

## ASPHALT-RUBBER SEAL COAT

Asphalt-rubber seal coat shall consist of an application of asphalt-rubber binder and screenings precoated with paving asphalt. Asphalt-rubber seal coat shall conform to the provisions specified for seal coats in Section 37-2, "Seal Coats," of the Caltrans Standard Specifications 2010 and to these special provisions.

## PAVING ASPHALT

Paving asphalt to be used in the asphalt-rubber binder shall be Grade 64-16 and shall conform to the provisions in Section 92 of the Caltrans Standard Specifications and ASTM 6373. The paving asphalt for use in asphalt-rubber binder shall not be polymer modified.

## ASPHALT MODIFIER

The asphalt modifier shall be a resinous, high flash point, aromatic hydrocarbon compound and shall conform to the following requirements:

Asphalt Modifier		
Test Parameter	ASTM Designation	Requirement
Viscosity, m <sup>2</sup> /s (10 <sup>-6</sup> ) at 100°C	D 445	X ±3*
Flash Point, CL.O.C. °C	D 92	207 min.
Molecular Analysis		
Asphaltenes, % by mass	D 2007	0.1 max.
Aromatics, % by mass	D 2007	55 min.

\* "X" denotes the proposed asphalt modifier viscosity from 19 to 36. A change in "X" requires a new asphalt rubber binder submittal.

Asphalt modifier and asphalt binder must be blended at the production site. Asphalt modifier must be from 2.5 to 6.0 percent by weight of the asphalt binder in the asphalt rubber binder. The asphalt rubber binder supplier determines the exact percentage.

If blended, the asphalt binder must be from 375 to 440 degrees F when asphalt modifier is added and the mixture must circulate for at least 20 minutes. Asphalt binder, asphalt modifier, and crumb rubber modifier may be proportioned and combined simultaneously.

## CRUMB RUBBER MODIFIER (CRM)

Crumb rubber modifier (CRM) shall consist of a combination of scrap tire CRM and high natural CRM. CRM shall be ground or granulated at ambient temperature.

Steel and fiber must be separated. If steel and fiber are cryogenically separated, it must occur before grinding and granulating. Cryogenically-produced crumb rubber modifier particles must be large enough to be ground or granulated.

Wire must not be more than 0.01 percent by weight of crumb rubber modifier. Crumb rubber modifier must be free of contaminants except fabric, which must not exceed 0.05 percent by weight of crumb rubber modifier.

The length of an individual crumb rubber modifier particle must not exceed 3/16 inch.

Crumb rubber modifier must be dry, free-flowing particles that do not stick together. A maximum of 3 percent calcium carbonate or talc by weight of crumb rubber modifier may be added. Crumb rubber modifier must not cause foaming when combined with the asphalt binder and asphalt modifier.

Specific gravity of crumb rubber modifier must be from 1.1 to 1.2 determined under California Test 208.

When tested under ASTM D 297, crumb rubber modifier must comply with the requirements shown in the following table:

Test Parameter	Scrap Tire CRM Percent		High Natural CRM Percent	
	Minimum	Maximum	Minimum	Maximum
Acetone Extract	6.0	16.0	4.0	16.0
Rubber Hydrocarbon	42.0	65.0	50.0	—
Natural Rubber content	22.0	39.0	40.0	48.0
Carbon Black Content	28.0	38.0	—	—
Ash Content	—	8.0	—	—

The CRM for asphalt-rubber binder shall conform to the gradations specified below when tested in conformance with the requirements in ASTM C 136, except as follows:

- A. Split or quarter 100 g $\pm$ 5 g from the CRM sample and dry to a constant mass at a temperature of not less than 57°C nor more than 63°C and record the dry sample mass. Place the CRM sample and 5 g of talc in a 0.5-L jar. Seal the jar, then shake the jar by hand for a minimum of one minute to mix the CRM and the talc. Continue shaking or open the jar and stir until particle agglomerates and clumps are broken and the talc is uniformly mixed.
- B. Place one rubber ball on each sieve. Each ball shall have a mass of 8.5 g  $\pm$ 0.5 g, have a diameter of 24.5 mm  $\pm$ 0.5 mm, and shall have a Shore Durometer "A" hardness of 50  $\pm$ 5 in conformance with the requirements in ASTM Designation: D 2240. After sieving the combined material for 10 minutes  $\pm$ 1 minute, disassemble the sieves. Material adhering to the bottom of a sieve shall be brushed into the next finer sieve. Weigh and record the mass of the material retained on the 2.36-mm sieve and leave this material (do not discard) on the scale or balance. Observed fabric balls shall remain on the scale or balance and shall be placed together on the side of the scale or balance to prevent the fabric balls from being covered or disturbed when placing the material from finer sieves onto the scale or balance. The material retained on the next finer sieve (2.00-mm sieve) shall be added to the scale or balance. Weigh and record that mass as the accumulative mass retained on that sieve (2.00-mm sieve). Continue weighing and recording the accumulated masses retained on the remaining sieves until the accumulated mass retained in the pan has been determined. Prior to discarding the CRM sample, separately weigh and record the total mass of fabric balls in the sample.
- C. Determine the mass of material passing the 75- $\mu$ m sieve (or mass retained in the pan) by subtracting the accumulated mass retained on the 75- $\mu$ m sieve from the accumulated mass retained in the pan. If the material passing the 75- $\mu$ m sieve (or mass retained in the pan) has a mass of 5 g or less, cross out the recorded number for the accumulated mass retained in the pan and copy the number recorded for the accumulated mass retained on the 75- $\mu$ m sieve and record that number (next to the crossed out number) as the accumulated mass retained in the pan. If the material passing the 75- $\mu$ m sieve (or mass retained in the pan) has a mass greater than 5 g, cross out the recorded number for the accumulated mass retained in the pan, subtract 5 g from that number and record the difference next to the crossed out number. The adjustment to the accumulated mass retained in the pan is made to account for the 5 g of talc added to the sample. For calculation purposes, the adjusted total sample mass is the same as the adjusted accumulated mass retained in the pan. Determine the percent passing based on the adjusted total sample mass and record to the nearest 0.1 percent.

### Scrap Tire CRM Gradation

Percentage Passing			
Sieve Size	Gradation Limit	Operating Range	Contract Compliance
No. 8	100	100	100
No. 10	98-100	95-100	90-100
No. 16	45-75	35-85	32-88
No. 30	2-20	2-25	1-30
No. 50	0-6	0-10	0-15
No. 100	0-2	0-5	0-10
No. 200	0	0-2	0-5

### High Natural CRM Gradation

Percentage Passing			
Sieve Size	Gradation Limit	Operating Range	Contract Compliance
No. 10	100	100	100
No. 16	95-100	92-100	85-100
No. 30	35-85	25-95	20-98
No. 50	10-30	6-35	2-40
No. 100	0-4	0-7	0-10
No. 200	0-1	0-3	0-5

### **ASPHALT-RUBBER BINDER**

Asphalt-rubber binder shall consist of a mixture of paving asphalt, asphalt modifier, and crumb rubber modifier.

At least 15 days before its intended use, the Contractor shall furnish the Engineer four 1-quart cans filled with the asphalt-rubber binder proposed for use on the project. The Contractor shall supply the Engineer, for approval, a binder formulation and samples of all materials to be used in the asphalt-rubber binder, at least 15 days before construction is scheduled to begin. The binder formulations shall consist of the following information:

- A. Paving Asphalt and Modifiers:
  1. Source and grade of paving asphalt.
  2. Source and identification (or type) of modifiers used.
  3. Percentage of asphalt modifier by weight of paving asphalt.
  4. Percentage of the combined blend of paving asphalt and asphalt modifier by total weight of asphalt-rubber binder to be used.
  5. Laboratory test results for test parameters shown in these special provisions.
  
- B. Crumb Rubber Modifier (CRM):
  1. Source and identification (or type) of scrap tire and high natural CRM.
  2. Percentage of scrap tire and high natural CRM by total weight of the asphalt-rubber blend.
  3. If CRM from more than one source is used, the above information will be required for each CRM source used.
  4. Laboratory test results for test parameters shown in these special provisions.
  
- C. Asphalt-Rubber Binder:
  1. Laboratory test results of the proposed blend for test parameters shown in these special provisions.
  2. The minimum reaction time and temperature.

The method and equipment for combining the paving asphalt, asphalt modifier, and CRM shall be so designed and accessible that the Engineer can readily determine the percentages by weight for each material being incorporated into the mixture.

The proportions of the materials, by total weight of asphalt-rubber binder, shall be 79 percent ±1 percent combined paving asphalt and asphalt modifier and 21 percent ±1 percent CRM. However, the minimum amount of CRM shall not be less than 20.0 percent. Lower values shall not be rounded up. The CRM shall be combined at the production site and shall contain 76 percent ±2 percent scrap tire CRM and 24 percent ±2 percent high natural CRM, by weight.

The blended paving asphalt and asphalt modifier mixture and the CRM shall be combined and mixed together at the production site in a blender unit to produce a homogeneous mixture.

The temperature of the blended paving asphalt and asphalt modifier mixture shall not be less than 375 °F nor more than 440 °F when the CRM is added. The combined materials shall be reacted for a minimum of 45 minutes after incorporation of the CRM at a temperature of not less than 375 °F nor more than 425 °F. The temperature shall not be higher than 10 °F below the actual flash point of the asphalt-rubber binder.

After reacting, the blended asphalt-rubber binder shall conform to the following requirements:

Blended Asphalt-Rubber Binder

Test Parameter	ASTM Test Method	Requirement	
		Minimum	Maximum
Cone Penetration @ 25°C, 1/10 mm	D 217	25	60
Resilience @ 25°C, Percent rebound	D 5329	18	50
Field Softening Point, °C	D 36	55	88
Viscosity @190°C, Pa • s (x10 <sup>-3</sup> )	ASTM D 7741	1500	2500
Vialit Test "French Chip"	Caltrans Method	90%	-

1) The Vialit test shall be performed according to Caltrans specifications except asphalt rubber shall be applied to the test plates in an amount equivalent to the specified application rate for the project. The 48 hour cure shall be at ambient temperature not 60C. Test pan lips shall be high enough to prevent asphalt cement from over flowing. Aggregate used shall be the aggregate proposed for use on the project and shall be pre-coated as required for asphalt rubber chip seal.

The reacted asphalt-rubber binder shall be maintained at a temperature of not less than 375 °F nor more than 415 °F.

Stop heating unused asphalt rubber binder 4 hours after the 45-minute reaction period. Reheating asphalt rubber binder that cools below 375 degrees F is a reheat cycle. Do not exceed 2 reheat cycles. If reheating, asphalt rubber binder must be from 375 to 415 degrees F before use.

During reheating, you may add scrap tire crumb rubber. Scrap tire crumb rubber must not exceed 10 percent by weight of the asphalt rubber binder. Allow added scrap tire crumb rubber to react for at least 45 minutes. Reheated asphalt rubber binder must comply with the specifications for asphalt rubber

**SCREENINGS**

Screenings for asphalt rubber seal coat must comply with the \_\_\_\_\_ grading.

Before precoating with asphalt binder and when tested under California Test 202, screenings for asphalt rubber seal coat must have the gradation shown in the following table:

### Asphalt Rubber Seal Coat Screenings Gradation

Sieve sizes	Percentage passing by weight		
	Coarse 1/2" max	Medium 1/2" max	Fine 3/8" max
3/4"	100	100	100
1/2"	75–90	85–90	95–100
3/8"	0–20	0–30	70–85
No. 4	0–2	0–5	0–15
No. 8	--	--	0–5
No. 200	0–1	0–1	0–1

Screenings must have the values for the properties shown in the following table:

### Seal Coat Screenings

Properties	Test method	Value
Cleanness value, min	California Test 227	80
Durability, min	California Test 229	52

### EQUIPMENT

The Contractor shall utilize the following equipment for asphalt-rubber seal coat operations:

- A. Self-propelled power brooms that clean the existing pavement and remove loose screenings without dislodging screenings set in the asphalt-rubber binder. Gutter brooms or steel-tined brooms shall not be used;
- B. Pneumatic tired rollers conforming to the provisions in Section 39-3.03, "Spreading and Compacting Equipment," of the Standard Specifications, except that the rollers shall have an air pressure of 100 pounds per square inch and maintained so that the air pressure will not vary more than  $\pm 5$  pounds per square inch in each tire or the tires shall be foam filled. A sufficient number of rollers shall be used so that one complete coverage will be provided in one pass;
- C. A self-propelled screenings spreader, equipped with a screenings hopper in the rear and belt conveyors to carry the screenings to the front of a spreading hopper. The screenings spreader shall be capable of providing a uniform screening spread rate over the entire width of the traffic lane in one application;
- D. An asphalt heating tank equipped to heat and maintain the blended paving asphalt and asphalt modifier mixture at the necessary temperature before blending with the CRM. This unit shall be equipped with a thermostatic heat control device and a temperature reading device and shall be accurate to within  $\pm 5$  °F and shall be of the recording type;
- E. A mechanical mixer for the complete, homogeneous blending of paving asphalt, asphalt modifier, and CRM. Paving asphalt and asphalt modifier shall be introduced into the mixer through meters conforming to the provisions in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications. The blending system shall vary the rate of delivery of paving asphalt and asphalt modifier proportionate with the delivery of CRM. During the proportioning and blending of the liquid ingredients, the temperature of paving asphalt and the asphalt modifier shall not vary more than  $\pm 25$  °F. The paving asphalt feed, the asphalt modifier feed, and CRM feed shall be equipped with devices by which the rate of feed can be determined during the proportioning operation. Meters used for proportioning individual ingredients shall be equipped with rate-of-flow indicators to show the rates of delivery and resettable totalizers so that the total amounts of liquid ingredients introduced into the mixture can be determined. The liquid and dry ingredients shall be fed directly into the mixer at a uniform and controlled rate. The rate of feed to the mixer shall not exceed that which will permit complete mixing of the materials. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected by a reduction in the volume of material or by other adjustments. Mixing shall continue until a homogeneous mixture of uniformly distributed and properly

- blended asphalt-rubber binder of unchanging appearance and consistency is produced. The Contractor shall provide a safe sampling device that delivers a representative sample of the completed asphalt-rubber binder of sufficient size to permit the required tests;
- F. An asphalt-rubber binder storage tank equipped with a heating system to maintain the proper temperature of the asphalt-rubber binder and an internal mixing unit that maintains a homogeneous mixture of blended paving asphalt, asphalt modifier, and CRM;
  - G. A self-propelled truck or trailer mounted distributor, equipped with an internal mixing unit that maintains a homogeneous mixture of blended paving asphalt, asphalt modifier and CRM. The distributor shall have a pump or pumps that sprays asphalt-rubber binder within  $\pm 0.05$  gallon per square yard of the specified rate. The distributor shall have a fully circulating spray bar that applies the asphalt-rubber binder without a streaked or otherwise irregular pattern. The distributor shall be equipped with a tachometer, pressure gages, volume measuring devices, and thermometer. The distributor shall have a platform on the rear of the vehicle and an observer shall accompany the distributor. The observer shall ride in such a position that all spray nozzles are in full view and readily accessible for unplugging plugged nozzles, should plugging occur; and
  - H. Tailgate discharge trucks for hauling screenings shall be equipped with a device to lock onto the hitch at the rear of the screenings spreader. Haul trucks shall be compatible with the screenings spreader so that the dump bed will not push down on the spreader when fully raised or have too short a bed which results in screenings spilling while dumping into the receiving hopper.
  - I. Under supports for scale bearing points for scale structures where the total load, live plus dead load, is less than 17 tons, shall be as follows:
    - 1. Structure shall be supported on at least 4 legs. The total load on any one leg shall not be greater than 14.5 psi.
    - 2. Undersupport shall be structural grade steel with a minimum cross sectional dimension of 20 inches and a minimum thickness of 1.5 inch.
    - 3. Entire scale structure including supports shall be constructed so no movement or deflection is possible during production operations. Only metal shall be used in the scale support structure.
    - 4. Scale structure shall be level during device calibration and material production.
    - 5. Adequate drainage shall be provided to prevent saturation of the ground under the scale. The ground under the scale shall remain in a condition which will support 14.5 psi at each support.
    - 6. At the option of the Contractor, the scale structure shall be installed using concrete under supports in conformance with the provisions in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications may be used.

Equipment shall be approved by the Engineer prior to use.

#### **ASPHALT-RUBBER BINDER APPLICATION**

Apply asphalt rubber binder immediately after the reaction period. At the time of application, the temperature of asphalt rubber binder must be from 385 to 415 degrees F.

Apply asphalt rubber binder at a rate from 0.55 to 0.65 gal/sq yd. The Engineer determines the exact rate. Apply asphalt rubber binder when the atmospheric temperature is from 60 to 105 degrees F and the pavement surface temperature is at least 55 degrees F.

Do not apply asphalt rubber binder unless there are sufficient screenings available to cover the asphalt rubber binder within 2 minutes. Intersections, turn lanes, gore points, and irregular areas must be covered within 15 minutes.

Do not apply asphalt rubber binder when weather or road conditions are unsuitable, including high wind or when the pavement is damp. In windy conditions you may adjust the distributor bar height and distribution speed, and use shielding equipment, if the Engineer authorizes your request.

## **SCREENINGS APPLICATION**

During transit, cover precoated screenings for asphalt rubber seal coat with tarpaulins if the ambient air temperature is below 65 degrees F or the haul time exceeds 30 minutes.

At the time of application, screenings for asphalt rubber seal coat must be from 225 to 325 degrees F.

Spread screenings at a rate from 28 to 40 lb/sq yd. The exact rate is determined by the Engineer. Spread to within 10 percent of the determined rate.

## **ROLLING AND SWEEPING**

Perform initial rolling within 90 seconds of spreading screenings. Do not spread screenings more than 200 feet ahead of the initial rolling.

For final rolling, you may request use of a steel-wheeled roller weighing from 8 to 10 tons, static mode only.

Perform a final sweeping before Contract acceptance. The final sweeping must not dislodge screenings.

Dispose of swept screenings at least 150 feet from any waterway.

## **MEASUREMENT AND PAYMENT**

Screenings for asphalt rubber seal coat are measured by coated weight after they are preheated and precoated with asphalt binder. The weight of screenings must be the coated weight.

If recorded batch weights are printed automatically, the bid item for screenings for asphalt-rubber seal coat are measured using the printed batch weights, provided:

1. Total aggregate weight for screenings per batch is printed
2. Total asphalt binder weight per batch is printed
3. Each truckload's zero tolerance weight is printed before weighing the first batch and after weighing the last batch
4. Time, date, mix number, load number and truck identification are correlated with a load slip
5. A copy of the recorded batch weights is certified by a licensed weighmaster and submitted to the Engineer

Screenings for asphalt rubber seal coat is paid for as screenings (hot applied).

Asphalt-rubber binder is measured under the specifications for asphalts.

If test results for gradation tests do not comply with the specifications, deductions are taken.

Each gradation test for scrap tire crumb rubber represents 10,000 lbs or the amount used in that day's production, whichever is less.

Each gradation test for high natural rubber represents 3,400 lbs or the amount used in that day's production, whichever is less.

For each gradation test, the following pay deductions will be taken from the asphalt rubber bid item:

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**Gradation Test**

Material	Test result <sup>a</sup>	Deductio n
Scrap tire crumb rubber	Operating range < TR < Contract compliance	\$250
Scrap tire crumb rubber	TR > Contract compliance	\$1,100
High natural crumb rubber	Operating range < TR < Contract compliance	\$250
High natural crumb rubber	TR > Contract compliance	\$600

<sup>a</sup>Test Result = TR