

International Surfacing Systems, Inc.

GUIDE SPECIFICATION FOR ASPHALT-RUBBER STRESS ABSORBING MEMBRANE AND ASPHALT-RUBBER STRESS ABSORBING MEMBRANE INTERLAYER

Qualification of Asphalt-Rubber Applicator

The contractor will be required to pre-qualify with this specifying agency the asphalt-rubber applicator process and/or subcontractor or supplier. The data required to be submitted for qualification approval will include experience records and equipment list indicating ability to comply with the specification. The asphalt-rubber applicator must have constructed a minimum of three asphalt-rubber surface treatments (SAM or SAMI) over existing pavements that have been in place at least three years under traffic.

1. DESCRIPTION

General

This item shall consist of a bituminous surface Stress Absorbing Membrane (SAM) or Stress Absorbing Membrane Interlayer (SAMI) composed of a single application of asphalt-rubber material and pre-coated aggregate in accordance with these specifications.

2. MATERIAL COMPONENTS

Asphalt Cement

The type and grade of asphalt cement utilized to manufacture the asphalt-rubber binder shall be PG 70-10, PG 64-16, PG 58-22 or PG 52-28, which shall comply with requirements of the Table #1.

**Table #1
* Asphalt Cement Grading Requirements**

Climate	PG Grading
Cold	PG 52-28
Moderate	PG 58-22
Hot	PG 64-16 or PG 70-10

* The exact grade of asphalt cement shall be determined by the asphalt-rubber supplier dependant of the specific project requirements and conditions (climate and traffic).

Asphalt Modifier

The asphalt modifier, **if required**, will be a resinous, high flash point, aromatic hydrocarbon compound and shall conform to the requirements in Table #2.

Table #2
Asphalt Modifier Requirements

Test Parameter	ASTM Designation	Requirement
Viscosity, cSt. At 212° F (100° C)	D 445	X +/- 3 •
Flash Point, COC, degrees F (C)	D 92	410° F (210° C) minimum
Molecular Analysis: Asphaltenes, percent by weight	D 2007	0.1 maximum
Aromatics, percent by weight	D 2007	55 minimum

- The symbol “X” is the viscosity of the asphalt modifier the Contractor proposes to furnish. The Value of “X” which the Contractor proposes shall be between 19 and 36, and shall be submitted in writing to the Engineer. Any proposed changes to these requirements requested by the Contractor, in the value “X” shall require a new asphalt-rubber binder design.

Granulated Reclaimed Tire Rubber and High Natural Rubber (CRM)

The CRM shall be produced primarily from the processing of automobile and truck tires. The rubber shall be produced by ambient temperature grinding processes only. The high natural CRM, **if required**, shall consist of ground or granulated rubber derived from materials that utilize high natural rubber sources. The gradation of both types of CRM when tested in accordance with ASTM C-136 (dry sieve only) and using a 100 gram sample, shall meet the requirements in Table #3.

Table #3
CRM Grading Requirements

Sieve Size	Reclaimed Tire CRM Percent Passing	High Natural CRM Percent Passing
#8 (2.36 mm)	100	100
#10 (2 mm)	95 - 100	100
#16 (1.18 mm)	45 - 75	95 - 100
#30 (600 m)	2 - 20	35 - 85
#50 (300 m)	0 - 10	10 - 30
#200 (75 m)	---	0 - 1

The use of CRM from multiple sources is acceptable provided that the overall blend of rubber meets the gradation requirements.

The individual CRM particles, irrespective of diameter, shall not be greater in length than 3/16 of an inch (5mm).

The CRM shall have a specific gravity of 1.15 ± 0.05 as determined by, and shall be free of loose fabric, wire and other contaminants except that up to 4 percent (by weight of rubber) calcium carbonate or talc may be added to prevent the rubber particles from sticking together. The rubber shall be sufficiently dry so as to be free flowing and not produce a foaming problem when blended with the hot asphalt cement. The CRM shall be accepted by certification from the rubber supplier. The Reclaimed Tire CRM material shall conform to the chemical analysis in Table # 4 and the High Natural Rubber CRM shall conform to the chemical analysis in Table #5.

**Table #4
Reclaimed Tire CRM Chemical Requirements**

Test	ASTM Test Method	Minimum	Maximum
Acetone Extract	D 297	6.0 %	16.0 %
Ash Content	D 297	----	8.0 %
Carbon Black Content	D 297	28.0 %	38.0 %
Rubber Hydrocarbon	D 297	42.0 %	65.0 %
Natural Rubber Content	D 297	22.0 %	39.0 %

**Table #5
High Natural Rubber CRM Chemical Requirements**

Test	ASTM Test Method	Minimum	Maximum
Acetone Extract	D 297	4.0 %	16.0 %
Rubber Hydrocarbon	D 297	50.0 %	----
Natural Rubber Content	D 297	40.0 %	48.0 %

2.4 Asphalt-Rubber Binder

The temperature of the blended paving grade asphalt cement and asphalt modifier mixture shall not be less than 375° F (190° C) nor more than 425° F (219° C) when the CRM is homogeneously blended in the field. The combined materials shall be reacted for a minimum of 45 minutes after the incorporation of all the CRM. The asphalt-rubber binder shall meet the following criteria in Table #6, when the reaction is complete.

**Table #6
Specification Limits for Asphalt-Rubber Binder**

		Hot Climate	Moderate Climate	Cold Climate
Apparent viscosity, 347 F (175 C) Spindle 3 @ 12 RPM: cps (ASTM D2669)	Min Max	1500 3500	1500 3500	1500 3500
Penetration, 77 F (25 C), 100g, 5 sec; 1/10 dm (ASTM D5)	Min Max	20 75	50 100	75 150
Penetration, 39.2 F (4 C), 200g, 60 sec; 1/10 dm (ASTM D5)	Min	10	15	25
Softening Point, F (C) (ASTM D36)	Min	135 F (57 C)	130 F (54 C)	125 F (52 C)
Resilience, 77 F (25 C), % (ASTM D3407)	Min	30	25	15

Climate Definitions

Hot Climate	Average July Max @ 110 F (43 C) Average January Low @ 30 F (-1 C) or above
Moderate Climate	Average July Max @ 100 F (38 C) Average January Low @ 15 – 30 F (-9 to -1 C)
Cold Climate	Average July Max @ 80 F (27 C) Average January Low @ 15 F (-9 C) or lower

Note: Certain climates may overlap the above, defined areas. When in doubt of the type of asphalt cement to utilize, always look to the lower penetration materials in the hot temperature range and the higher penetration materials in the low temperature range.

The viscosity shall be conducted by using a hand held HAAKE VISCOMETER, with rotor 1, 24mm in depth x 53mm in height, or equivalent. The reacted asphalt-rubber binder shall be maintained at a temperature of not less than 375° F (190° C) nor more than 425° F (219° C).

If material in a batch of asphalt-rubber binder is not used with-in six hours after the reaction period is complete, heating of the material shall be discontinued. When the asphalt-rubber binder temperature cools below 375° F (190° C) and is then reheated, it shall be considered a reheat cycle. The total number of reheat cycles shall not exceed two (2). The binder material shall be uniformly reheated to a temperature of not less than 375° F (190° C). Additional scrap tire CRM may be added to the reheated asphalt-rubber binder and reacted for a minimum of 30 minutes and shall not exceed 10 percent of the total binder weight. Reheated asphalt-rubber binder shall conform to the requirements for blended asphalt-rubber binder.

2.5 Asphalt-Rubber Binder Formulation

The asphalt-rubber supplier, shall furnish to the Engineer within 15 days of the notice to proceed, the asphalt-rubber binder formulation shall contain the following information:

Asphalt Cement

Source of Asphalt Cement
Grade of Asphalt Cement
Percentage of Asphalt Cement by total weight of asphalt-rubber mixture

Asphalt Modifier (**If required**)

Source of Modifier
Grade of Modifier
Percentage of Modifier by total weight of asphalt-rubber mixture

Reclaimed Tire Rubber (CRM)

Source of CRM
Grade of CRM
Percentage of CRM by total weight of the asphalt-rubber mixture

High Natural Rubber (CRM) (**if required**)

Source of CRM
Grade of CRM
Percentage of CRM by total weight of the asphalt-rubber mixture

If CRM from more than one source is to be utilized, then the above information will be required for each type of CRM used.

2.6 Aggregate Cover Material

Aggregate shall be composed of clean and durable crushed rock or crushed gravel conforming to the following requirements:

Proposed aggregate samples shall be submitted to the asphalt-rubber supplier prior to the preparation of the mix design to test the aggregate for stripping characteristics. All testing results shall be submitted to the project engineer.

If the aggregate is to be crushed stone, it shall be manufactured from sound, hard, durable material of accepted quality and crushed to specification size. All strata, streaks and pockets of clay, dirt, sandstone, soft rock or other unsuitable material accompanying the sound rock shall be discarded and not allowed to enter the crusher.

If the aggregate material is to be crushed gravel, it shall consist of hard, durable fragments of stone or gravel of accepted quality and crushed to specification size. All strata, streaks, pockets of sand, excessively fine gravel, clay or other unsuitable material including all stones, rocks and boulders of inferior quality shall be discarded and not allowed to enter the crusher. The crushing of the gravel shall separate the #4, 3/8 and 1/2 inch (4.75, 9, and 12 mm) sieves and shall have a minimum 95% of the particles with a minimum of one mechanically fractured face and 90% of the particles shall have a minimum of two mechanically fractured faces.

The crushed aggregate shall not contain more than 8% by weight of flat or elongated pieces and shall be free from wood, roots and vegetable or other organic extraneous matter. The crushed coarse aggregate shall have a percentage of wear not more than 7 percent at 100 revolutions and not more than 30 percent at 500 revolutions, as determined by ASTM C131.

The aggregate shall show no evidence of disintegration nor show a total loss greater than 12% when subjected to 5 cycles of the sodium sulfate accelerated soundness test specified in ASTM C88.

The crushed aggregate for asphalt rubber applications shall meet the requirements for gradation given in Table 7, when tested in accordance with ASTM C136.

**Table 7
Aggregate Gradation Requirements**

3/8 inch SAM & SAMI Aggregate Gradation		1/2 inch SAM & SAMI Aggregate Gradation	
Sieve Size	Percent Passing	Sieve Size	Percent Passing
1/2 inch (12 mm)	100	3/4 inch (15 mm)	100
3/8 inch (9 mm)	70 - 85	1/2 inch (12 mm)	95 - 100
1/4 inch (4.75 mm)	0 - 15	3/8 inch (9mm)	70 - 85
#8 (2.36 mm)	0 - 5	1/4 inch (4.75 mm)	0 - 15
#200 (75 m)	0 - 1	#8 (2.36 mm)	0 - 5
---	---	#200 (75 m)	0 - 1

The aggregate shall be pre-coated or hot pre-coated with 0.5 - 0.25 percent emulsified asphalt or paving grade asphalt cement. The Engineer shall determine the appropriate amount of pre-coat. The pre-coated aggregate shall have a “salt and pepper” appearance and when used hot shall be supplied to the project site at 250 F to 325 F (121 C to 162 C).

Method for Vialit Test Concerning Aggregate Retention in Chip Seal Applications (Vialit Plate Shock Test).

European Standard EN12272-3, as modified for hot spray applied polymer/rubberized binders.

Scope

This method is an indicator of aggregate retention for hot applied chip seal, pavement preservation surface treatments.

Summary of Method

Hot applied, modified binder materials are applied at 79 grams (.42 gal/sy) to standard size, clean and dry, stainless steel plates. Exactly one hundred (100) washed and graded aggregate particles are embedded into the required binder type. The sample is allowed to cure under specified conditions. Following this cure, the individual plates are conditioned at three different temperatures for 30 minutes. Then a 500 gram steel ball is dropped three (3) times from a distance of 50 cm (20 inches) onto the inverted stainless steel plates. The results are recorded at percent aggregate retention with 90% retention being the minimum allowable value.

Steps for Modified Test Method

- 1) Hot asphalt cement/modified binder is pre-heated to approximate application temperature (330 F (165 C) to 375 F (190 C)).
 - 2a) Tare weight of plate is recorded.
 - 2b) Individual plates are pre-heated in an oven to a minimum of 330 F (165 C).
 - 2c) 79 grams of asphalt cement/modified binder applied to each plate.
 - 2d) Plates are returned to the 330 F (165 C) minimum temperature oven for 15 minutes.
 - 2e) Plates are removed from the oven and placed on a warm hotplate and the binder is spread and smoothed with a hot blade.
 - 2f) Application weight is verified and adjusted as needed.
 - 2g) 100 particles of washed and graded aggregate, meeting the project specification requirements, are applied in a 10 x 10 matrix, with the plate still on the warm hotplate.
 - 2h) Three (3) plates are prepared for each combination of binder and aggregate.
- 3) Plates are again returned to the 330 F (165 C) minimum temperature oven for 15 minutes.
 - 4a) Plates are removed from the oven and allowed to cool at room temperature for four to six hours.
 - 4b) Once the room temperature cure is complete, individual plates are conditioned for 30 minutes at each of the following temperatures: 41 F (5 C), 14 F (-10 C) and -8 F (-22 C).
- 5) After the 500 gram steel ball has been dropped three times on each of the three samples, report the number of stones attached as percent aggregate retention at test temperature.

Purpose of Vialit Aggregate Retention Test

It should be the contractor/agencies responsibility as partners to construct a quality pavement preservation chip seal project. There needs to be insurance that good adhesion occurs between binder and aggregate, at the time of placement. The Vialit Retention Test provides a method to assess the active adhesivity of the binder and the aggregate being utilized in conditions, which are very close to the actual project variables and environment.

3. EQUIPMENT

3.1 General

The equipment used by the contractor for pavement cleaning and excess aggregate removal shall include a self-propelled rotary power broom, mobile pick-up broom or top dumping mobile pick-up broom.

3.2 Asphalt-Rubber Equipment

All equipment utilized in the production and application of asphalt-rubber binder materials shall be described as follows:

- a) An asphalt cement heating tank with a hot oil heat transfer system or a retort heating system capable of heating the asphalt cement to the proper temperature for blending with the CRM.
- b) An asphalt-rubber mechanical blender shall have a two stage continuous mixing process capable of producing a homogenous blend of asphalt cement and CRM, at the mix design specified ratios, as directed by the engineer. This unit shall be equipped with a granulated rubber feed system capable of supplying the asphalt cement feed system, as not to interrupt the continuity of the blending process. The maximum capacity of the primary blending vessel shall be 500 gallons (1900 liters). Both the primary and secondary blenders shall be equipped with an agitation device orientated horizontally in the blending vessel. The blending unit shall be capable of fully blending the individual rubber particles with the asphalt cement. A separate asphalt cement feed pump and finished product pump are required. This unit shall have an asphalt cement totalizing meter in gallons and a flow rate meter in gallons per minute.
- c) A trailer mounted self-powered distributor truck equipped with a heating unit, and an internal mixing device capable of maintaining a uniform mixture of asphalt cement and CRM. It shall be equipped with a full circulating spreader bar and pumping system capable of applying asphalt-rubber material within 0.05 gallons per square yard tolerance of the specified application rate, and must achieve a uniform covering of the surface to be treated. The distributor shall have a boot board on the rear of the vehicle and a bootman shall accompany the distributor. The bootman shall ride in a position so that all the spray bar tips are in full view and readily assessable for unplugging, if a plugged tip should occur. The distributor shall also include a tachometer, pressure gauge, a volume-measuring device, thermometer and shall also have a computer rate control (CRC) installed.

3.3 Aggregate Cover Material Spreader

The cover material (chip) spreader shall be a self-propelled machine with an aggregate receiving hopper in the rear, belt conveyors to carry the pre-coated aggregate to the front, and a full width spreading hopper. The spreader shall be in good mechanical condition and shall be capable of applying the cover aggregate uniformly across the spread width and at the specified application rate. When utilizing hot pre-coated aggregate, heat-treated belts should be installed on the chip spreader.

3.4 Rolling Equipment

A minimum of three continually operated self-propelled pneumatic-tired rollers (and one steel wheel roller, **if required**, based on the hardness of the aggregate) shall be used for the required rolling of the cover material. The pneumatic-tired rollers' shall carry a minimum loading of 3,000 pounds (1,361 kg) on each wheel and a minimum pressure of 90 pounds per square inch in each tire.

3.5 Hauling Equipment

Trucks for hauling the cover aggregate shall be tailgate discharge and shall be equipped with a device to lock onto the hitch of the cover material spreader. Haul trucks shall also be compatible with the cover aggregate spreader so that the dump bed will not push down on the spreader when fully raised, or have too short of a bed which results in aggregate spillage while dumping into the receiving hopper.

4. **CONSTRUCTION METHODS**

4.1 General

Immediately prior to the application of the asphalt-rubber membrane, the surface shall be thoroughly cleaned in order to insure adequate adhesion of the asphalt-rubber to the existing pavement surface.

4.2 Weather Conditions

Asphalt-rubber material shall be applied only when the existing surface is dry and the atmospheric temperature is above 55 F (13 C) and rising. No material shall be applied when rain is imminent or when the wind is excessive, as directed by the Engineer.

4.3 Asphalt-Rubber Mixing and Reaction

The percentage of Reclaimed Tire Rubber CRM shall be 15 – 20 percent by weight of the total asphalt-rubber mixture; the exact CRM content shall be determined by the binder design submitted by the asphalt-rubber supplier. During membrane placement the CRM percentage shall not fluctuate by more than 1 (one) percent by weight of total asphalt-rubber mixture. The High Natural CRM shall be 3 – 6 percent, which will replace an equal percentage of the Reclaimed Tire Rubber CRM.

The temperature of the asphalt cement shall be between 375 F and 450 F (190 C and 231 C) at the addition of the CRM. The asphalt cement and the CRM shall be combined and mixed together in the asphalt-rubber blending unit and reacted in the distributor or a reaction vessel for a minimum period of 45 minutes from the time the CRM is added to the asphalt cement. The temperature of the asphalt-rubber mixture shall be above 350 F (176 C) during the reaction period, but shall not exceed 450 F (231 C) at any time. Exceeding the 450 F (231 C) limit will be grounds for rejection of the affected binder material.

When a job delay occurs after full reaction, the asphalt-rubber may be allowed to cool. The asphalt-rubber binder shall be re-heated slowly just prior to application to a temperature between 350 F and 400 F (176 C and 231 C) An additional quantity of asphalt cement and / or CRM may be added as required to produce a material with the appropriate viscosity. See re-heat cycle (page 4).

4.4 Application of Asphalt-Rubber Binder

Placement of the asphalt-rubber membrane shall be made only under the following conditions:

- a) The pavement surface temperature shall be 50 F (10 C) and rising.
- b) The pavement surface is clean and dry.
- c) The wind conditions are not excessive.
- d) All of the construction equipment such as the asphalt-rubber distributor, aggregate spreader, haul trucks loaded with cover material, rollers and brooms are in position and ready to commence placement operations.
- e) Rain is not imminent.

The asphalt-rubber mixture shall be applied to the roadway immediately following mixing and reaction at a temperature of 350 F to 400 F (176 C to 231 C) at a rate of 0.55 to 0.75 gallons per square yard (2.42 to 3.30 liters per square meter). Transverse joints shall be constructed by placing building paper across and over the end of the previous asphalt-rubber application. Once the application has progressed beyond the paper, the paper shall be removed immediately and disposed of as directed by the engineer. The use of paper may be discontinued if the contractor chooses to squeegee the excess asphalt-rubber binder material at the transverse joints prior to the placement of the cover aggregate. All longitudinal joints shall not exceed a 12-inches (30 cm) overlap.

Distributor bar height, distribution, speed and shielding materials shall be utilized to reduce the effects of excess wind upon the spray distribution (fan). The Engineer shall delay or reschedule work when high gusting or dirty winds prevent or adversely affect binder or aggregate application.

The application of asphalt-rubber binder to areas not accessible with the distributor bar on the distributor truck, shall be accomplished by using pressurized hand wands or other means approved by the engineer.

The contractor shall comply with all Federal, State and Local environmental laws, regulations and ordinances.

4.5 Application of Aggregate Cover Material

Cover material shall be applied immediately onto the asphalt-rubber membrane, after application, at a rate of 26 to 34 pounds per square yard (11.79 to 15.42 kilograms per square meter). The actual amount selected within this range will be determined in the field based on the appearance of the SAM after initial rolling. At all times the application rate shall be kept to a minimum.

At the time of application, **when using hot pre-coated aggregate**, the temperature of the aggregate shall range from 250 F to 325 F (121 C to 162 C)

4.6 Rolling

At least three operational pneumatic-tired rollers (and one steel wheel roller, **if required**, based on the hardness of the aggregate) shall be provided to accomplish the required embedment of the aggregate cover material. At some project locations, or when production rates dictate, additional or fewer rollers may be utilized as directed by the

engineer. At no time shall there be less than 3 (three) operational pneumatic-tired rollers and 1 (one) 12 to 14 ton operational steel wheel roller on a project.

Sufficient rollers shall be used for the initial rolling to cover the width of the aggregate spread with one pass. The first pass shall be made immediately behind the cover material spreader as the aggregate is being placed. If the spreading is stopped for an extended period, the cover material spreader be moved ahead or off the side so that all cover material may be immediately rolled. Three complete passes with rollers shall be made with the pneumatic rollers and one pass with the steel wheel roller.

4.7 Flush Coat

For SAM applications, a fog seal or flush coat shall be applied during the same day of the placement of the SAM. The surface shall be dry and free of loose material at the time of application. This timeframe may be extended by the Engineer when weather and / or traffic conditions are not favorable. The flush coat shall not be applied when the surface is wet or when there is threat of rain. The ambient temperature shall be a minimum of 70 F (21 C) and rising, with constant sunshine.

Asphaltic emulsion shall be grade CSS1, CSS1H or CQS1H diluted 50/50 with water shall be used for the flush coat. Immediately before applying the emulsion, the area to be flushed shall be cleaned of all loose aggregate and foreign material. This will be accomplished by power brooms or pick-up brooms and supplemented by hand brooms when necessary.

The diluted asphalt emulsion shall be well mixed before application and shall be applied by a distributor truck, in sound mechanical condition, at a rate of 0.10 to 0.20 gallons per square yard (0.44 to 0.88 liters per square meter), allowing for a residual after the emulsion “breaks” of 0.03 to 0.06 gallons per square yard (0.11 to 0.23 liters per square meter).

4.8 Sand Cover

Sand cover material, **if required**, shall conform shall conform to the fine aggregate grading requirements of the specifying agency.

Sand shall be spread by means of a self propelled chip spreader equipped with a computerized device that will allow for application of the sand at a uniform rate over the full width of a traffic lane in a single application. Sand shall be spread at a rate of 2 to 4 pounds per square yard (0.91 to 1.81 kilograms per square meter). The exact rate will be determined by the Engineer. If approved by the Engineer other equipment may be used to spread the sand.

4.9 Traffic Control

Except when it is necessary that hauling equipment must travel on the newly applied SAM, traffic of all types shall be kept off the membrane until it has had time to set properly. The speed of the hauling equipment shall not exceed 15 miles per hour (24 kilometers per hour) when traveling over a membrane that has not had sufficient time to properly set.

5. METHOD OF MEASUREMENT

Asphalt –Rubber Bituminous Material

The asphalt-rubber bituminous material shall be measured by the ton (by the kilogram) and shall be the actual weight in tons (kilograms) of material used in the accepted work by the Engineer.

Cover Aggregate Material

The quantity of the cover aggregate material shall be measured by the square yard (square meter) and accepted by the Engineer.

Flush Coat

The emulsified asphalt material, diluted 50/50, shall be measured by the ton at the specified application rate approved by the Engineer.

Sand Cover

The quantity of the sand cover material shall be measured by the square yard (square meter) and accepted by the Engineer.

6. BASIS OF PAYMENT

Payment shall be made at the contract unit price per ton (per kilogram) for asphalt-rubber bituminous material used in the SAM application and per square yard (per square meter) for the cover aggregate material. The emulsified asphalt flush coat shall be paid for by the ton (per kilogram) at the specified application rate. These prices shall be full compensation for furnishing all materials and for all preparation, hauling and application of the materials, including labor, equipment, tools and incidentals necessary to complete the item.

Note: The specifying agency may choose to adjust all pay items to be paid by the square yard (square meter).