

SURFACINGS AND PAVEMENTS

SECTION 37: BITUMINOUS SEALS

37-1 SEAL COATS

37-1.01 DESCRIPTION

- This work shall consist of an application or applications of asphaltic emulsion and screenings or an application of a mixture of asphaltic emulsion and added water.
- The Type of seal coat (fog, fine, medium fine, medium, coarse, or double) to be applied will be designated on the plans or specified in the special provisions.
- Fog seal coat shall consist of an application of a mixture of slow-setting type asphaltic emulsion and additional water. The water shall be added and mixed with the asphaltic emulsion (which contains up to 43 percent water) so that the resulting mixture will contain one part asphaltic emulsion and not more than one part added water. The exact quantity of added water will be determined by the Engineer.
- Fine, medium fine, medium and coarse seal coats shall consist of an application of asphaltic emulsion followed with an application of screenings. Double seal coat shall consist of an application of asphaltic emulsion followed with an application of screenings, and another application of asphaltic emulsion followed with another application of screenings.

37-1.02 MATERIALS

- Asphaltic emulsion shall conform to the provisions in Section 94, "Asphaltic Emulsions," and shall be of the grade specified in the special provisions, except that asphaltic emulsion for fog seal coat shall be any of the grades of slow-setting type asphaltic emulsion.
- Liquid asphalt for prime coat, if required, shall be of the grade specified in the special provisions, and shall conform to the provisions in Section 93, "Liquid Asphalts."
- A 2-L {half-gallon} sample of the asphaltic emulsion, as delivered to the project, will be taken in a plastic container from the spray bar of the distributor truck at mid-load.
- The size of screenings for the various types of seal coats shall conform to the following:

Seal Coat Types	Size of Screenings
Fine	6.3-mm x 2.00-mm { $\frac{1}{4}$ " x No. 10}
Medium fine	8.0-mm x 2.36-mm { $\frac{5}{16}$ " x No. 8}
Medium	9.5-mm x 3.35-mm { $\frac{3}{8}$ " x No. 6}
Coarse	12.5-mm x 4.75-mm { $\frac{1}{2}$ " x No. 4}
Double	
1st application	12.5-mm x 4.75-mm { $\frac{1}{2}$ " x No. 4}
2nd application	6.3-mm x 2.00-mm { $\frac{1}{4}$ " x No. 10}

- Screenings shall conform to the following requirements prior to depositing on the roadbed.

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- Screenings shall consist of broken stone, crushed gravel or both. At least 90 percent by mass of the screenings shall consist of crushed particles as determined by California Test 205.
- Screenings shall be clean and free from dirt and other deleterious substances.
- The percentage composition by mass of screenings shall conform to one of the following gradings:

Sieve Sizes	Percentage Passing			
	Coarse 12.5-mm X 4.75-mm {1/2" x No. 4}	Medium 9.5-mm X 3.35-mm {3/8" x No. 6}	Medium Fine 8.0-mm X 2.36-mm {5/16" x No. 8}	Fine 6.3-mm X 2.00-mm {1/4" x No. 10}
19.0-mm {3/4"}	100	—	—	—
12.5-mm {1/2"}	95-100	100	—	—
9.5-mm {3/8"}	50-80	90-100	100	100
4.75-mm {No. 4}	0-15	5-30	30-60	60-85
2.36-mm {No. 8}	0-5	0-10	0-15	0-25
1.18-mm {No. 16}	—	0-5	0-5	0-5
600-µm {No. 30}	—	—	0-3	0-3
75-µm {No. 200}	0-2	0-2	0-2	0-2

- Screenings shall also conform to the following quality requirements:

Tests	California Tests	Requirements
Los Angeles Rattler Loss at 100 Rev. (max.)	211	10%
Los Angeles Rattler Loss at 500 Rev. (max.)	211	40%
Film Stripping (max.)	302	25%
Cleanness Value (min.)	227	80

- If the results of the aggregate grading for screenings does not meet the gradation specified, the seal coat represented by the test shall be removed. However, if requested in writing by the Contractor and approved by the Engineer, the seal coat may remain in place, and the Contractor shall pay to the State \$2.00 per tonne {\$1.75 per ton} for the screenings represented by the test and left in place.
- If the results of the Cleanness Value test for screenings is below 80, the seal coat represented by the test shall be removed. However, if requested in writing by the Contractor and approved by the Engineer, seal coat containing screenings with a Cleanness Value below 80, but not less than 75, may remain in place. The Contractor shall pay to the State the following amount for the screenings represented by the test and left in place.

Cleanness Value	Payment to State
80 or over	None
79	\$2.20 per tonne { \$2.00 per ton }
77	\$4.40 per tonne { \$4.00 per ton }
75	\$6.60 per tonne { \$6.00 per ton }

- When both the aggregate grading and the Cleanness Value for screenings 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 Contractor under the contract. No single aggregate grading or Cleanness Value test shall represent more than 275 tonnes {300 tons} or one day's production, whichever is smaller.
- Samples for the aggregate grading and Cleanness Value tests will be taken from the conveyor belt of the spreader prior to application.

37-1.03 MAINTAINING TRAFFIC

- At locations where public traffic is being routed over a surface upon which a seal coat is to be applied, the seal coat shall not be applied to more than one-half the width of the traveled way at a time, and the remaining width shall be kept free of obstructions and open for use by public traffic until the seal coat first applied is ready for use by traffic.
- The Contractor shall provide for the passage of public traffic through the work in conformance with the provisions in Sections 7-1.08, "Public Convenience," and 7-1.09, "Public Safety," including the pilot cars, flaggers and equipment necessary to control traffic, as determined by the Engineer.
- Pilot cars utilized by the Contractor or required by Section 37-1.07, "Finishing," to convoy or otherwise control traffic shall have radio contact with other pilot cars and personnel in the work area. The maximum speed of the pilot cars convoying or controlling traffic through the traffic control zone shall be 25 km/h {15 miles per hour} on 2-lane two-way roadways and 40 km/h {25 miles per hour} on multilane divided and undivided roadways. Pilot cars shall only use traffic lanes open to public traffic.
- On 2-lane two-way roadways, C6 "LOOSE GRAVEL" signs and W6 (35) speed advisory signs shall be furnished and placed adjacent to both sides of the traveled way where screenings are being spread on a traffic lane. The first C6 sign in each direction shall be placed where traffic first encounters loose screenings, regardless of which lane the screenings are being spread on. The W6 (35) signs need not be placed in those areas with posted speed limits of less than 40 MPH. The signs shall be placed at maximum 600-m {2,000-foot} intervals along each side of the traveled way and at public roads or streets entering the seal coat area as directed by the Engineer.
- On multilane roadways (freeways, expressways and multilane conventional highways) where screenings are being spread on a traffic lane, C6 "LOOSE GRAVEL" signs and W6 (35) speed advisory signs shall be furnished and placed adjacent to the outside edge of the traveled way nearest to the lane being worked on. The first C6 sign shall be placed where the screenings begin with respect to the direction of travel on that lane. The W6 (35) signs need not be placed in those areas with posted speed limits of less than 40 MPH. The signs shall be placed at maximum 600-m {2,000-foot} intervals along the edge of traveled way and at

on-ramps, public roads or streets entering the seal coat area as directed by the Engineer.

- The C6 and W6 signs shall be maintained in place at each location until final brooming of the seal coat surface at that location is completed. The C6 and W6 signs shall conform to the provisions for construction area signs in Section 12, "Construction Area Traffic Control Devices." The signs may be set on temporary portable supports with the W6 below the C6 or on barricades with the W6 sign alternating with the C6 sign.

37-1.04 PREPARATION FOR SEAL COAT

- Immediately before applying the asphaltic emulsion, the surface to be sealed shall be clean and dry. Cleaning shall be performed by sweeping, flushing or other means necessary to remove all loose particles of paving, all dirt and all other extraneous material.
- When seal coats are to be applied to an untreated material, a prime coat consisting of liquid asphalt shall be applied to the material in place at a rate of from 0.90- to 1.5 L/m² {0.20- to 0.33-gallon per square yard}. The exact rate will be determined by the Engineer.

37-1.05 APPLYING ASPHALTIC EMULSION

- Asphaltic emulsion shall be applied in accordance with the provisions in Section 94, "Asphaltic Emulsions," and the provisions specified in this Section 37-1.05.
- The application rate of fog seal coat (asphaltic emulsion and added water) shall be such that the original emulsion will be spread at a rate of 0.2- to 0.5-L/m² {0.05- to 0.10-gallon per square yard}. The exact rate of application will be determined by the Engineer.
- The application rates of asphaltic emulsion for the other types of seal coats shall be within the following ranges in liters per square meter {gallons per square yard}. The exact rates will be determined by the Engineer.

Seal Coat Types	Ranges
Fine	0.7 to 1.4 {0.15 to 0.30}
Medium fine	1.1 to 1.6 {0.25 to 0.35}
Medium	1.1 to 1.8 {0.25 to 0.40}
Coarse	1.4 to 1.8 {0.30 to 0.40}
Double	
1st application	0.9 to 1.6 {0.20 to 0.35}
2nd application	0.9 to 1.4 {0.20 to 0.30}

- Asphaltic emulsion at the time of application shall be between 55°C {130° F} and 80°C {180° F}.
- Asphaltic emulsion shall not be applied when weather conditions are unsuitable. Seal coats requiring screenings shall not be applied until sufficient screenings are on hand to immediately cover the asphaltic emulsion, or when the atmospheric temperature is below 20°C {65° F} or above 40°C {110° F}, or when the pavement temperature is below 25°C {80° F}. Fog seal coat shall not be applied when the atmospheric temperature is below 5°C {40° F}.
- The Engineer will notify the Contractor, no later than 4:00 p.m., if it is anticipated that the next working day will not be suitable for the application of seal

coat. This notice may be given on the day preceding the date the Contractor intends to begin work, any working day after the Contractor has begun work, and any day previously named by the Engineer as a day unsuitable for applying seal coat. When the Engineer has declared a day to be unsuitable by reason of expected low temperature or unsuitable weather conditions, the Contractor shall not apply any new seal coat. If maintenance of previously applied seal coat can be performed, the Contractor shall continue to perform the maintenance. These unsuitable days will not be counted as working days regardless of the actual weather conditions and the fact that seal coat maintenance work is performed by the Contractor.

- If the Contractor has not been notified by the Engineer of an anticipated unsuitable day and at the beginning of the work day the weather is unsuitable for the application of seal coats, but maintenance of previously applied seal coat can be performed, the Contractor shall not apply any seal coat. Binder and screenings brought to the project shall be returned, stored or disposed of as directed by the Engineer. The Contractor shall continue maintenance of previously applied seal coat. The State will compensate the Contractor for show-up by paying for the direct cost of delivery and return, storage or disposal of the binder and screenings and for show-up time for workers who would have applied the seal coat but are not required for seal coat maintenance. The direct cost will be determined in conformance with the provisions in Section 9-1.03, "Force Account Payment," except there will be no markup allowance pursuant to Section 9-1.03A, "Work Performed by Contractor." The day will be considered a nonworking day.
- The provisions for compensation for show-up on unsuitable days will not apply if the Contractor has not provided the Engineer with the name of an authorized representative and a means of communication for providing notice as provided herein.
- After the application of a fog seal coat, asphaltic emulsion that becomes tacky shall be sprinkled with water in the amount ordered and as directed by the Engineer.
- When more than one type of seal coat is to be applied, the fog seal coat shall be applied at least 4 days in advance of the application of an adjoining seal coat requiring screenings. The seal coats shall be applied in such a manner that the joint between 2 types will present a neat and uniform appearance true to the line shown on the typical cross section and established by the Engineer.
- Applying asphaltic emulsion shall be discontinued sufficiently early in the day to permit the termination of traffic control prior to darkness. Asphaltic emulsion shall be applied to only one designated traffic lane at a time, and the entire width of the lane shall be covered in one operation.
- Asphaltic emulsion shall not be applied a greater distance than can be immediately covered by screenings, unless otherwise permitted by the Engineer.
- The cut off of asphaltic emulsion shall be made on building paper or similar material spread over the surface. Paper shall also be placed over the treated surface for a sufficient length at the beginning of a spread to avoid spraying existing pavement or previously placed screenings and so that the nozzles are spreading properly when the uncovered surface is reached. The building paper shall then be removed and disposed of in a manner satisfactory to the Engineer.
- The distribution of asphaltic emulsion shall not vary more than 15 percent transversely from the average as determined by tests, nor more than 10 percent

longitudinally from the specified rate of application as determined by California Test 339.

37-1.06 SPREADING SCREENINGS

- Screenings for seal coats shall be spread immediately following the application of the asphaltic emulsion. The spread rate of screenings for the various types of seal coats shall be within the following ranges in kilograms per square meter {pounds per square yard}. The exact rate will be determined by the Engineer. The completed spread shall be within 10 percent of the rate determined by the Engineer.

Seal Coat Types	Ranges
Fine	6.5 to 10.9 {12 to 20}
Medium fine	8.7 to 13.6 {16 to 25}
Medium	10.9 to 16.3 {20 to 30}
Coarse	12.5 to 16.3 {23 to 30}
Double	
1st application	12.5 to 16.3 {23 to 30}
2nd application	6.5 to 10.9 {12 to 20}

- Screenings shall be spread by means of a self-propelled chip spreader, equipped with a mechanical device which will spread the screenings at a uniform rate over the full width of a traffic lane in one application. The joint between adjacent applications of screenings shall coincide with the line between designated traffic lanes.
- Operating the chip spreader at speeds which cause the chips to roll over after striking the bituminous covered surface will not be permitted.
- The transverse cut off of screenings shall be complete and any excess screenings shall be removed from the surface prior to resuming operations.
- Stockpiling of screenings prior to placing will be permitted; however, any contamination resulting during storage or from reloading operations will be cause for rejection.
- Screenings shall be surface damp at the time of application, but excess water on the aggregate surface will not be permitted. Screenings shall be redampened in the vehicles prior to delivery to the spreader when directed by the Engineer.
- Asphaltic emulsion shall be covered with screenings before setting or "breaking" of the asphaltic emulsion occurs.

37-1.07 FINISHING

- After the screenings have been spread upon the asphaltic emulsion, piles, ridges or uneven distribution shall be carefully removed to ensure against permanent ridges, bumps or depressions in the completed surface. Additional screenings shall be spread in whatever quantities may be required to prevent picking up by the rollers or traffic, after which the surface shall be rolled.
- Rollers shall be pneumatic-tired type. A minimum of 2 pneumatic-tired rollers conforming to the provisions in Section 39-5.02, "Compacting Equipment," shall be furnished.
- Initial rolling shall consist of one complete coverage and shall begin immediately behind the spreader. Asphaltic emulsion and screenings shall not be spread more than 760 meters {2,500 feet} ahead of completion of initial rolling operations. Secondary rolling shall begin immediately after completion of the

initial rolling. The amount of secondary rolling shall be sufficient to adequately seat the screenings and in no case shall be less than 2 complete coverages.

- Unless otherwise provided in the special provisions or directed by the Engineer, seal coat surfaces shall be maintained, including the traffic control required for maintenance operations, for a period of 4 consecutive calendar days beginning on the day screenings are applied to the asphaltic emulsion. Maintenance of the surface shall include brooming and the distribution of screenings over the surface to absorb any free bituminous material, to cover any area deficient in cover coat material and to prevent formation of corrugations. Clean sand may be used in lieu of screenings to cover any excess of asphaltic emulsion which comes to the surface. The use of roadside material for this purpose will not be permitted.

- Brooms for finishing and maintaining seal coat screenings shall be the self-propelled type. When brooming is required adjacent to curbs, gutters, dikes, berms, railings or other barriers which would prevent loose screenings from being swept completely off the roadway, the self-propelled brooms shall also be capable of removing the loose screenings from the surface during brooming. In addition to the self-propelled brooms required for maintaining previously placed screenings, at each location where screenings are to be spread, a minimum of 3 self-propelled brooms shall be available, prior to the start of spreading the screenings at a location.

- The surface of the seal coat shall be broomed as often as necessary during the 4 calendar day maintenance period to maintain the surface free of loose screenings. At the end of the 4 consecutive calendar day maintenance period, any excess screenings shall be removed from paved areas. Brooming of seal coat surfaces shall be performed in such a manner that the screenings set in the asphaltic emulsion will not be displaced.

- The exact time of brooming will be determined by the Engineer. As a minimum, brooming will be required at the following approximate times:

1. On 2-lane two-way roadways, from 2 to 4 hours after traffic, controlled with pilot cars, has been routed on the seal coat.
2. On multilane roadways, from 2 to 4 hours after screenings have been placed.
3. In addition to previous brooming, immediately prior to opening any lane to public traffic, not controlled with pilot cars.
4. As a first order of work on the morning following application of screenings, on any lane that has been open to public traffic, not controlled with pilot cars.
5. At the end of the 4 calendar day maintenance period.

- The following shall apply to seal coat operations on 2-lane two-way roadways under one-way traffic control:

Upon completion of secondary rolling, public traffic shall be controlled with pilot cars and routed over the new seal coat for a period of from 2 to 4 hours. The exact time shall be as determined by the Engineer.

The Contractor shall schedule the operations such that seal coat is placed on both lanes of the traveled way each work shift, and such that one-way

traffic control is discontinued before darkness. At the end of the work shift, the end of the seal coat on both lanes shall generally match.

- The following shall apply to seal coat operations on multilane roadways:

Initial brooming may begin after the screenings have been in place for a period of from 2 to 4 hours. When the initial brooming is not completed during the work shift in which the screenings were placed, the initial brooming shall be completed as the first order of work at the beginning of the next work shift.

Public traffic shall be controlled with pilot cars and shall be routed on the new seal coat surface of a lane, for a minimum of 2 hours after completion of initial brooming and prior to opening the lane to traffic not controlled with pilot cars. When traffic is controlled with pilot cars, a maximum of one lane in the direction of travel shall be open to public traffic. Once traffic, controlled with pilot cars, is routed over the seal coat at a location, continuous control shall be maintained at that location until the seal coat placement and brooming on adjacent lanes to receive seal coat is completed.

- Excess screenings remaining on the surface after the first application of a "double" seal coat shall be removed prior to the second application of asphaltic emulsion.
- When directed by the Engineer, excess screenings shall be salvaged and stockpiled at designated locations.
- Excess screenings which in the opinion of the Engineer are not salvable and which interfere with drainage shall be removed and disposed of by the Contractor at the Contractor's expense. The removed screenings shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," or along embankment slopes, or at other suitable locations if permitted by the Engineer.
- The completed surface shall present a uniform appearance and shall be free from ruts, humps, depressions or irregularities due to an uneven distribution of asphaltic emulsion or screenings.

37-1.08 MEASUREMENT

- Quantities of screenings to be paid for by the tonne {ton} will be determined in conformance with the provisions in Section 9-1.01, "Measurement of Quantities."
- Quantities of liquid asphalt and asphaltic emulsion to be paid for will be determined in conformance with the provisions in Sections 93, "Liquid Asphalts," and 94, "Asphaltic Emulsions," respectively.

37-1.09 PAYMENT

- Seal coat will be paid for at the contract price per tonne {ton} for screenings, and the contract price per tonne {ton} for asphaltic emulsion (polymer modified), and for liquid asphalt (prime coat), for whatever items are provided and involved. The prices shall include preparation for seal coat and furnishing and applying asphaltic emulsion and screenings.
- The above prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in applying seal coat, complete in place, including furnishing, placing,

maintaining, and removing C6 and W6 signs, when required, and temporary supports or barricades for the signs, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

- Salvaging and stockpiling excess screenings will be paid for as extra work as provided in Section 4-1.03D.
- Water furnished and applied to tacky emulsion and for mixing with an asphaltic emulsion will not be paid for and full compensation therefor will be considered as included in the contract price paid for the asphaltic emulsion.
- When there is a contract item for traffic control system, full compensation for furnishing and using pilot cars to reduce the speed of traffic and convoy or otherwise control traffic, as specified, shall be considered as included in the contract lump sum price paid for traffic control system, and no separate payment will be made therefor. When there is no contract item for traffic control system, full compensation for furnishing and using the pilot cars shall be considered as included in the contract prices paid for the various items of seal coat work, and no separate payment will be made therefor.

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- μm {No. 50} 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.

Sieve Sizes	Percentage Passing		
	Type I	Type II	Type III
9.5-mm { $\frac{3}{8}$ "}	—	100	100
4.75-mm {No. 4}	100	94-100	70-90
2.36-mm {No. 8}	90-100	65-90	45-70
1.18-mm {No. 16}	60-90	40-70	28-50
600- μ m {No. 30}	40-65	25-50	19-34
75- μ m {No. 200}	10-20	5-15	5-15

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

Tests	California Test	Requirements		
		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 the State \$2.00 per tonne {\$1.75 per ton} 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 {\$1.75 per ton} 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 Contractor under the contract. No single aggregate grading or Sand Equivalent test shall represent more than 275 tonnes {300 tons} 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 tests 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 Stripping	T114	Pass
Compatibility	T115	Pass ^a
Cohesion Test ^b , kg - mm within one h	T139	200 min.
Wet Track Abrasion, g/m ²	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 and shall show the results of the tests on individual materials, comparing the test results to those required 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	Range
I	15 - 20
II	12 - 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 {gallons} 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 {3 tons} 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 {500 gallons} 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 $\pm 3^{\circ}\text{C}$ { $\pm 5^{\circ}\text{F}$ }.
- 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 operation will be permitted.

37-2.05 MIXING AND SPREADING EQUIPMENT

- The slurry seal shall 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 provisions in Section 37-2.04, "Proportioning," shall be in working order prior to commencing mixing 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 {2 inches} 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 {7.5 feet} in width shall have baffles, reversible motor driven augers, or other suitable means, to ensure uniform application 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 {50° F} 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 {0.08- to 0.15-gallon per square yard}. The exact rate will be determined by the Engineer.
- Slurry seal shall be spread at a rate within the following ranges in kilograms {pounds} of dry aggregate per square meter {square yard}. 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 {8 - 12}
II	5.5 - 8.0 {10 - 15}
III	11.0 - 13.5 {20 - 25}

- Longitudinal joints shall correspond with the edges 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 {3 inches}. 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 {ton}. 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 {ton} 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

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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.