

Special Specification 3003

Emulsion Treatment (Road Mixed)



1. DESCRIPTION

Mix and compact emulsion, additives, water, and base, with or without asphalt 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. The Engineer will verify that the specification requirements are met before the sources can be used. The Engineer may sample and test project materials at any time for verification of properties. Use Tex-100-E for material definitions.

- 2.1. **Emulsion.** Provide an asphalt-emulsion that meets the requirements of Table 2.
- 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 emulsion.
- 2.3. **Additive.** Determine the amount and type of additive, if any, during the mix design. When an additive is required, the total amount in the mix will not exceed 1.5% by weight of material.
- 2.3.1. **Lime.** When lime is required, furnish lime that meets the requirements of DMS-6350, "Lime and Lime Slurry," and DMS-6330, "Pre-Qualification of Lime Sources." Use hydrated lime or commercial lime slurry as shown on the plans.
- 2.3.2. **Cement.** When cement is required, furnish hydraulic cement that meets the requirements of DMS-4600, "Hydraulic Cement," and the Department's Hydraulic Cement Quality Monitoring Program (HCQMP). Sources not on the HCQMP will require testing and approval before use.
- 2.3.3. **Fly Ash.** When fly ash is required, furnish fly ash that meets the requirements of DMS-4615, "Fly Ash for Soil Treatment."
- 2.4. **Mix Design.** Submit a mix design to the Engineer for approval, before the start of the project. Include the optimum moisture content, maximum dry density, percent additive, percent additional flexible base, percent existing material, and optimum percent asphalt-emulsion required to meet the mixture requirements in Table 1. Prepare unconfined compressive strength (UCS) specimens in accordance with Tex-113-E. Perform additional mix designs based on existing material variability, as directed by the Engineer.

Table 1
Laboratory Mixture Design Properties¹

Property	Test Procedure	Criteria
Min indirect tensile strength (ITS), psi	Tex-226-F	50
Min unconfined compressive strength (UCS), psi	Tex-117-E, Part II	150
Min retained UCS, psi	Tex-117-E ²	80%

1. Air dry specimens at 77 ±5°F for 72 hr. before testing.
2. Average of three specimens subjected to 10-day capillary moisture absorption before conducting UCS (similar to Tex-117-E, Part I, or Tex-121-E, Part I, without oven drying).

Table 2
Emulsified Asphalt Properties

Test	Method	Min	Max
Residue from distillation, %	AASHTO T 59	60	-
Oil distillate by distillation, %	AASHTO T 59	-	0.5
Sieve Test, %	AASHTO T 59	-	0.1
Penetration, 25°C, dmm	AASHTO T 49	55	95

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

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.

Provide a self-propelled mixer capable of fully mixing the existing road to the depth required, incorporate the asphalt-emulsion and water, and mix the materials to produce a homogeneous material. Provide a mixer with a minimum power of 400 HP. Provide a machine capable of mixing at least 8 ft. (2.4 m) wide and 12 in. (30.5 cm) deep in each pass. The mixer must contain a system for adding asphalt-emulsion with a full width spray bar consisting of a positive displacement pump interlocked to the machine speed so that the amount of emulsion being added is automatically adjusted with changes in machine speed. The emulsion injection system must be capable of incorporating up to 7 gal. per square yard of emulsion. Provide individual valves on the emulsion injection system spray bar that are capable of being turned off as necessary to minimize emulsion overlap on subsequent passes.

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. **Preshaping.** Pulverize existing bituminous surface and all existing pavement layers to the required depth. Incorporate water and additional flexible base during this operation, if needed. Shape roadway material in accordance with applicable bid items to conform to typical sections shown on the plans and as directed before the addition of asphalt-emulsion. Compact the material to support equipment and / or traffic, and to provide depth control during mixing.
- 4.2. **Mixing.** Before mixing, aerate if too wet and add water if too dry. Add emulsion at the percentage determined in Section 3003.2.4., "Mix Design." Monitor the required depth of mixing regularly.

Complete the entire operation of mixing the existing road and incorporating additional flexible base, water, and asphalt-emulsion in one pass. Ensure that each adjacent pass of the mixer overlaps the previous pass by a minimum of 6 in. Use multiple passes if the quality control requirements specified in Article 3003.5., "Quality Control," are not met. If an additional pass of the mixer significantly improves dispersion of the emulsion, use this additional pass for the entire project.

After mixing, the Engineer will sample the mixture at roadway moisture and test in accordance with Tex-101-E, Part III, to determine compliance with the gradation requirements in Table 3.

Table 3
Gradation Requirements

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

4.3. **Application of Additive.** Uniformly apply additive in advance of the mixer. 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.

4.3.1. **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 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. Take the temperature in the shade and away from artificial heat. Suspend application when the Engineer determines that weather conditions are unsuitable.

4.3.1.1. **Dry Placement.** When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of hydrated lime with approved equipment. Only hydrated lime may be distributed by bag. Do not use a motor grader to spread hydrated lime.

4.3.1.2. **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.

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

Distribute slurry uniformly by making successive passes over a measured section of roadway until the specified lime content is reached.

4.3.2. **Cement.** Uniformly apply cement using dry placement unless otherwise shown on the plans. Add cement at the percentage determined in the mix design. Apply cement only on an area where mixing, compacting, and finishing can be completed during the same working day. 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 with approved equipment.

4.3.3. **Fly Ash.** Uniformly apply fly ash using dry placement unless otherwise shown on the plans. Add fly ash at the percentage determined in the mix design. Apply fly ash only on an area where mixing, compacting, and finishing can be completed during the same working day. Before applying fly ash, bring the prepared roadway to approximately optimum moisture content. When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of fly ash with approved equipment.

4.3.4. **Emulsion.** Uniformly apply emulsion as specified in Section 3003.4.2., "Mixing." Add emulsion at the percentage determined in Section 3003.2.4., "Mix Design." Apply emulsion only on an area where mixing and compaction can be completed during the same working day.

Suspend emulsion application if the weather forecast calls for freezing temperatures within 7 days after incorporation of the emulsion. Finish emulsion application before the historical weather database predicts freezing temperatures within 7 days after completion of the emulsion portion of the project. Suspend application when the Engineer determines that weather conditions are unsuitable.

4.4. **Compaction.** Compact the mixture using density control, unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved.

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 super-elevated curves, begin rolling at the low side and progress toward the high side. Offset alternate trips of the roller. Operate rollers at a speed between 2 and 6 mph, as directed.

Perform initial compaction using a heavy tamping roller applying high amplitude and low frequency. Maintain the heavy tamping roller within 500 ft. of the mixer at all times. 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 of the pads at the material-heavy tamping roller drum interface.

After the completion of heavy tamping rolling, remove remaining tamping marks. Cut no deeper than the depth of the tamping marks. Achieve desired slope and shape to the lines and grades shown on the plans. Perform final surface shaping on the same day as the asphalt-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 that loses required moisture, density, stability, or finish within 24 hours of completion of compaction. Add additional emulsion and additives at the percentage directed.

Reworking includes loosening, adding material or removing unacceptable material if necessary; mixing as directed; compacting; and finishing. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.

When an area fails to meet or loses required moisture, density, stability, or finish more than 24 hours after completion of compaction and before the next course is placed or the project is accepted, remove the unacceptable material and replace with new material that meets the mix design requirements. Compact and finish until specification requirements are met. Perform the work at no additional expense to the Department.

4.4.1. **Ordinary Compaction.** Roll with 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.

4.4.2. **Density Control.** The Engineer will determine roadway density of completed sections in accordance with Tex-115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

Compact the bottom course to at least 95% of the maximum density determined in accordance with Tex-113-E, unless otherwise shown on the plans. Compact subsequent courses treated under this Item to at least 97% of the maximum density determined in accordance with Tex-113-E, unless otherwise shown on the plans.

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. Do not allow equipment or traffic on the finished course during curing, unless otherwise approved. The Engineer may allow traffic on the finished course during curing if proof rolling indicates adequate stability. Proof roll in accordance with Item 216, "Proof Rolling."

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 seals or additional courses within 14 calendar days of final compaction.

When the plans show no specific detour, the Contractor will provide one-way traffic control until proof rolling permits the return of normal traffic to the compacted material.

5. QUALITY CONTROL

The Contractor is responsible for quality control (QC) of the process and the completed base. The Engineer will provide sampling frequencies.

- 5.1. **Asphalt-Emulsion.** A representative from the asphalt-emulsion supplier will check the mixing and curing properties at the beginning of the project and will make recommendations for design changes to the Engineer.
- 5.2. **Moisture Content.** Check moisture content in accordance with Tex-103-E before addition of emulsion. Check the moisture content on the same day emulsion is applied. If rain has occurred after testing and before emulsion addition, recheck the moisture content.
- 5.3. Adjust by moisture addition (water truck) or aeration if the average moisture content is not within 1% of the mix design recommendation. Recheck the moisture content if manipulation has occurred.
- 5.4. **Emulsion Content.** Apply the amount of asphalt-emulsion recommended in the mix design. The Engineer must approve changes in asphalt-emulsion content or supplier. Check the percentage of emulsion added using meter readings or truck weigh tickets; the quantity of material reclaimed (depth, width, and length); and estimated in-place density determined by Tex-113-E (mix design or field check) or nuclear density gauge. Determine emulsion content on the first day of processing during the first emulsion transport. Adjust equipment calibration if necessary. Check emulsion content again if adjustments are made. Determine subsequent emulsion content as directed by the Engineer, but not less than once per day.
- 5.5. **Density.** Obtain samples to the full depth of reclamation before rolling and store in a sealed container for no longer than 2 hours. Compact in accordance with Tex-113-E and adjust mixing and compaction operations to achieve maximum dry density established in the mix design.

6. MEASUREMENT

- 6.1. **Emulsion.** Emulsion will be measured by the gallon.
- 6.2. **Additive.**
- 6.2.1. **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 a location approved by the Engineer. Scales must conform to the requirements of Item 520, "Weighing and Measuring Equipment."
- When lime is furnished in bags, each bag must 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.
- 6.2.1.1. **Hydrated Lime.**
- 6.2.1.1.1. **Dry.** Lime will be measured by the ton (dry weight).
- 6.2.1.1.2. **Slurry.** Lime will be measured by the ton (dry weight) of the hydrated lime used to prepare the lime slurry at the jobsite.
- 6.2.1.2. **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.
- 6.2.2. **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 a location approved by the Engineer. Scales must conform to 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 a shipment, as determined by weighing 10 bags taken at random, must be at least the manufacturer's certified weight.

- 6.2.3. **Fly Ash.** Fly ash will be measured by the ton (dry weight). When fly ash is furnished in trucks, the weight of fly ash will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at a location approved by the Engineer. Scales must conform to the requirements of Item 520, "Weighing and Measuring Equipment."

When fly ash is furnished in bags, each bag must 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.

- 6.3. **Emulsion Treatment.** Emulsion treatment will be measured by the square yard of surface area. The dimensions for determining the surface area is established by the widths shown on the plans and lengths measured at placement.

7. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid in accordance with Section 7.1, "Emulsion"; Section 7.2, "Lime"; Section 7.3, "Cement"; Section 7.4, "Fly Ash"; and Section 7.5, "Emulsion Treatment."

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

Mixing, spreading, blading, shaping, compacting, and finishing new or existing base material will be paid for under Section 7.5., "Emulsion Treatment." Removal and disposal of existing asphalt concrete pavement will be paid for in accordance with pertinent Items or Article 4.2., "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, 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, "Proof Rolling."

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 4.2., "Changes in the Work."

- 7.1. **Emulsion.** Emulsion will be paid for at the unit price bid for "Emulsion." This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.
- 7.2. **Lime.** Lime will be paid for at the unit price bid for "Lime" of the specified type (Hydrated (Dry), Hydrated (Slurry), or Commercial Lime Slurry). This price is full compensation for furnishing lime.
- 7.3. **Cement.** Cement will be paid for at the unit price bid for "Cement." This price is full compensation for furnishing cement.
- 7.4. **Fly Ash.** Fly ash will be paid for at the unit price bid for "Fly Ash." This price is full compensation for furnishing fly ash.

- 7.5. **Emulsion Treatment.** Emulsion treatment will be paid for at the unit price bid for “Emulsion Treatment (Existing Base),” or “Emulsion 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 additives and emulsion, 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.