

Date: July 15, 2011

To: MAG Specification and Detail Committee members

From: Jeff Benedict

RE: case 11-26 section 332 and 715 Slurry Seal material and application

Purpose: This case has moved material items into 715 and updated 332 applications sections to bring specification into current practice and technologies.

Revisions: Moved job mix formula to 715 from 332 (in whole) cleaned up language and updated 715 to allow the use of the polymer modified emulsion binders. This will be a major change to both sections, though only the addition of the PMQSH is an addition. Tables are clearer and updated.

SECTION 332

PLACEMENT AND CONSTRUCTION OF ASPHALT EMULSION SLURRY SEAL COAT

332.1 DESCRIPTION:

The work covered by this specification consists of furnishing all labor, equipment, and materials necessary to perform all operations required for the application of an asphalt emulsion slurry surface.

NOTE . . . THESE SPECIFICATIONS DO NOT COVER THE APPLICATION OF COAL TAR SLURRY SEALS.

332.2 MATERIALS:

The asphalt emulsion material, mineral aggregate and mineral filler shall be as specified in Section 715.

332.3 DETERMINATION OF JOB MIX:

~~The job mixture shall be designed to provide a suitable surface for traffic conditions, climate and curing. All materials shall be pre tested in a qualified laboratory to determine their suitability for use in the slurry seal. The Wet Track Abrasion Test (W.T.A.T.) will be used for design purposes to establish the mix design to be used in the specified slurry seal.~~

~~The test will show a maximum wear loss of 75 grams per square foot. Samples of materials to be used on the job shall be used to run the W.T.A.T. The test will be performed in accordance with ASTM D 3910 Design Testing and Construction of Slurry Seal.~~

~~**332.3.1 Composition of Slurry Seal Mixtures:** The job mixture shall conform to the requirements of the contract documents. The mixture shall attain an initial set in not less than 5 minutes not more than one hour. In cases where the surface is not critical to be open to traffic, a longer set time may be allowed, however not to exceed 12 hours. The setting time may be adjusted by the addition or removal of approved mineral fillers or chemical agents. The mixture shall be one of three types whose combined aggregates conform to the graduation requirements of Table 715-1. The mixture shall be sufficiently free flowing to fill cracks in the pavement. The mixture shall not segregate during or after laydown. The mixture shall produce a skid resistant surface.~~

~~**332.3.2 Trial Applications:** The Contractor shall place a test strip of 60 square yards in the area designated by the Engineer. The test section shall be placed using the same equipment and methods as will be used on the job. The slurry mixture placed in a test strip shall conform to the design mix as determined by the W.T.A.T. with minor variations to obtain crack filling, set time, pavement bond and a skid resistant texture. If the materials do not meet the requirements for fluidity, non segregation, or surface texture, a new job mix shall be formulated and tested. Work shall not proceed before approval of design mix and acceptance following the placing of a test strip.~~

332.34 EQUIPMENT:

~~**332.34.1 General:** When requested by the Engineer, descriptive information on the slurry seal mixing and applications equipment to be used will be submitted for approval no less than 7 days before the work starts.~~

~~**332.34.2 Self Contained Slurry Machine:** The mixing machine will be a continuous flow type. It will be capable of accurately delivering a predetermined proportion of pre-wetted aggregate, mineral filler, water and asphalt emulsion to the mixing chamber and discharging the thoroughly blended mixture on a continuous basis. The mixing machine will be equipped with a mineral filler feeder. The feeder will have an accurate metering device or method to introduce a predetermined proportion into the mixer. The filler will be introduced into the mixing chamber at the same time and location as the aggregate.~~

The mixing machine will be equipped with a water pressure system and fog-type spray bar, adequate for complete water fogging of the surface to be sealed.

The mixing machine will be mounted on a truck or other vehicle capable of producing evenly controlled low rates of speed throughout the operation to ensure the slurry is spread evenly and all cracks are filled.

| **332.34.3 Slurry Spreading Equipment:** Attached to the mixer machine shall be a mechanical type squeegee spreader equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. The box shall be kept clean. Build-up of asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags shall be approved by the Engineer.

| **332.34.4 Rollers:** Rollers shall be approved by the Engineer.

| **332.34.5 Cleaning Equipment:** Power brooms, pick-up brooms, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface.

| **332.34.6 Auxiliary Equipment:** Hand squeegees, shovels, and other equipment shall be provided as necessary to perform the work.

| **332.45 PREPARATION OF THE SURFACE:**

332.5.1 Immediately before applying the slurry, the area to be surfaced shall be cleaned of dirt, loose material, and other objectionable material. In urban areas, the surface shall be cleaned with a self-propelled pick-up sweeper. In rural areas, power brooms may be used. When necessary, cleaning shall be supplemented by hand brooms. Water flushing will not be permitted in areas where cracks are present in the pavement surface.

The slurry shall not be applied until an inspection of the surface has been made by the Engineer and he has determined that it is suitable.

| **332.45.2 Tack Coat:** When specified, a tack coat shall be applied in accordance with Section 329 using the same type and grade of asphalt emulsion as specified for the slurry seal.

| **332.45.3 Water Fogging:** When required by local conditions, the surface, directly ahead of the slurry box, shall be pre-wetted by fogging. The fogging shall be accomplished in such a manner that the entire surface is damp with no apparent flowing water or puddles.

| **332.56 WEATHER LIMITATIONS:**

The slurry seal shall not be applied unless the pavement temperature is at least 45°F. and rising. The mixture shall not be applied during unsuitable weather.

| **332.67 PROTECTION OF UNCURED SURFACE:**

Adequate methods such as barricades, flagmen, pilot cars, etc., shall be used to protect the uncured slurry surface from all types of traffic.

| **332.78 MIXING AND APPLICATION:**

The mixing time shall not exceed four minutes. Excessive mixing will not be allowed. The resulting mixture shall have the desired consistency, when placed on the surface. If breaking, hardening, segregation, balling or lumping occurs during the mixing process, the batch will be discarded.

A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained.

No streaks caused by oversized aggregate shall be left in the finished surface. Build-up on longitudinal and transverse joints will be kept to a minimum. Approved squeegees shall be used to spread slurry in areas nonaccessible to the slurry mixer.

| **332.89 ROLLING:**

As soon as the asphalt slurry has been set sufficiently to prevent any material from being picked up, it shall be rolled until all ridges have been ironed out and a uniform surface is obtained.

| **332.910 MEASUREMENT:**

Quantities and materials for this work will be paid for at the contract price per unit of measurement for each of the following pay items as indicated in the proposal.

- | | |
|---------------------------------------|-------------------|
| (A) Bituminous tack coat if specified | Ton (Diluted) |
| (B) Emulsified asphalt for slurry | Ton (Undiluted) |
| (C) Aggregate for slurry | Ton (Surface Dry) |

SECTION 715

SLURRY SEAL MATERIALS

715.1 GENERAL:

Slurry seal shall consist of a properly proportioned mixture of emulsified asphalt, mineral aggregate, mineral fillers, additives (if necessary), and water.

All material sources must be approved prior to their use. The Contractor will submit a job mix formula and if requested prequalifications for materials—samples at least seven days prior to start of construction. ~~When construction.~~ When requested, additional samples will be furnished during the construction period at no cost to the Contracting Agency. This is a non-pay item.

715.2 AGGREGATE:

715.2.1 Mineral Filler: Mineral filler shall consist of finely divided matter, such as hydrated lime, ~~portland~~Portland cement, limestone dust or fly ash, conforming to the requirements of ASTM D-4318. Mineral filler shall be used only when needed to reduce the setting time, to improve the workability or to reduce the stripping characteristics of the aggregate emulsion mixture. The minimum amount of the required filler will be used and it will be considered as part of the blended aggregate. The expected range shall be between .25% and 2.0% by weight of aggregate.

715.2.2 Mineral Aggregate: Mineral aggregate shall consist of sound and durable sand and/or crushed stone as per MAG Section 701 combined with an approved mineral filler where it is required. The mineral filler will be considered as part of the blended aggregate. The material shall be non-plastic (ASTM D-4318) with a sand equivalent (ASTM D-2419) of at least 50. The abrasion loss (ASTM C-131) shall not exceed 35 percent. Historical test data from source aggregate may be used that was run within the past two years. ~~Ninety percent of the aggregate retained on the No. 50 sieve shall have at least one fractured face.~~ Mineral aggregates used shall be 100% crushed. No natural sand shall be allowed. The gradation of ~~material~~mineral aggregate without mineral filler shall conform to Table 715-1.

| <u>TABLE 715-1</u> | | | |
|--|-----------------------------|------------------------------|-------------------------------|
| <u>SLURRY SEAL AGGREGATE</u> | | | |
| <u>SIEVE SIZE</u> | <u>Type I % PASSING</u> | <u>Type II % PASSING</u> | <u>Type III % PASSING</u> |
| <u>3/8</u> | <u>100</u> | <u>100</u> | <u>100</u> |
| <u>No. 4</u> | <u>100</u> | <u>85/100</u> | <u>70/90</u> |
| <u>No. 8</u> | <u>90/100</u> | <u>65/90</u> | <u>45/70</u> |
| <u>No. 16</u> | <u>65/90</u> | <u>45/70</u> | <u>28/50</u> |
| <u>No. 30</u> | <u>40/60</u> | <u>30/50</u> | <u>19/34</u> |
| <u>No. 50</u> | <u>25/42</u> | <u>18/30</u> | <u>12/25</u> |
| <u>No. 100</u> | <u>15/30</u> | <u>10/21</u> | <u>7/18</u> |
| <u>No. 200</u> | <u>10/20</u> | <u>5/15</u> | <u>5/15</u> |
| <u>Emulsified Asphalt content as a % of Dry Wt. Of Aggregate (approx.) ASTM D-3910 (W.T.A.T. TEST)</u> | <u>18</u> | <u>16</u> | <u>14</u> |
| <u>Residual Asphalt Range requirements % of Dry Wt. of Aggregate ASTM D-3910 (W.T.A.T. TEST)</u> | <u>10-16</u> | <u>7.5-13</u> | <u>6.5-12</u> |

| | | | |
|--|-------------|--------------|--------------|
| <u>Pounds of Aggregate per Square Yard (approx.)</u> | <u>8-10</u> | <u>12-18</u> | <u>18-25</u> |
|--|-------------|--------------|--------------|

715.3 BITUMINOUS MATERIAL:

The emulsified asphalt used for seal coating shall be quick setting or slow setting as per Section 713.
Polymer modified cationic quick setting emulsion (PMCQS-1h) may be used when approved by the Engineer.

The quick setting emulsified asphalt shall be of the anionic or cationic quick set type such as QSH₂ or CQSH₂ or PMCQS-1h that will react to chemically active mineral fillers such as ~~p~~Portland cement in such a way that the applied slurry mixture can support controlled traffic in 45-60 minutes after application. The amount of chemically active filler shall be determined by job mix formula~~mix design~~ and field performance.

Polymer modified cationic quick setting emulsion (PMCQS1-h) shall be homogeneous and the polymer used shall consist of either a solid polymer milled / blended into the asphalt or latex blended into the emulsifier solution prior to the emulsification process. The PMCQS-1h shall contain a minimum of three percent polymer and shall conform to section 713.

Slow setting emulsion may be used when traffic control is not a critical item.

| Quick Set Emulsion Mix Properties | |
|--|-----------------------------------|
| Slurry Seal Mixing, 70-85 degree F., Sec. | 120 Sec. Min. |
| Slurry Seal Setting text, 70-85 degree F., 1 hour cure | No Brown Stain |
| Slurry Seal Water Resistance Test, 70-85 degree F., 30 minute cure | No More Than Slight Discoloration |

~~Slow setting emulsion may be used when traffic control is not a critical item.~~

Placement of slurry seal is temperature dependent and should be tested under field conditions.

715.4 WATER:

Water shall be potable and be compatible with the slurry ingredients used.

714.5 DETERMINATION OF JOB MIX FORMULA:

The job mixture shall be designed to provide a suitable surface for traffic conditions, climate and curing. All materials shall be pre-tested in a qualified laboratory to determine their suitability for use in the slurry seal. The Wet Track Abrasion Test (W.T.A.T.) will be used for design purposes to establish the mix design to be used in the specified slurry seal.

The test will show a maximum wear loss of 75 grams per square foot. Samples of materials to be used on the job shall be used to run the W.T.A.T. The test will be performed in accordance with ASTM D-3910 Design Testing and Construction of Slurry Seal.

715.5.1 Composition of Slurry Seal Mixtures: The job mixture shall conform to the requirements of the contract documents. The mixture shall attain an initial set in not less than 5 minutes not more than one hour. In cases where the surface is not critical to be open to traffic, a longer set time may be allowed, however not to exceed 12 hours. The setting time may be adjusted by the addition or removal of approved mineral fillers or chemical agents. The mixture shall be one of three types whose combined aggregates conform to the graduation requirements of Table 715-1. The mixture shall be sufficiently free flowing to fill cracks in the pavement. The mixture shall not segregate during or after laydown. The mixture shall produce a skid-resistant surface.

715.5.2 Trial Applications: The Contractor shall place a test strip of 60 square yards in the area designated by the Engineer. The test section shall be placed using the same equipment and methods as will be used on the job. The slurry mixture placed in a test strip shall conform to the design mix as determined by the W.T.A.T. with minor variations to obtain crack filling, set time, pavement bond and a skid resistant texture. If the materials do not meet the requirements for fluidity, non-segregation, or surface texture, a new job mix shall be formulated and tested. Work shall not proceed before approval of design mix and acceptance following the placing of a test strip.

715.56 TEST CERTIFICATES & REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section 711.

715.67 CONVERSION OF QUANTITIES:

Volumetric conversions shall be accomplished in accordance with Section 713.

| TABLE 715-1 | | | |
|---|-----------------------------|------------------------------|-------------------------------|
| SLURRY SEAL AGGREGATE | | | |
| SIEVE SIZE | Type I % PASSING | Type II % PASSING | Type III % PASSING |
| 3/8 | 100 | 100 | 100 |
| No. 4 | 100 | 85/100 | 70/90 |
| No. 8 | 90/100 | 65/90 | 45/70 |
| No. 16 | 65/90 | 45/70 | 28/50 |
| No. 30 | 40/60 | 30/50 | 19/34 |
| No. 50 | 25/42 | 18/30 | 12/25 |
| No. 100 | 15/30 | 10/21 | 7/18 |
| No. 200 | 10/20 | 5/15 | 5/15 |
| Emulsified Asphalt content as a % of Dry Wt. Of Aggregate (approx.) ASTM D 3910 (W.T.A.T. TEST) | 18 | 16 | 14 |
| Residual Asphalt Range requirements % of Dry Wt. of Aggregate ASTM D 3910 (W.T.A.T. TEST) | 10-16 | 7.5-13 | 6.5-12 |
| Pounds of Aggregate per Square Yard (approx.) | 8-10 | 12-18 | 18-25 |