown on the plans or as directed. Add cement at the percentage determined in the mixture design. Apply cement only on an area where mixing the cement and emulsion, compacting, and finishing can be completed during the same working day.
- 6.3.2.1. **Dry Placement.** Distribute the required quantity of dry cement using approved equipment. Minimize dust and scattering of cement by wind.
- 6.4. **Weather Restrictions.** Suspend additive and emulsion application when:
  - the surface temperature is below 50°F,
  - the weather forecast calls for freezing temperatures within 3 days after incorporation of the emulsion, or
  - the Engineer determines the weather condition is unsuitable.
- 6.5. **Mixing.** Thoroughly mix the material using approved equipment. Mix until a homogenous mixture is obtained.
- 6.5.1. **Moisture.** Do not start mixing the material being treated if the moisture content determined in accordance with Section 290.7.4., “Moisture Content,” is greater than 70% of the optimum moisture content from the mixture design, unless otherwise directed. Sprinkle when necessary, in accordance with Item 204, or aerate the treated material to adjust the moisture content.
- 6.5.2. **Lime.** When applicable, begin mixing within 6 hr. of application of lime. Hydrated lime exposed to the open air for 6 hr. or more between application and mixing, or that experiences excessive loss due to washing or blowing, will not be accepted for payment. Thoroughly mix the material and lime using approved equipment. Allow the mixture to mellow for a minimum of 24 hr., or as directed, before mixing with emulsion.
- 6.5.3. **Emulsion.** Apply the emulsion to obtain the optimum emulsion content determined in accordance with Section 290.2.4., “Mixture Design.” Apply emulsion only to areas where mixing and compaction can be completed during the same working day. Do not dilute the emulsion at the jobsite. Monitor the required depth of mixing and meet the gradation requirements shown in Table 2.

Complete the entire operation of mixing the existing road and incorporating additional flexible base and cement when applicable, water, and emulsion in one pass. Overlap each adjacent pass of the mixer with the previous pass by a minimum of 6 in. and apply emulsion to the overlapped material. Use multiple passes if the process control requirements specified in Article 290.7., “Process Control,” are not met.

After mixing, the Engineer will sample the mixture at roadway moisture for a minimum of one per 3,000 cu. yd. or one per day at roadway moisture and test in accordance with [Tex-101-E](#), Part III, to determine compliance with the gradation requirements shown in Table 2. When test results fail to meet the requirements shown in Table 2, modify operations until the Engineer’s test results meet the gradation requirements.

**Table 2  
Gradation Requirements**

Sieve Size	Min Percent Passing
1-3/4 in.	100
3/4 in.	85

- 6.5.4. **Emulsion Sampling.** Obtain a 1-qt. sample of the emulsion witnessed by the Engineer for each day of production. The Contractor will notify the Engineer when the sampling will occur. Sample in accordance with [Tex-500-C](#), Part III. Label the container with the corresponding producer name, producer facility location, grade, district, date sampled, all applicable bills of lading (if available), and project information including highway and control number. The Engineer will retain these samples for 1 yr. The Engineer may also obtain independent samples. If obtaining an independent emulsion sample and upon request of the Contractor, the Engineer will split a sample of the emulsion with the Contractor.

At least once per project, the Engineer will collect split samples of the emulsion grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300 and will retain the other split sample for 60 days.



- 6.5.5. **Irregularities.** Avoid spilling water or emulsion onto the surface of the existing or reclaimed surface when connecting or disconnecting transports from the reclaimer or when filling water trucks. When excess water is spilled onto the existing or reclaimed surface, identify the location and rework material that fails to meet or loses the required density, stability, or finish within 24 hr. of completion of compaction. Reworking includes loosening, adding material, or removing unacceptable material if necessary; mixing; compacting; and finishing as directed. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.
- 6.6. **Compaction.** Compact the emulsified asphalt base mixture in one lift using density control, unless otherwise shown on the plans. Use a minimum 18-ton vibratory, heavy tamping roller, and a heavy pneumatic tire roller to meet density, unless otherwise directed.
- Begin rolling and perform initial compaction using a vibratory, heavy tamping roller applying high amplitude and low frequency. Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least half the width of the roller unit. Begin rolling at the low side and progress toward the high side on superelevated curves. Offset alternating trips of the roller.
- Continue rolling until the heavy tamping roller “walks out” of the material. Walking out for the heavy tamping roller is defined as light being evident between all the pads at the material and heavy tamping roller drum interface.
- After the completion of tamping rolling, remove remaining tamping marks. Cut slightly below the depth of the tamping marks and ensure material being cut is kept moist at all times. Achieve the desired slope and shape to the lines and grades as shown on the plans. Perform final surface shaping on the same day emulsion is incorporated. Clip, skin, or tight-blade the surface to remove and waste accumulated fines. Do not use fines to fill surface irregularities.
- Use a vibratory roller and pneumatic roller to compact the bladed material. Do not finish-roll in vibratory mode. If necessary, use a light spray of water to aid in final compaction density and appearance.
- Rework material that fails to meet or loses the required density, stability, or finish after completion of compaction. Add additional emulsified asphalt and additives at the percentages determined in accordance with Section 290.2.4., “Mixture Design,” unless otherwise directed. Reworking includes loosening, adding material, or removing unacceptable material if necessary; mixing; compacting; and finishing as directed. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.
- Suspend field operations when significant changes of materials being treated occur. Provide the Engineer with recommendations to modify operations based on the changes of materials. This may include changes in additives or percentages of emulsion or verification of the maximum dry density and optimum moisture content. Provide the Engineer with an emulsion treatment proposal for all areas requiring full-depth repair.
- Notify the Engineer when significant changes of materials being treated occur. The Engineer may suspend field operations and investigate the areas of concern.
- Before final acceptance, the Engineer will select the locations of tests and measure the depth of the emulsion treatment in accordance with [Tex-140-E](#) at a minimum of one per 3,000 cu. yd. or one per day. Correct areas deficient by more than 1/2 in. in thickness by reshaping, recompacting, and refinishing at the Contractor’s expense, unless otherwise directed.
- 6.6.1. **Ordinary Compaction.** Roll using approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing treated material as required, reshaping, and recompacting.
- 6.6.2. **Density and Moisture Control.** Compact to at least 97.0% of the maximum dry density, and moisture within 2.0 percentage points below the optimum moisture content and no more than 0.5 percentage point above the

optimum moisture content as determined, in accordance with [Tex-122-E](#), unless otherwise shown on the plans. Do not achieve density by drying the material after compaction. Unless otherwise directed:

- perform additional compaction or rework using the reclaimer unless otherwise directed, and recompact when the material does not meet the density but meets the moisture content,
- aerate and recompact when the moisture content is more than 0.5% above the optimum moisture content, and
- rework, add moisture, and recompact when the moisture content is more than 2.0% below the optimum moisture content.

Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine the roadway density and moisture content of completed sections in accordance with [Tex-115-E](#), Part I using the correction factor determined in accordance with Article 290.5., "Control Section." The Engineer will determine random locations for testing in accordance with [Tex-115-E](#), Part IV. The Engineer will perform testing for each day of production at a minimum of one per 3,000 cu. yd. or one per day.

When the density is less than 97.0% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

6.6.3. **Miscellaneous and Small Areas.** Miscellaneous areas are those that typically involve discontinuous operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed by the Engineer.

6.7. **Curing.** Cure the finished section until the moisture content is a minimum of 2% below the optimum moisture content, or as directed, before applying the next successive course or prime coat. The Engineer may allow traffic on the finished section during curing when proof rolling indicates adequate stability. Apply fog seal daily at a rate between 0.05 and 0.10 gal. per square yard in accordance with Item 315, "Fog Seal," when traffic is allowed on the finished section during curing, unless otherwise directed.

Proof roll the roadbed in accordance with Item 216. If deformation occurs, do not allow traffic to return to the finished section until the mixed material is firm enough to accommodate traffic without deformation. Apply prime coat and seal coat or additional courses within 14 calendar days of final compaction.

When no specific detour is required, provide one-way traffic control until proof rolling permits the return of normal traffic to the compacted material.

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## 7. PROCESS CONTROL

Perform process control testing during the treatment process and for the completed base in accordance with Table 3 at locations independent of the Engineer's testing locations, unless otherwise directed. Test results from process control will not be used for acceptance. The Contractor may perform additional testing as they deem necessary for process control.

Report test results and all pertinent information in accordance with Section 290.6.1., "Reporting and Responsibilities." When test results do not meet specification requirements, modify operations and perform the test methods shown in Table 3. Suspend operations when any of the test results performed after the modifications do not meet specification requirements.

**Table 3**  
**Min Testing Frequency**

Description	Test Method	Min Frequency
Depth of pulverization	<a href="#">Tex-140-E</a>	One per 350 cu. yd. (Min one per day of production)
Gradation	<a href="#">Tex-101-E</a> , Part III	
Emulsion content	Meter readings or truck weight tickets	
Moisture content <sup>1</sup>	<a href="#">Tex-103-E</a>	One per 350 cu. yd. (Min two per day of production)

1. Measure the moisture content in accordance with [Tex-103-E](#) before adding the emulsion.

- 7.1. **Depth of Pulverization.** Determine the depth of pulverization in accordance with [Tex-140-E](#).
- 7.2. **Gradation.** Sample the roadway mixture after mixing with the moisture and measure the gradation in accordance with [Tex-101-E](#), Part III.
- 7.3. **Emulsion Content.** Verify the percentage of emulsion added to the pulverized material using meter readings or truck weight tickets as approved; the quantity of material treated (depth, width, and length); and estimated in-place density. Changes in the emulsion content, type, or supplier must be approved before the start of production. Notify the Engineer when adjustments to the emulsion content are made during any day's production.
- 7.4. **Moisture Content.** Measure the moisture content in accordance with [Tex-103-E](#) before adding the emulsion. Verify the moisture content when precipitation occurs after testing and before the emulsion is added.

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## 8. MEASUREMENT

- 8.1. **Emulsion.** Emulsified asphalt material will be measured by one of the following methods.
- 8.1.1. **Weight.** Emulsion will be measured in tons using certified scales meeting the requirements of Item 520, "Weighing and Measuring Equipment," unless otherwise approved. The transporting truck must have a seal attached to the draining device and other openings. Random checking on public scales at the Contractor's expense may be required to verify weight accuracy.
- Upon work completion or temporary suspension, any remaining asphalt material will be weighed by a certified public weigher. The quantity to be measured will be the number of tons received minus the number of tons remaining after all directed work is complete.
- 8.1.2. **Volume.** Emulsion will be measured by the gallon of emulsified asphalt used in the emulsified asphalt and water mixture.
- 8.2. **Additive.**
- 8.2.1. **Lime.** When lime is furnished in trucks, the weight of lime will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location. Scales must meet the requirements of Item 520.
- 8.2.1.1. **Commercial Lime Slurry.** Lime slurry will be measured by the ton (dry weight) as calculated from the minimum percent dry solids content of the slurry, multiplied by the weight of the slurry in tons delivered.
- 8.2.1.2. **Quicklime.**
- 8.2.1.2.1. **Dry.** Lime will be measured by the ton (dry weight) of the quicklime.

- 8.2.1.2.2. **Slurry.** Lime slurry will be measured by the ton (dry weight) of the quicklime used to prepare the slurry multiplied by a conversion factor of 1.28 to give the quantity of equivalent hydrated lime, which will be the basis of payment.
- 8.2.2. **Cement.** Cement will be measured by the ton (dry weight). When cement is furnished in trucks, the weight of cement will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location. Scales must meet the requirements of Item 520.
- 8.3. **Emulsion Treatment.** Emulsion treatment will be measured by the square yard of surface area. The dimensions for determining the surface area are established by the widths shown on the plans and lengths measured at placement.

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## 9. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for in accordance with Section 290.8.1., "Emulsion"; Section 290.8.2.1., "Lime"; Section 290.8.2.2., "Cement"; and Section 290.8.3., "Emulsion Treatment."

Furnishing and delivering new base will be paid for in accordance with Item 247, unless otherwise shown on the plans.

Furnishing and delivering fog seal will be paid for in accordance with Item 315, unless otherwise shown on the plans.

Removal and disposal of existing asphalt concrete pavement will be paid for in accordance with pertinent Items or Article 4.4., "Changes in the Work."

Additives and emulsion used for reworking a section will not be paid for directly, but will be subsidiary to this Item.

Sprinkling and rolling, including proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade or existing base will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade or existing base will be in accordance with pertinent Items or Article 4.4., "Changes in the Work."

When an additional additive is required by the mixture design or required by the Engineer and not shown on the plans, it will be paid for in accordance with Article 4.4., "Changes in the Work."

- 9.1. **Emulsion.** Emulsion will be paid for at the unit price bid. This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.
- 9.2. **Lime.** Lime will be paid for at the unit price bid for one of the following types: "Hydrated (Dry)," "Hydrated (Slurry)," or "Commercial Lime Slurry." This price is full compensation for furnishing lime.
- 9.3. **Cement.** Cement will be paid for at the unit price bid. This price is full compensation for furnishing cement.
- 9.4. **Emulsion Treatment.** Emulsion treatment will be paid for at the unit price bid for the depth specified. No payment will be made for thickness or width exceeding those shown on the plans.

This price is full compensation for shaping existing material, loosening, mixing, pulverizing, spreading, applying additives and emulsified asphalt, compacting, finishing, curing, curing materials, blading, shaping and maintaining shape, replacing mixture, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.

# Item 291

## Foamed Asphalt Treatment (Road-Mixed)



### 1. DESCRIPTION

Perform full-depth reclamation (FDR) using an in-place mixing process to obtain a homogenous mixture of the existing surface and the underlying base material (with or without new material and additive added) using a foamed asphalt.

### 2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and, when necessary, changes to material sources. The Engineer will verify the specification requirements are met before approving the sources for use. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

- 2.1. **Asphalt.** Furnish PG 64-22 that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions," unless otherwise shown on the plans.
- 2.2. **Additional Material.** When shown on the plans, required by the mixture design, or directed, furnish base or reclaimed asphalt pavement material that meets the requirements of Item 247, "Flexible Base," for the type and grade required. Unless otherwise shown on the plans, the compressive strength of the flexible base is waived.
- 2.3. **Additive.** When shown on the plans, required by the mixture design, or directed, use the type and amount of additive required. Do not exceed 1.0% by weight of material, unless otherwise shown on the plans.
- 2.3.1. **Lime.** When shown on the plans, required by the mixture design, or directed, furnish lime in accordance with [DMS-6350](#), "Lime and Lime Slurry." When dry lime is required, provide dry quicklime. When lime slurry is required, provide commercial lime slurry or quicklime slurry.
- 2.3.2. **Cement.** When shown on the plans, required by the mixture design, or directed, furnish hydraulic cement in accordance with [DMS-4600](#), "Hydraulic Cement," and the Department's Hydraulic Cement Quality Monitoring Program (HCQMP). Sources not in the HCQMP will require testing and approval before use.
- 2.4. **Mixture Design.** The Engineer will provide a mixture design in accordance with [Tex-134-E](#), unless otherwise directed, before the start of any work pertinent to this Item. The Contractor may propose a mixture design developed in accordance with [Tex-134-E](#). When the Contractor elects to propose a mixture design, the Engineer will determine the location or locations to sample and witness the sampling to obtain materials. Provide asphalt and design the mixture from each sampling location selected by the Engineer meet the requirements shown in Table 1. Report the mixture design using the test template in accordance with Section 290.6.1., "Reporting and Responsibilities."

**Table 1**  
**Mixture Design Properties**

Mixture Property	Min Requirement
<b>Foamed Asphalt</b>	
Asphalt binder half-life	6.0 sec.
Asphalt binder expansion ratio	8 times
<b>Laboratory Mixture Properties</b>	
Indirect tensile strength (IDT), psi	50
Moisture-conditioned IDT, psi	30

- 2.5. **Mixture Design Verification.** Provide the Engineer with representative samples of all materials that will be included in the treatment process at least 4 weeks before the start of production, unless otherwise directed. The Engineer will verify the foamed asphalt properties and the target foamed asphalt content that produces a mixture to meet the requirements shown in Table 1. When the foamed asphalt properties fail to meet the requirements shown in Table 1, provide the Engineer with asphalt from a different source and a new representative sample from the roadway to be reclaimed. When the mixture fails to meet the requirements shown in Table 1, the Engineer will provide a new mixture design.
- 2.6. **Water.** Furnish water free of industrial waste and other objectionable material that is compatible for foaming the asphalt.

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### 3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work.

- 3.1. **Storage Facility.** Store cement, quicklime, and dry hydrated lime in closed, weatherproof containers.
- 3.2. **Slurry Equipment.** Use slurry tanks equipped with agitation devices to slurry cement, hydrated lime, or quicklime at the project or another approved location. The Engineer may approve other slurry methods. Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with a sampling device in accordance with [Tex-600-J](#), Part I.
- 3.3. **Dry Distribution Equipment.** Provide equipment to spread the cement or lime evenly across the area to be treated. Provide equipment with a rotary vane feeder to spread the cement or lime, when shown on the plans.
- 3.4. **Rollers.** Provide rollers in accordance with Item 210, "Rolling," and Section 291.6.6., "Compaction."
- 3.5. **Proof Rollers.** Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.
- 3.6. **Asphalt Transports.** Provide asphalt transports with a pintle hitch on the rear bumper to allow the reclaimer to connect and push the transport during mixing.
- 3.7. **Reclaimer for Foamed Asphalt Treatment.** Use a reclaimer with the following equipment and capabilities:
- self-propelled mixer capable of fully mixing the existing road to the depth shown on the plans with foam asphalt, water, and when applicable, additives and additional material to produce a homogeneous material;
  - minimum power capability of 600 horsepower;
  - a pintle hitch on the rear bumper to allow the reclaimer to connect and push the transport during mixing;
  - ability to increase the effective volume of the mixing chamber in relation to depth of cut;
  - two microprocessor-controlled systems, complete with two independent pumping systems and spray bars, to regulate the application of foamed asphalt cement, separate from water that is used to increase the moisture content of the mixed material;
    - Both systems must perform in relation to the forward speed of the reclaimer and the mass of the material being processed.
  - two spray bars, one for foamed asphalt cement and one for compaction moisture, each fitted with self-cleaning nozzles at a maximum spacing of one nozzle for each 6 in. in width of the mixing chamber;
    - Monitor the flow rate of each nozzle to verify that all nozzles are producing foamed asphalt at the same rate.
  - foamed asphalt cement produced at the spray bar in individual expansion chambers into which hot asphalt cement, water, and air are injected under pressure through individual and small orifices that promote atomization;

- The rate of addition of water into the hot asphalt cement must be kept at a constant percentage by mass of asphalt cement by the same microprocessor.
- system within the operator cabin to verify the foamed asphalt is being evenly distributed across the full width of the spray bar at the rate specified, demonstrated to the Engineer to verify even spraying;
- electrical heating system capable of maintaining the temperature of asphalt cement flow components above 300°F;
- single asphalt cement feed pipe installed between the recycler and the supply tanker; and
  - Do not use circulating systems that incorporate a return pipe to the supply tanker.
- inspection or test nozzle fitted at one end of the spray bar that produces a representative sample of the foamed asphalt cement.

#### 4. STAFFING REQUIREMENTS

Provide at least one staff member with at least 2 years' experience in supervising FDR projects using foamed asphalt onsite to oversee the startup operations, unless otherwise directed. This staff member must be onsite for the first 3 days of production of the FDR process or as deemed necessary by the Engineer.

Provide Soils & Base 102 (SB102) Field Specialists certified by the Department-approved soils and base certification program to conduct daily sampling and testing for the duration of the project, in accordance with this Specification. Supply the Engineer with a list of certified personnel and copies of their current certifications, either hardcopy or electronic, before beginning production and when personnel changes are made.

#### 5. CONTROL SECTION

Construct a control section at an approved location. Process material in the control section for an area within the typical section, minimum 300 ft. in length, and to the depth shown on the plans. Meet the requirements of Article 291.7., "Process Control," with the Engineer witnessing the sampling and testing, and provide test results and any pertinent information to the Engineer upon completion of the control section. Compact the control section in accordance with Section 291.6.6., "Compaction," and Section 291.6.6.2., "Density and Moisture Control," unless otherwise directed.

The Engineer will determine the moisture content of the reclaimed and treated material in accordance with [Tex-103-E](#). The Engineer will use this moisture content to determine a correction factor in accordance with Section 291.6.6.2., "Density and Moisture Control."

When directed, proof roll the control section in accordance with Item 216. Proceed to full construction when approved.

#### 6. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the materials, density, and moisture content as required by the approved mixture design. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans, or as directed.

- 6.1. **Reporting and Responsibilities.** Use Department-provided templates to record and calculate all test data and pertinent information for the mixture design and process control testing. Obtain the current version of the templates from the Department's website or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. Record and electronically submit all test results and pertinent information on Department-provided templates.
- 6.2. **Preparation of Existing Pavement for Treatment.** Before treating, remove existing asphalt pavement in accordance with Item 105, "Removing Treated and Untreated Base and Asphalt Pavement," when shown on

the plans or as directed. Shape existing material in conformance with applicable bid items to conform to typical sections shown on the plans and as directed.

- 6.3. **Application of Additive.** Apply the required additive uniformly across the roadway in advance of the mixer, when required. Minimize dust and scattering of additives by wind. Do not apply additives when, in the opinion of the Engineer, wind conditions cause blowing additive to become dangerous to traffic or objectionable to adjacent property owners.
- 6.3.1. **Lime.** Uniformly apply lime using dry or slurry placement as shown on the plans or as directed. Add lime at the percentage determined in the mixture design. Apply lime only to the area to be reclaimed during the same working day.
- 6.3.1.1. **Dry Placement.** When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of hydrated lime using approved equipment. Do not use a motor grader to spread hydrated lime.
- 6.3.1.2. **Slurry Placement.** Provide slurry free of objectionable materials, at or above the approved minimum dry solids content, and with a uniform consistency that will allow ease of handling and uniform application. Inject slurry directly into mixing chamber using an independent metered spray system. Alternatively, distribute slurry uniformly by making successive passes over a measured section of roadway until the specified lime content is reached.
- Deliver commercial lime slurry to the jobsite or prepare lime slurry at the jobsite or other approved location by using hydrated lime, as specified.
- 6.3.2. **Cement.** Uniformly apply cement as shown on the plans or as directed. Add cement at the percentage determined in the mixture design. Apply cement only on an area where mixing the cement and foamed asphalt, compacting, and finishing can be completed during the same working day.
- 6.3.2.1. **Dry Placement.** Distribute the required quantity of dry cement using approved equipment. Minimize dust and scattering of cement by wind.
- 6.4. **Weather Restrictions.** Suspend additive and foaming application when:
- the surface temperature is below 50°F,
  - the weather forecast calls for freezing temperatures within 3 days after incorporation of the foamed asphalt, or
  - the Engineer determines the weather condition is unsuitable.
- 6.5. **Mixing.** Thoroughly mix the material using approved equipment. Mix until a homogenous mixture is obtained.
- 6.5.1. **Moisture.** Do not start mixing the material being treated if the moisture content determined in accordance with Section 291.7.4., "Foamed Asphalt Treatment Water Content," is greater than the optimum moisture content from the mixture design, unless otherwise directed. Sprinkle when necessary, in accordance with Item 204, or aerate the treated material to adjust the moisture content.
- 6.5.2. **Lime.** When applicable, begin mixing within 6 hr. of application of lime. Hydrated lime exposed to the open air for 6 hr. or more between application and mixing, or that experiences excessive loss due to washing or blowing, will not be accepted for payment. Thoroughly mix the material and lime using approved equipment. Allow the mixture to mellow for a minimum of 24 hr., or as directed, before mixing with foamed asphalt.
- 6.5.3. **Foamed Asphalt.** Supply transports of asphalt to the project site at a minimum of 320°F and meeting the requirements shown in Table 1, unless otherwise approved. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer after each day of treatment, or as directed. Record the temperature determined from the temperature gauge on the transport and record on each ticket, or as directed.



Apply the foamed asphalt to obtain the optimum foamed asphalt content determined in accordance with Section 291.2.4., "Mixture Design." Apply foamed asphalt only to areas where mixing and compaction can be completed during the same working day. Monitor the required depth of mixing and meet the gradation requirements shown in Table 2.

Complete the entire operation of mixing the existing road and incorporating additional flexible base and cement when applicable, water, and foamed asphalt in one pass. Overlap each adjacent pass of the mixer with the previous pass by a minimum of 6 in. and apply foamed asphalt to the overlapped material. Use multiple passes if the process control requirements specified in Article 291.7., "Process Control," are not met.

After mixing, the Engineer will sample the mixture at roadway moisture for a minimum of one per 3,000 cu. yd. or one per day at roadway moisture and test in accordance with [Tex-101-E](#), Part III, to determine compliance with the gradation requirements shown in Table 2. When test results fail to meet the requirement shown in Table 2, modify operations until the Engineer's test results meet the gradation requirements.

**Table 2  
Gradation Requirements**

Sieve Size	Min Percent Passing
1-3/4 in.	100
3/4 in.	85

6.5.4. **Asphalt Binder Sampling.** Obtain a 1-qt. sample of the asphalt binder witnessed by the Engineer for each day of production. The Contractor will notify the Engineer when the sampling will occur. Sample in accordance with [Tex-500-C](#), Part III. Label the container with the corresponding producer name, producer facility location, grade, district, date sampled, all applicable bills of lading (if available), and project information including highway and control number. The Engineer will retain these samples for 1 yr. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of the binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, and will retain the other split sample for 1 yr.

6.5.5. **Irregularities.** Avoid spilling water or asphalt onto the surface of the existing or reclaimed surface when connecting or disconnecting transports from the reclaimer or when filling water trucks. When excess water is spilled onto the existing or reclaimed surface, identify the location and rework material that fails to meet or loses the required density, stability, or finish within 24 hr. of completion of compaction. Reworking includes loosening, adding material, or removing unacceptable material if necessary; mixing; compacting; and finishing as directed. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.

6.6. **Compaction.** Compact the foamed asphalt base mixture in one lift using density control, unless otherwise shown on the plans. Use a minimum 18-ton vibratory, heavy tamping roller, and a medium pneumatic tire roller to meet density, unless otherwise directed.

Begin rolling and perform initial compaction using a vibratory, heavy tamping roller applying high amplitude and low frequency. Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least half the width of the roller unit. Begin rolling at the low side and progress toward the high side on superelevated curves. Offset alternating trips of the roller.

Continue rolling until the heavy tamping roller "walks out" of the material. Walking out for the heavy tamping roller is defined as light being evident between all the pads at the material-heavy tamping roller drum interface.

After the completion of tamping rolling, remove remaining tamping marks. Cut slightly below the depth of the tamping marks and ensure material being cut is kept moist at all times. Achieve the desired slope and shape

to the lines and grades as shown on the plans. Perform final surface shaping on the same day the foamed asphalt is incorporated. Clip, skin, or tight-blade the surface to remove and waste accumulated fines. Do not use fines to fill surface irregularities.

Use a vibratory roller and pneumatic roller to compact the bladed material. Do not finish-roll in vibratory mode. If necessary, use a light spray of water to aid in final compaction density and appearance.

Rework material that fails to meet or loses the required density, stability, or finish after completion of compaction. Add additional foamed asphalt and additives at the percentages determined in accordance with Section 291.2.4., "Mixture Design," unless otherwise directed. Reworking includes loosening, adding material, or removing unacceptable material if necessary; mixing; compacting; and finishing as directed. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.

Suspend field operations when significant changes of materials being treated occur. Provide the Engineer with recommendations to modify operations based on the changes of materials. This may include changes in additives or percentages of foamed asphalt or verification of the maximum dry density and optimum moisture content. Provide the Engineer with a foamed asphalt treatment proposal for all areas requiring full-depth repair.

Notify the Engineer when significant changes of materials being treated occur. The Engineer may suspend field operations and investigate the areas of concern.

Before final acceptance, the Engineer will select the locations of tests and measure the depth of the foamed asphalt treatment in accordance with [Tex-140-E](#) at a minimum of 1 per 3,000 cu. yd. or one per day. Correct areas deficient by more than 1/2 in. in thickness by reshaping, recompacting, and refinishing at the Contractor's expense, unless otherwise directed.

- 6.6.1. **Ordinary Compaction.** Roll using approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing treated material as required, reshaping, and recompacting.
- 6.6.2. **Density and Moisture Control.** Compact to at least 97.0% of the maximum dry density, and moisture within 2.0 percentage points below the optimum moisture content and no more than 0.5 percentage point above the optimum moisture content as determined in accordance with [Tex-134-E](#), unless otherwise shown on the plans. Do not achieve density by drying the material after compaction. Unless otherwise directed:
- perform additional compaction or rework using the reclaimer unless otherwise directed, and recompact when the material does not meet the density but meets the moisture content,
  - aerate and recompact when the moisture content is more than 0.5% above the optimum moisture content, and
  - rework, add moisture, and recompact when the moisture content is more than 2.0% below the optimum moisture content.

Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine the roadway density and moisture content of completed sections in accordance with [Tex-115-E](#), Part I using the correction factor determined in accordance with Article 291.5., "Control Section." The Engineer will determine random locations for testing in accordance with [Tex-115-E](#), Part IV. The Engineer will perform testing for each day of production at a minimum of one per 3,000 cu. yd. or one per day.

When the density is less than 97.0% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

6.6.3. **Miscellaneous and Small Areas.** Miscellaneous areas are those that typically involve discontinuous operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed by the Engineer.

6.7. **Curing.** Cure the finished section for a minimum of 2 hr., or as directed, before opening to traffic. The Engineer may allow traffic on the finished section during curing when proof rolling indicates adequate stability. Apply fog seal daily at a rate between 0.05 and 0.10 gal. per square yard in accordance with Item 315, "Fog Seal," when traffic is allowed on the finished section during curing, unless otherwise directed.

Proof roll the roadbed in accordance with Item 216. If deformation occurs, do not allow traffic to return to the finished section until the mixed material is firm enough to accommodate traffic without deformation. Apply prime coat and seal coat or additional courses within 14 calendar days of final compaction.

When no specific detour is required, provide one-way traffic control until proof rolling permits the return of normal traffic to the compacted material.

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## 7. PROCESS CONTROL

Perform process control testing during the treatment process and for the completed base in accordance with Table 3 at locations independent of the Engineer's testing locations, unless otherwise directed. Test results from process control will not be used for acceptance. The Contractor may perform additional testing as they deem necessary for process control.

Report test results and all pertinent information in accordance with Section 291.6.1., "Reporting and Responsibilities." When test results do not meet specification requirements, modify operations and perform the test methods shown in Table 3. Suspend operations when any of the test results performed after the modifications do not meet specification requirements.

**Table 3**  
**Min Testing Frequency**

Description	Test Method	Min Frequency
Depth of pulverization	<a href="#">Tex-140-E</a>	One per 350 cu. yd. (Min one per day of production.)
Gradation	<a href="#">Tex-101-E</a> , Part III	
Foamed asphalt content	Meter readings or truck weight tickets	
Foamed asphalt treatment water content	Meter readings	
Moisture content <sup>1</sup>	<a href="#">Tex-103-E</a>	One per 350 cu. yd. (Min two per day of production.)

1. Measure the moisture content in accordance with [Tex-103-E](#) before adding the foamed asphalt.

7.1. **Depth of Pulverization.** Determine the depth of pulverization in accordance with [Tex-140-E](#).

7.2. **Gradation.** Sample the roadway mixture after mixing with the moisture and measure the gradation in accordance with [Tex-101-E](#), Part III.

7.3. **Foamed Asphalt Content.** Verify the percentage of asphalt added to the pulverized material using asphalt meter readings or truck weight tickets as approved; the quantity of material treated (depth, width, and length); and estimated in-place density. Changes in asphalt content, type, or supplier must be approved before the start of production. Notify the Engineer when adjustments to the asphalt content are made during any day's production.

7.4. **Foamed Asphalt Treatment Water Content.** Apply the water content determined from the mix design to produce the foamed asphalt. Measure the water content added using a water monitoring device from the

reclaimer. When necessary, adjust the water content and notify the Engineer within 1 hr. after material is reclaimed and treated.

- 7.5. **Moisture Content.** Measure the moisture content in accordance with [Tex-103-E](#) before adding the foamed asphalt. Verify the moisture content when precipitation occurs after testing and before the foamed asphalt is added.

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## 8. MEASUREMENT

- 8.1. **Asphalt.** Asphalt will be measured by one of the following methods.

- 8.1.1. **Weight.** Asphalt will be measured in tons using certified scales meeting the requirements of Item 520, "Weighing and Measuring Equipment," unless otherwise approved. The transporting truck must have a seal attached to the draining device and other openings. Random checking on public scales at the Contractor's expense may be required to verify weight accuracy.

Upon work completion or temporary suspension, any remaining asphalt material will be weighed by a certified public weigher. The quantity to be measured will be the number of tons received minus the number of tons remaining after all directed work is complete.

- 8.1.2. **Volume.** Asphalt will be measured by the gallon.

- 8.2. **Additive.**

- 8.2.1. **Lime.** When lime is furnished in trucks, the weight of lime will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location. Scales must meet the requirements of Item 520.

- 8.2.1.1. **Commercial Lime Slurry.** Lime slurry will be measured by the ton (dry weight) as calculated from the minimum percent dry solids content of the slurry, multiplied by the weight of the slurry in tons delivered.

- 8.2.1.2. **Quicklime.**

- 8.2.1.2.1. **Dry.** Lime will be measured by the ton (dry weight) of the quicklime.

- 8.2.1.2.2. **Slurry.** Lime slurry will be measured by the ton (dry weight) of the quicklime used to prepare the slurry multiplied by a conversion factor of 1.28 to give the quantity of equivalent hydrated lime, which will be the basis of payment.

- 8.2.2. **Cement.** Cement will be measured by the ton (dry weight). When cement is furnished in trucks, the weight of cement will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location. Scales must meet the requirements of Item 520.

- 8.3. **Foamed Asphalt Treatment.** Foamed asphalt treatment will be measured by the square yard of surface area. The dimensions for determining the surface area are established by the widths shown on the plans and lengths measured at placement.

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## 9. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for in accordance with Section 291.8.1., "Asphalt"; Section 291.8.2.1., "Lime"; Section 291.8.2.2., "Cement"; and Section 291.8.3., "Foamed Asphalt Treatment."

Furnishing and delivering new base will be paid for in accordance with Item 247, unless otherwise shown on the plans.

Furnishing and delivering fog seal will be paid for in accordance with Item 315, unless otherwise shown on the plans.

Removal and disposal of existing asphalt concrete pavement will be paid for in accordance with pertinent Items or Article 4.4., "Changes in the Work."

Additives and foamed asphalt used for reworking a section will not be paid for directly, but will be subsidiary to this Item.

Sprinkling and rolling, including proof rolling, will not be paid for directly, but will be subsidiary to this Item unless otherwise shown on the plans.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade or existing base will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade or existing base will be in accordance with pertinent Items or Article 4.4., "Changes in the Work."

When an additional additive is required by the mixture design or required by the Engineer and not shown on the plans, it will be paid for in accordance with Article 4.4., "Changes in the Work."

- 9.1. **Asphalt.** Asphalt will be paid for at the unit price bid. This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.
- 9.2. **Lime.** Lime will be paid for at the unit price bid for one of the following types: "Hydrated (Dry)," "Hydrated (Slurry)," or "Commercial Lime Slurry." This price is full compensation for furnishing lime.
- 9.3. **Cement.** Cement will be paid for at the unit price bid. This price is full compensation for furnishing cement.
- 9.4. **Foamed Asphalt Treatment.** Foamed asphalt treatment will be paid for at the unit price bid for the depth specified. No payment will be made for thickness or width exceeding those shown on the plans.

This price is full compensation for shaping existing material, loosening, mixing, pulverizing, spreading, applying additives and foamed asphalt, compacting, finishing, curing, curing materials, blading, shaping and maintaining shape, replacing mixture, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.

# Item 292

## Asphalt Treatment (Plant-Mixed)



### 1. DESCRIPTION

Construct a base or subbase of asphalt-treated material composed of a compacted mixture of aggregate and asphalt binder mixed hot in a mixing plant. Use this material for base repair work, bond breaker, detours, maintenance, and roadway and shoulder widening.

### 2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source. The Engineer will verify the specification requirements are met when the Contractor makes a source change. All source changes may require a new laboratory mixture design, trial batch, or both.

- 2.1. **Aggregate.** Furnish aggregates that conform to the requirements shown in Table 1 and specified in this Section unless otherwise shown on the plans. Each source must meet the requirements shown in Table 1. Stockpile aggregates for each source and type separately. Do not add material to an approved stockpile unless approved. The Engineer may allow testing of the proposed combined aggregates, rather than each source, to meet Table 1 requirements.

**Table 1**  
**Aggregate Quality Requirements**

Property	Test Method	Specification Requirement
Wet ball mill, % Max	<a href="#">Tex-116-E</a>	50
Max increase, % passing #40		20
Los Angeles abrasion <sup>1</sup> , % Max	<a href="#">Tex-410-A</a>	50
Liquid limit, Max	<a href="#">Tex-104-E</a>	40
Plasticity index, Max	<a href="#">Tex-106-E</a>	10
Sand equivalent, % Min	<a href="#">Tex-203-F</a>	40
Decantation, % Max	<a href="#">Tex-406-A</a>	5.0
Crushed faces <sup>2</sup> , % Min	<a href="#">Tex-460-A</a>	60

1. May be used instead of the Wet Ball Mill test.
2. Only applies to crushed gravel.

- 2.2. **Recycled Materials.** Use of reclaimed asphalt pavement (RAP) and reclaimed asphalt shingles (RAS) is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 2. The allowable percentages shown in Table 2 may be decreased or increased when shown on the plans. Determine the asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with [Tex-236-F](#). The Engineer may verify the asphalt content of the stockpiles at any time during production. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. Calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 2 during mixture design and production. Use a separate cold feed bin for each stockpile of RAP and RAS during production.

- 2.2.1. **Reclaimed Asphalt Pavement.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Fractionated RAP is defined as a stockpile that contains RAP material with at least 95.0% passing the 1/2-in. sieve, before burning in the ignition oven, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 1/2-in. screen to fractionate the RAP.

Use of Contractor-owned RAP, including hot-mix asphalt (HMA) plant waste, is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with [Tex-406-A](#), Part I. Determine the plasticity index in accordance with [Tex-106-E](#) if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

- 2.2.2. **Reclaimed Asphalt Shingles.** RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is processed manufacturer's shingle scrap byproduct. Post-consumer RAS is processed shingle scrap removed from residential structures. Up to 3% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 2. RAS may be used separately or in conjunction with RAP. Comply with all regulatory requirements stipulated for RAS by TCEQ.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8-in. sieve when tested in accordance with [Tex-200-F](#), Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt.

Add sand meeting the requirements shown in Table 3 and with a maximum linear shrinkage of 3.0% when tested in accordance with [Tex-107-E](#), or fine RAP to RAS stockpiles if needed to keep the processed material workable. For any stockpile that contains RAS, the entire stockpile will be considered a RAS stockpile and be limited to no more than 3.0% of the mixture in accordance with Table 2.

Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." If the RAS has not come into contact with any hazardous materials, treat it as an established nonhazardous recyclable material. Use RAS from shingle sources on the Department's MPL. Before use, remove substantially all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with [Tex-217-F](#), Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval to the Engineer before submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

**Table 2**  
**Max Allowable Amounts of Recycled Binder, RAP, and RAS**

Mixture Description and Location	Maximum Ratio of Recycled Binder to Total Binder <sup>1</sup> (%)	Maximum Allowable Recycled Material (%)	
		Fractionated RAP <sup>2</sup>	RAS <sup>3</sup>
Non-surface	40.0	35.0	3.0

1. Combined recycled binder from fractionated RAP and RAS.
2. May replace up to 3.0% fractionated RAP with RAS.
3. May be used separately or as a replacement for no more than 3.0% of the allowable fractionated RAP.

**Table 3**  
**Gradation Requirements for Sand When Added to RAS**

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70-100
#200	0-30

- 2.3. **Asphalt Binder.** Furnish PG64-22 asphalt binder that meets requirements of Item 300, "Asphalts, Oils, and Emulsions," unless otherwise shown on the plans.
- 2.4. **Tack Coat.** Furnish CSS-1H, SS-1H, EBL, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300. Specialized tack coat materials listed on the Department's MPL for Tracking Resistant Asphalt Interlayer (TRAIL) will be allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use, unless required in conformance with the manufacturer's recommendation for approved TRAIL product use.
- 2.5. **Additives.** Use the type of additive specified when shown on the plans. Use the rate of additive specified in conformance with the manufacturer's recommendation. Additives that facilitate mixing or compaction or improve the quality of the mixture are allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project, unless otherwise directed.
- 2.6. **Lime and Liquid Antistripping Agent.** Lime or liquid antistripping agent is required when shown on the plans. When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.
- 2.7. **Warm-Mix Asphalt (WMA).** WMA is allowed for use on all projects. Use WMA additives or processes from the Department's MPL.

### 3. EQUIPMENT

Provide machinery, tools, and equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

### 4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required in accordance with this Item, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving, unless otherwise shown on the plans.

- 4.1. **Certification.** Personnel certified by the Department-approved certification program must produce the mixture design and placement sampling. Provide a mixture design developed by a Level 2 certified specialist. Provide a Level 1B certified specialist to conduct placement sampling.



4.2. **Reporting and Responsibilities.** Use Department-provided templates to record and calculate all test data, including mixture design, production, and placement. Obtain the current version of the templates from the Department’s website or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested.

4.3. **Mixture Design.** Produce a mixture design in accordance with [Tex-204-F](#), Part IV. Determine the optimum asphalt content required to produce a mixture meeting the requirements shown in Table 4 for the grade shown on the plans. The gradation of the combined aggregates will be determined in accordance with [Tex-200-F](#), Part I.

Design the mixture using a Superpave Gyratory Compactor (SGC), and 50–75 gyrations as the design number of gyrations. Use a target laboratory-molded density from 96.0–97.0% to design the mixture; however, adjustments can be made to the Ndesign value as shown in Table 4.

**Table 4  
Mix Requirements**

Master Gradation Bands <a href="#">Tex-200-F</a> , Part I, % Passing by Weight				
Sieve Size	Grade 1	Grade 2	Grade 3 <sup>1</sup>	Grade 4
1-3/4"	–	100	–	As shown on the plans
1-1/2"	100	90–100	–	
1"	90–100	–	–	
1/2"	–	–	98–100	
3/8"	45–70	–	–	
#4	30–55	25–55	30–70	
#40	15–30	15–40	15–45	
Target laboratory-molded density, %	96.0–97.0%			
Design gyrations (Ndesign) <sup>2</sup>	50–75			
Asphalt content, %, Min	4.0	4.0	4.5	
Indirect tensile strength, <a href="#">Tex-226-F</a> <sup>3</sup> , psi	85–200	85–200	85–200	
Boil test, <a href="#">Tex-530-C</a> <sup>4</sup>	–	–	–	

1. Applicable to 1" bond breaker mixtures.
2. May be changed to a number of gyrations within a range of 35–100 when approved.
3. Tested at the optimum asphalt content.
4. Used to establish a baseline for comparison to production results. May be waived when directed.

4.4. **Ignition Oven Correction Factors.** The Engineer will determine the aggregate and asphalt correction factors from the ignition oven in accordance with [Tex-236-F](#), Part II. Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used. Correction factors must be performed every 12 mo. Notify the Contractor before performing [Tex-236-F](#), Part II. Allow the Contractor to witness the Engineer perform [Tex-236-F](#), Part II.

4.5. **Boil Test.** The Engineer will test and retain the tested sample from [Tex-530-C](#) until completion of the project or as directed. This sample will be used for comparison purposes during production. The Engineer may waive the requirement for the boil test.

4.6. **Mix Design Verification.** Provide a plant-produced trial batch upon receiving conditional approval of the mixture design and authorization to produce a trial batch for verification testing. Produce a trial batch mixture that meets the requirements shown in Tables 1, 2, 3, and 4. The Engineer may waive a trial batch to verify the mixture design if similar designs have proven satisfactory.

4.6.1. **Trial Batch Production Equipment.** Use only equipment and materials proposed for use on the project to produce the trial batch.

- 4.6.2. **Trial Batch Quantity.** Produce enough quantity of the trial batch to ensure the mixture meets the specification requirements.
- 4.6.3. **Number of Trial Batches.** Produce trial batches as necessary to obtain a mixture that meets the specification requirements.
- 4.6.4. **Trial Batch Testing.** Within 1 full working day, the Engineer will test the trial batch to ensure the gradation, laboratory-molded density, minimum asphalt content, and indirect tensile strength meet the requirements shown in Table 4. The asphalt content cannot be less than the minimum asphalt content shown in Table 4 and not vary by more than 0.5% from the optimum asphalt content determined from the mixture design. The allowable difference between the trial batch and mix design gradation must not exceed a tolerance of 5.0% and must be within the master gradation band.
- 4.7. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance with the specification. Submit a new mix design and perform a new trial batch when the asphalt binder content of:
- RAP stockpile used in the mix is more than 0.5% higher than the value shown in the mixture design report, or
  - RAS stockpile used in the mix is more than 2.0% higher than the value shown in the mixture design report.
- 4.7.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300 or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and HMA discharge temperatures (in legible and discernible increments) in accordance with Item 320, unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, or in any case longer than 12 hr. unless otherwise approved.
- 4.7.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 325°F. The Department will not pay for or allow placement of any mixture produced at more than 325°F.
- Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with [Tex-212-F](#), Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.
- 4.8. **Hauling Operations.** Before use, clean all truck beds to ensure that the mixture will not become contaminated. When a release agent is necessary, use a release agent on the Department's MPL to coat the truck bed. Do not use diesel or any release agent not shown on the Department's MPL.
- 4.9. **Placement Operations.** Prepare the surface by removing objectionable material such as moisture, dirt, sand, leaves, and other loose impediments before placing the mixture. Remove vegetation from pavement edges. Coordinate mixture delivery and paver speed to ensure a continuous placement operation. Suspend placement operations when, in the opinion of the Engineer, a continuous paving operation is not maintained. Place the mixture to produce a smooth, finished surface with a uniform appearance and texture that meet typical section requirements. Offset longitudinal joints of successive courses of stabilized base by at least 6 in. Place the mix adjacent to gutters and structures so that the pavement will drain properly.
- 4.9.1. **Weather Conditions.** Tack coat and mixture may be placed only when the roadway surface temperature is 45°F or higher unless otherwise approved. Measure the roadway surface temperature using a handheld infrared thermometer. Place tack coat or mixtures only when the Engineer determines that general weather conditions and moisture conditions of the roadway surface are suitable.
- 4.9.2. **Tack Coat.** The Engineer may waive the requirement to place tack coat.

4.9.2.1. **Application.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply the tack coat to all surfaces that will come in contact with the subsequent material placement, unless otherwise directed. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use, unless required in conformance with the manufacturer's recommendation for approved TRAIL product use, or when shown on the plans.

4.9.2.2. **Sampling.** The Engineer will obtain at least one sample of the tack coat binder per project per source in accordance with [Tex-500-C](#), Part III, and test it to verify compliance with Item 300. The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use. Label the can with the producer name, producer facility location, grade, district, date sampled, all applicable bills of lading (if available), and project information including highway and control number. For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in accordance with Item 300.

4.9.3. **Lay-Down Operations.** Dump and spread the asphalt mixture on the approved prepared surface using a spreading and finishing machine. Place the material without tearing, shoving, gouging, or segregating the mixture.

Do not jar or bounce the finishing machine when loading it. Obtain the required lines and grades without hand finishing. The Engineer may authorize hand finishing when the mixture is:

- placed in a narrow strip along the edge of existing pavement,
- used to level small areas, or
- placed in small irregular areas where the use of a finishing machine is not practical.

Leveling courses and other areas may be spread using a motor grader or other equipment when shown on the plans or approved.

When mixture is placed in windrows, operate windrow pickup equipment so that substantially all the mixture deposited on the roadbed is picked up and loaded into the spreading and finishing machine.

Adjust the hopper flow gates of the spreading and finishing machine to provide an adequate and consistent flow of material. Operate the augers at least 85% of the time. Keep the augers one-half to three-quarters full of mixture. Maintain an adequate flow of material to the center of the paver for the full width of the mat.

Immediately take appropriate corrective action if surface irregularities including, but not limited to, segregation, rutting, raveling, flushing, fat spots, mat slippage, color, texture, roller marks, tears, gouges, or streaks are detected. Continue placement for no more than 1 day of production while appropriate action is taken. If no appropriate corrective action is taken or if the problem still exists after 1 day, suspend paving until the Engineer approves further production.

4.10. **Compaction.** Compact the pavement using density control, unless otherwise shown on the plans or approved. Use ordinary compaction for miscellaneous areas.

Furnish the type, size, and number of rollers necessary to ensure desired compaction. Use additional rollers as required to remove any roller marks. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use the control strip method in accordance with [Tex-207-F](#), Part IV, on the first day of production to establish the rolling pattern that will produce the desired in-place air voids, unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures, and in locations that will not allow thorough compaction using rollers. The Engineer may require rolling using a trench roller in widened areas, in trenches, and in other limited areas.

Complete all compaction operations using breakdown rollers before the pavement temperature drops below 180°F unless otherwise allowed. Compaction using a pneumatic or light finish roller operated in static mode is allowed for pavement temperatures above 160°F.

- 4.10.1. **Density Control.** Compact the pavement uniformly to contain 3.8–8.5% in-place air voids, unless otherwise shown on the plans. The Engineer will determine in-place air voids from roadway cores taken in accordance with Section 292.4.11.3., “Placement Sampling.” The Engineer will determine air voids in accordance with [Tex-207-F](#) and [Tex-227-F](#). Before drying to a constant weight, cores may be pre-dried using a CoreDry or similar vacuum device to remove excess moisture.

Take immediate corrective action to bring the paving operation to 3.8–8.5% in-place air voids when the air voids of roadway cores exceed this amount. The Engineer will allow paving to resume when the proposed corrective action is likely to yield 3.8–8.5%. The Engineer may suspend operations or may allow the Contractor to continue operations for no more than 1 day while taking appropriate corrective action. If the in-place air voids are not within 3.8–8.5% within 1 full day of operation, suspend operations.

- 4.10.2. **Ordinary Compaction.** Furnish the type, size, and number of rollers required for compaction, as approved or directed. Establish rolling patterns in accordance with [Tex-207-F](#), Part IV, unless otherwise directed. Follow the selected rolling pattern unless changes in mixture or placement conditions that affect compaction occur. When changes occur, establish a new rolling pattern. Placement sampling and testing of roadway cores are not required.

- 4.10.3. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, pavement repair sections less than 300 ft., and other similar areas. Temporary detours are subject to in-place air void determination when shown on the plans. Miscellaneous areas also include bond breaker, thin level-up, and thin overlays when the layer thickness shown on the plans is less than the minimum untrimmed core height eligible for testing in accordance with Section 292.4.11.3., “Placement Sampling.” The specified layer thickness is based on the rate of 110 lb. per square yard for each inch of pavement unless another rate is shown on the plans. Miscellaneous areas are not subject to in-place air void determination.

- 4.11. **Sampling and Testing.**

- 4.11.1. **Production Sampling.**

- 4.11.1.1. **Mixture Sampling.** The Engineer will obtain mixture samples in accordance with [Tex-222-F](#).

- 4.11.1.2. **Asphalt Binder Sampling.** Obtain a 1-qt. sample of the asphalt binder witnessed by the Engineer for each day of production. The Contractor must notify the Engineer when the sampling will occur. Sample in accordance with [Tex-500-C](#), Part II. Label the container with the corresponding producer name, producer facility location, grade, district, date sampled, and project information including highway and control number. The Engineer will retain these samples for 1 yr. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division (MTD) to verify compliance with Item 300, and will retain the other split sample for 1 yr.

- 4.11.2. **Production Testing.** The Engineer will perform production tests.

- 4.11.2.1. **Operational Tolerances.** The Engineer will determine compliance with operational tolerances. The gradation of the aggregate must be within 5.0% of the trial batch gradation and within the master grading limits for the specified grade, except that a tolerance of 2% is allowed on the sieve size for each mixture grade that shows 100% passing in Table 4. The laboratory-molded density must be within  $96.0 \pm 1.0\%$ . The asphalt content must not be less than the minimum asphalt content and not vary by more than 0.5% from the optimum asphalt content determined from the mixture design. The Engineer may suspend production when test results exceed these operational tolerances.
- 4.11.2.2. **Individual Loads of Asphalt-Treated Base.** The Engineer may reject individual truckloads of mixture. When a load of mixture is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances required in accordance with Section 292.4.11.2.1., "Operational Tolerances," payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.
- 4.11.3. **Placement Sampling.** The Engineer will select random numbers for all coring locations at the beginning of the project. The Engineer will determine the random locations in accordance with [Tex-225-F](#), Part II and mark the locations. The random sample location will be no more than necessary to achieve a 2-ft. clearance if the location is within 2 ft. of a longitudinal joint or pavement edge.

Provide the equipment and means to obtain and trim roadway cores onsite. Onsite is defined as in close proximity to where the cores are taken. Obtain the cores within 1 working day of the time of placement unless otherwise approved. Obtain two 6-in. diameter cores side-by-side from within 1 ft. of the random location marked by the Engineer. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness.

Trim the cores immediately after obtaining them from the roadway in accordance with [Tex-251-F](#). The minimum untrimmed core height eligible for density testing is 1.75 in. Trim the cores onsite in the presence of the Engineer. Use a permanent marker or paint pen to designate as Core A or Core B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after witnessing the trimming of the cores and will retain custody of the cores until the Department's testing is completed. Before turning the trimmed cores over to the Engineer, the Contractor may wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use Department-provided security bags and the Roadway Core Custody protocol located on the Department's website to provide a secure means and process that protect the integrity of the cores during transport.

Instead of the Contractor trimming the cores onsite immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Either the Department or Contractor representative may perform trimming of the cores. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Dry the core holes and tack the sides and bottom immediately after obtaining the cores. Fill the hole with the same type of mixture and properly compact the mixture. Repair the core holes using other methods when approved.

- 4.11.4. **Irregularities.** Remove and replace, at the expense of the Contractor and to the satisfaction of the Engineer, any mixture that does not bond to the existing pavement or has other surface irregularities identified by the Engineer.
- 4.12. **Production Asphalt Binder Properties.** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by MTD. The aging ratio is the dynamic shear rheometer (DSR) value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high-temperature performance grade of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with [Tex-211-F](#).
- 4.13. **Ride Quality.** When shown on the plans, measure ride quality using Surface Test Type A in accordance with Item 585, "Ride Quality for Pavement Surfaces."
- 4.14. **Opening to Traffic.** Open the completed course to traffic when permitted or directed. If the surface ravels, flushes, ruts, or deteriorates in any manner before final acceptance, correct it at the Contractor's expense and to the satisfaction of the Engineer.

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## 5. MEASUREMENT

- 5.1. **Asphalt-Treated Base.** Base will be measured by the ton of composite mixture, which includes asphalt, aggregate, RAP, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."
- 5.2. **Tack Coat.** Tack coat will be measured at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.

The Engineer may allow the use of a metering device to determine asphalt volume used and application rate if the device is accurate within 1.5% of the strapped volume.

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## 6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 292.5.1., "Asphalt-Treated Base," will be paid for at the unit price bid for "Asphalt-Treated Base" of the mixture grade and binder specified. This price is full compensation for surface preparation, materials, production, placement, equipment, labor, tools, and incidentals. State-owned RAP from sources shown on the plans to be available will be provided to the Contractor at no cost.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 292.5.2., "Tack Coat," will be paid for at the unit bid price for "Tack Coat" of the tack coat provided. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

## Item 295

# Ultra-High-Pressure Water Cutting Treatment



### 1. DESCRIPTION

Use ultra-high-pressure (UHP) water cutting treatment equipment to remove excess asphalt to improve the pavement surface texture.

### 2. MATERIALS

Furnish water free of industrial wastes, oils, acids, organic matter, or other objectionable matter. Lake or river water will not be allowed. Do not use chemicals, abrasive materials, grinders, detergents, or salt water. Supply all permits, equipment, and tools necessary to obtain the water.

### 3. EQUIPMENT

3.1. **Ultra-High-Pressure Water Cutting Equipment.** Furnish equipment using UHP water to score and remove asphalt material from the pavement surface. Restore the macrotexture of the pavement surface without any damage to the pavement surface.

Provide continuous and uniform production using UHP water cutting equipment with the following capabilities:

- UHP pump capable of delivering a minimum of 16 gpm while operating at 36,000 psi;
- multi-jet spray head capable of rotating at 2,000 rpm with a minimum width of 18-in. vacuum system connected directly to the multi-jet spray head capable of removing asphalt binder, granular debris, and water from the treated pavement surface, and discharging to a waste storage system of sufficient capacity;
- storage capacity to hold a sufficient amount of water to operate continuously for a minimum of 4 hr.;
- independent drive, separate from the truck transmission, capable of infinitely varying the forward speed of the truck from 0–7 mph during surface treatment;
- drive system capable of maintaining forward ground speed within 0.1 mph of pre-set target speed, over roadway slopes of  $\pm 3.0\%$  grade;
- capable of adjustment to vehicle speed, spray bar rotation speed, vacuum system pressure, and waste material removal, on the go, as needed to maintain the quality of the treatment process;
- capable of treating a minimum of 550 sq. yd. per hour; and
- instrumentation gauges visible to the operator at all times.

3.1.1. **Calibration and Monitoring.** The UHP water cutting equipment will be equipped with instrumentation to facilitate calibration, monitor treatment effectiveness, and capture treatment production data.

Gauge readings will be benchmarked to time (daily work shift), and capable of continuous measurement and recording as follows:

- forward ground speed, certified reliable to 0.1 mph within a range of 0.1–7.0 mph; and
- spray bar rotational speed, certified reliable to 10 rpm within a range of 100–2,000 rpm.

UHP pump system pressure, measured as follows:

- at the pump, certified reliable to 100 psi within a range of 5,000–50,000 psi;
- at the spray head, certified reliable to 100 psi within a range of 5,000–50,000 psi;

- pavement temperature, measured in front of the cutting head, certified reliable to 1°F within a range of 0–165°F;
- water storage tank level, certified reliable to 100 gal. over the full tank capacity range; and
- UHP pump usage, in hours, certified reliable to 0.1 hr.

- 3.2. **Routine Equipment Maintenance.** Maintain an inventory of common wear parts and replacement accessories for equipment to ensure routine maintenance tasks can be performed without delay to the project schedule.
- 3.3. **Operator.** Operate UHP water cutting equipment using personnel who are qualified through training and experience, including all safety aspects. Provide an operator certification from the equipment manufacturer or equivalent.
- 3.4. **Cleaning.** Use equipment for surface cleaning operations where applicable, in accordance with Item 738, “Cleaning and Sweeping Highways.” Use other cleaning equipment required in accordance with this Item.

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#### 4. CONSTRUCTION

Use UHP water cutting equipment to remove excess asphalt from the pavement surface. Haul and dispose of removed material in conformance with applicable federal, state, and local regulations. If requested, provide an appropriate level of documentation to verify proper disposal. Obtain approval for the sequence of work and the estimated daily production.

Operate the UHP water cutting equipment when the air temperature is at least 35°F and rising and less than 85°F, unless otherwise directed. Suspend operations when the Engineer determines that weather conditions are unsuitable.

Operate equipment in conformance with the manufacturer’s instructions, including all safety guidelines. Remove excess asphalt from the lane in the direction of travel, unless otherwise directed. Ensure the spray head is not directly in line with and followed by the vehicle tires. Maintain continuous visibility of the treatment area adjacent to and behind the cutting head for the operator or observer with sufficient detail to facilitate identification of any treatment anomalies.

Do not damage the pavement surface. Damage consists of but is not limited to raveling or localized removal of the wearing course that exposes the underlying base or pavement layer. Do not damage existing delineation features, such as pavement striping or raised pavement markers. Suspend work when the pavement is damaged, unless otherwise directed. Repair damage to the pavement surface or delineation features caused by the treatment operation, as directed, at the Contractor’s expense.

- 4.1. **Control Strip.** Before treatment operations of each location, the Engineer will select an area with a minimum length of 100 ft. and a width of the cutter head. The Engineer will select a test location within the control strip area and measure the macrotexture in each wheel path before and after treatment at that same test location in accordance with Section 295.4.2., “Macrotexture.”

Demonstrate that the equipment, personnel, and methods of operation can produce satisfactory treatment results. Determine the target settings for the pump operating pressure and flow rate, nozzle configuration, spray bar rotational speed, and vacuum system pressure to achieve optimal treatment of the flushed pavement surface. Determine the target production rate of the combined operation measured in square yards per hour, based on the control strip treatment equipment settings.

The Engineer will visually inspect the control strip area after treatment to confirm no damage to the treated pavement has occurred. When the macrotexture requirements in Section 295.4.2., “Macrotexture,” are met and no damage has occurred as determined by the Engineer, proceed to treat the remaining location.

- 4.2. **Macrotexture.** The Engineer will measure the texture depth by the sand patch method in accordance with [Tex-436-A](#). Measurements will be taken in both wheel paths at the same location after treatment at a



minimum frequency of one for every 7,500 sq. yd., in addition to the control strip. Alternatively, the Engineer may use a circular track meter to measure an average texture depth in accordance with ASTM E2157.

When measured in accordance with [Tex-436-A](#), the texture depth must be greater than 0.035 in. When measured using a circular track meter, the texture depth must be greater than 0.55 in. The Engineer may reduce the testing frequency when two consecutive tests meet the minimum requirement.

When these requirements are not met, repeat treatment of any deficient locations as directed. The Engineer will determine the extent of the area in need of additional treatment to correct deficient locations.

Remove and replace the UHP water cutting equipment from the project when it does not treat the pavement to achieve acceptable macrotexture results, causes damage to the pavement, or cannot maintain the established production rates, as directed. No additional time will be allowed for failure to bring the proper equipment to the project. When additional or new equipment is used on the project, construct a control strip in accordance with Section 295.4.1., "Control Strip."

Remove debris from the pavement surface when the vacuum system does not adequately remove the debris from the treatment using a broom, shovel, hand scraper, or any other applicable tools and equipment.

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**5. MEASUREMENT**

"UHP Water Cutting Treatment" will be measured by the square yard of completed and accepted work. Measurement will be based on the limits shown on the plans, regardless of the number of passes required.

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**6. 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 "Ultra-High-Pressure Water Cutting Treatment." This price is full compensation for treatment of the pavement; UHP water cutting, vacuuming, hauling, and disposing of material; debris removal; sweeping; and equipment, labor, tools, and incidentals. Demonstration work to receive approval for use of equipment will not be paid for unless work is performed in accordance with the Contract and is accepted.