

SURFACINGS AND PAVEMENTS
SECTION 37: BITUMINOUS SEALS
37-2 SLURRY SEAL

37-2.01 DESCRIPTION

- This work shall consist of mixing asphaltic emulsion, aggregate, set-control additives and water and spreading the mixture on a surfacing or pavement where shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

37-2.02 MATERIALS

- The materials for slurry seal immediately prior to mixing shall conform to the following requirements:

37-2.02A Asphaltic Emulsion

- Asphaltic emulsion shall be a quick-setting type, Grade QS1h anionic or Grade CQS1h cationic, conforming to the provisions in Section 94, "Asphaltic Emulsions." The grade of asphaltic emulsion shall be at the option of the Contractor.

37-2.02B Water

- Water shall be of such quality that the asphalt will not separate from the emulsion before the slurry seal is in place in the work. If necessary for workability, a set-control agent that will not adversely affect the slurry seal may be used.

37-2.02C Aggregate

- Aggregate shall consist of rock dust and plaster sand or other sands of similar nature except that 100 percent of any aggregate or combination of aggregates, larger than the 300 μ m sieve size, used in the mixture shall be obtained by crushing rock. The material shall be free from vegetable matter and other deleterious substances. Aggregate shall be free of caked lumps and oversize particles.
- The percentage composition by mass of the aggregate shall conform to the following gradings when determined by California Test 202, modified by California Test 105 when there is a difference in specific gravity of 0.2 or more between blends of different aggregates. The type of aggregate shall be as specified in the special provisions.

| Percentage Passing | | | |
|--------------------|--------|---------|----------|
| Sieve Sizes | Type I | Type II | Type III |
| 9.5-mm | - | 100 | 100 |
| 4.75-mm | 100 | 94-100 | 70-90 |
| 2.36-mm | 90-100 | 65-90 | 45-70 |
| 1.18-mm | 60-90 | 40-70 | 28-50 |
| 600-µm | 40-65 | 25-50 | 19-34 |
| 75-µm | 10-20 | 5-15 | 5-15 |

- The aggregate shall also conform to the following quality requirements:

| Tests | California | Requirements | | |
|------------------|------------|--------------|---------|----------|
| | Test | Type I | Type II | Type III |
| Sand Equivalent | 217 | 45 min. | 55 min. | 60 min. |
| Durability Index | 229 | 55 min. | 55 min. | 55 min. |

- If the results of the aggregate grading do not meet the gradation specified, the slurry seal represented by the test shall be removed. However, if requested in writing by the Contractor and approved by the Engineer, the slurry seal may remain in place and the Contractor shall pay to State \$2.00 per tonne for the aggregate represented by the test and left in place.
- If the result of the Sand Equivalent test for aggregate does not meet the requirement specified, the slurry seal represented by the test shall be removed. However, if requested in writing by the Contractor and approved by the Engineer the slurry seal may remain in place and the Contractor shall pay to the State \$2.00 per tonne for the aggregate represented by the test and left in place.
- When the results of both the aggregate grading and the Sand Equivalent test do not conform to the requirements specified, both payments to the State shall apply. The Department may deduct these amounts from any moneys due, or that may become due, the Contractors under the contract. No single aggregate grading or Sand Equivalent test shall represent more than 275 tonnes or one day's production, whichever is smaller.

37-2.03 MIX DESIGN

- At least 7 working days before slurry seal placement commences, the Contractor shall submit to the Engineer for approval a laboratory report of tests and proposed mix design covering the specific materials to be used on the project. The percentage of asphaltic emulsion proposed in the mix design shall be within the percentage range specified in Section 37-2.04, "Proportioning."
- The test and mix design shall be performed by a laboratory capable of performing the applicable International Slurry Seal Association (ISSA) tests. The proposed slurry seal mixture shall conform to the requirements specified when tested in accordance with the following tests:

| Test | ISSA Test | Requirement |
|------------------------------------|-----------|-------------|
| Slurry Seal Consistency, mm | T106 | 30 max. |
| Wet Striping | T114 | Pass |
| Compatibility | T115 | Pass |
| Cohesion Testb, kg-mm within one h | T139 | 200 min. |
| Wet Track Abrasion, g/m2 | T100 | 800 max. |

- a. Mixing test must pass at the maximum expected air temperature at the project site during application.
- b. Using project source aggregate and asphaltic emulsion and set-control agents if used.

- The original laboratory report shall be signed by the laboratory that performed the tests and mix design shall show the results of the tests on individual materials, comparing the test results to those requires by the specifications. The report shall clearly show the proportions of aggregate, filler (as determined from the tests, minimum and maximum), water (minimum and maximum), asphalt solids content based on the dry mass of aggregate and set-control agent usage. Previous laboratory reports covering the same materials may be accepted provided they are made during the same calendar year.
- Once the proportions of materials to be used are approved by the Engineer, no substitution of other material will be permitted unless the materials proposed for substitution are first tested and a laboratory report is submitted for the substituted design as specified above. Substituted materials shall not be used until the mix design for those materials is approved by the Engineer.

37-2.04 PROPORTIONING

- Aggregate, asphaltic emulsion, water and additives, including set-control agent if used, shall be proportioned by volume utilizing the mix design approved by the Engineer. If more than one kind of aggregate is used, the correct amount of each kind of aggregate used to produce the required grading shall be proportioned separately, prior to adding the other materials of the mixture, in a manner that will result in a uniform and homogeneous blend.
- The completed mixture, after addition of water and any set-control agent used, shall be such that the slurry seal mixture has proper workability and (a) will permit traffic, not controlled with pilot cars, on the slurry seal within one hour after placement without the occurrence of bleeding, raveling, separation or other distress, and (b) prevent development of bleeding, raveling, separation or other distress within 15 days after placing the slurry seal.
- Asphaltic emulsion shall be added at a rate within the following ranges of percent by mass of the dry aggregate. The exact rate will be determined by the Engineer from the approved design asphalt binder content, and the asphalt solids content of the asphaltic emulsion furnished.

| Type of Aggregate | Ranges |
|-------------------|--------|
| I | 15-20 |
| II | 15-18 |
| III | 10-15 |

- The Contractor shall furnish an aggregate moisture determination for every 2 hours of operation or maintain the moisture content to within a maximum daily variation of ± 0.5 percent.
- The aggregate shall be proportioned using a belt feeder operated with an adjustable, cutoff gate. The height of the gate opening shall be readily determinable. The emulsion shall be introduced into the mixer by a positive displacement pump. Variable rate emulsion pumps, if used, shall be equipped with a means to seal the adjusting unit in its calibrated condition. Water shall be introduced into the mixer through a meter registering in liters delivered.
- Uniformity of distribution of asphalt will be determined by extraction tests in conformance with the requirements in California Test 310. The bitumen ratio (kilograms of asphalt per 100 kilograms of dry aggregate) shall not vary more than 0.5-kg of asphalt above or 0.5-kg of asphalt below the amount designated by the Engineer. This requirement shall apply to samples taken from any location or Operation designated by the Engineer.
- The delivery rate of aggregate and emulsion per revolution of the aggregate feeder shall be calibrated at the appropriate gate settings for each mixer-spreader truck used on the project in conformance with the requirements in California Test 109 and the requirements of these specifications.
- The aggregate belt feeder shall deliver aggregate to the pugmill mixer with such volumetric consistency that the deviation for any individual aggregate delivery rate check-run shall not exceed 2.0 percent of the average of 3 runs of at least 3 tonnes each in duration. The emulsion pump shall deliver emulsion to the pugmill with such volumetric consistency that the deviation for any individual delivery rate check-run shall be within 2.0 percent of the mathematical average of 3 runs of at least 1900 liters each in duration.
- Check-runs shall be performed for each aggregate source using a vehicle scale that has been tested and approved in conformance with the requirements in California Test 109
- The emulsion storage located immediately before the emulsion pump shall be equipped with a device which will automatically shut down the power to the emulsion pump and aggregate belt feeder when the level of stored emulsion is lowered.
- A temperature-indicating device shall be installed in the emulsion storage tank at the pump suction level. The device shall indicate temperature of the emulsion and shall be accurate to $\pm 3^{\circ}\text{C}$.
- The belt delivering the aggregate to the pugmill shall be equipped with a device to monitor the depth of aggregate being delivered to the pugmill. The device for monitoring depth of aggregate shall automatically shut down the power to the aggregate belt feeder whenever the depth of aggregate is less than 70 percent of the target depth of flow. An additional device shall monitor movement of the aggregate belt by detecting revolutions of the belt feeder. The devices for monitoring no flow or belt movement as the case may be, shall automatically shut down the power to the aggregate belt when aggregate belt movement is interrupted. The device to detect revolutions of the belt feeder will not be required when the aggregate delivery belt is an integral part of its drive chain.
- To avoid shutdowns caused by normal fluctuations in delivery rates, a delay of 3 seconds between sensing less than desirable storage levels of aggregate or emulsion and shutdown of the proportioning operations will be permitted.

37-2.05 MIXING AND SPREADING EQUIPMENT

- The slurry seal be mixed in continuous pugmill mixers of adequate size and power for the type of slurry seal to be placed. Indicators required in conformance with the provision in Section 37-2.04, "Proportioning," shall be in working order prior to commencing mixture and spreading operations.
- Mixer-spreader trucks shall be equipped to proportion emulsion, water, aggregate, and set-control additives by volume. Rotating and reciprocating equipment on mixer-spreader trucks shall be covered with metal guards.
- The mixer-spreader truck shall not be operated unless low-flow and no-flow warning devices and revolution counters are in good working condition and functioning and metal guards are in place. Indicators required by these special provisions shall be visible while walking alongside the mixer-spreader truck.
- Aggregate feeders shall be connected directly to the drive on the emulsion pump. The drive shaft of the aggregate feeder shall be equipped with a revolution counter reading to the nearest full revolution of the aggregate delivery belt.
- At least 2 operational spreader trucks shall be available at the job site during the spreading operation except when continuous placement type mixer-spreader trucks are used.
- In addition to conforming to the provisions in Section 5-1.10, "Equipment and Plants," the identifying number of mixer-spreader trucks shall be at least 50 mm in height, located on the front and rear of the vehicle.
- The slurry mixture shall be uniformly spread by means of a controlled spreader box conforming to the following requirements:

The spreader shall be capable of spreading a traffic lane width and shall have strips of flexible rubber belting or similar material on each side of the spreader box and in contact with the pavement to positively prevent loss of slurry from the box. Spreader boxes over 2.3 meters in width shall have baffles, reversible motor driven augers, or other suitable means, to ensure uniform applications on superelevated sections and shoulder slopes. Spreader box skids shall be maintained in such manner as to prevent chatter (wash boarding) in the finished mat.

Rear flexible strike-off blades shall make close contact with the pavement and shall be capable of being adjusted to the various crown shapes so as to apply a uniform slurry seal.

Flexible drags, to be attached to the rear of the spreader box, shall be provided as directed by the Engineer. Drags and strike-off blades shall be cleaned or changed daily if problems with cleanliness and longitudinal scouring occur.

The spreader box shall be clean, free of slurry seal and emulsion, at the start of each work shift.

- Slurry mixture, to be spread in areas inaccessible to the controlled spreader box, may be spread by other approved methods.

37-2.06 PLACING

- The slurry mixture shall be uniformly spread on the existing surfacing within the rate specified without spotting, rehandling or otherwise shifting of the mixture.

- Slurry seal shall not be placed when the atmospheric temperature is below 10°C or during unsuitable weather.
- Before placing the slurry seal the pavement surface shall be cleaned by sweeping, flushing or other means necessary to remove all loose particles of paving, all dirt and all other extraneous material.
- When there is a contract item of asphaltic emulsion to be used for paint binder, the pavement surface shall be coated with an SS or CSS grade asphaltic emulsion mixed in the proportion of one part of emulsion to 3 parts of water. The mixture shall be applied at the approximate rate of 0.4- to 0.7-L/m². The exact rate will be determined by the Engineer.
- Slurry Seal shall be spread at a rate within the following ranges in kilograms of dry aggregate per square meter. The exact rate will be determined by the Engineer. The completed spread shall be within 10 percent of the rate determined by the Engineer.

| Type of Aggregate | Ranges |
|-------------------|-------------|
| I | 4.5 - 6.5 |
| II | 5.5 - 8.0 |
| III | 11.0 - 13.5 |

- Longitudinal joints shall correspond with the edged of existing traffic lanes. Other patterns of longitudinal joints may be permitted, if the patterns will not Adversely affect the quality of the finished product, as determined by the Engineer.
- Through traffic lanes shall be spread in full lane width units only . Longitudinal joints, common to 2 traffic lanes, shall be butt joints with overlaps not to exceed 75 mm. Building paper shall be placed at transverse joints, over previously placed slurry seal, or other suitable methods shall be used to avoid double placement of slurry seal. Hand tools shall be available in order to remove spillage. Ridges or bumps in the finished surface will not be permitted.
- The mixture shall be uniform and homogeneous after spreading on the existing surfacing and shall not show separation of the emulsion and aggregate after setting.
- Adequate means shall be provided to protect the slurry seal from damage by traffic until such time that the mixture has cured sufficiently so that the slurry seal will not adhere to and be picked up by the tires of vehicles.

37-2.07 MEASUREMENT

- Slurry seal will be measured by the tonne. The quantity of slurry seal to be paid for will be the combined mass of the aggregate and asphaltic emulsion used in the slurry seal mixture. The mass of added water and set-control additives used in the slurry seal mixture will not be included in the mass of the slurry seal to be paid for. The mass of the aggregate and asphaltic emulsion will be determined as provided in Section 9-1.01, “Measurement of Quantities,” except that no deduction will be made for water in the aggregate and asphaltic emulsion.

37-2.08 PAYMENT

- The contract price paid per tonne for slurry seal shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing the slurry seal, complete in place, including testing for and furnishing the mix design, cleaning the surface, furnishing added water and set-control additives, mixing water with asphaltic emulsion for coating

the pavement, and protecting the seal until it has set, all as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.