SECTION 418 – ASPHALT-RUBBER SURFACE TREATMENT (warm climate)

418.01 Description.

The asphalt rubber surface treatment shall consist of a single application of asphalt rubber binder and pre-coated aggregate, and an emulsified asphalt fog seal. The fog seal shall be in accordance with Section 409.

418.02 Materials.

The material used shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>703.10</td>
</tr>
<tr>
<td>Asphalt Cement</td>
<td>702.01</td>
</tr>
<tr>
<td>Blotter</td>
<td>703.13</td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td>702.03</td>
</tr>
</tbody>
</table>

Under Subsection 703.10(b), Los Angeles Abrasion, AASHTO T 96 Delete 40% max. and substitute 30% max.

Only one materials source shall be used for the cover aggregate.

The Independent Testing Laboratory shall perform the bituminous film stripping test in accordance with AASHTO T 182 and submit the results 21 days prior to beginning work.

(1) Aggregate.

Proposed aggregate samples shall be obtained by the Independent Testing Laboratory prior to preparation of the mix design and tested for aggregate stripping characteristics. The results shall be submitted to the COR with the Asphalt Rubber mix design.

If the aggregate material is to be crushed gravel or crushed stone, it shall consist of hard, durable fragments of stone or gravel of accepted quality and crushed to specification size. All strata, streaks and 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 aggregate shall result in a product in which the material retained on a No. 4 (4.75 mm) sieve shall have at least 85% of particles with at least one fracture face produced by crushing.

The crushed aggregate shall not contain more than 8% by weight of elongated or flat particles, and shall be free from wood, roots, or other organic matter.
Delete: Table 703-7 and substitute the following:

The crushed cover aggregate for the applications shall meet the requirements for gradation given in Table 418-1.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾” (19 mm)</td>
<td>100</td>
</tr>
<tr>
<td>½” (12.5 mm)</td>
<td>98 – 100</td>
</tr>
<tr>
<td>⅜” (9.5 mm)</td>
<td>70 – 100</td>
</tr>
<tr>
<td>¼” (6.3 mm)</td>
<td>0 – 15</td>
</tr>
<tr>
<td>No. 4 (4.75 mm)</td>
<td>0 – 5</td>
</tr>
<tr>
<td>No. 8 (2.36 mm)</td>
<td>0 – 2</td>
</tr>
<tr>
<td>No. 200 (75 µm)</td>
<td>0 -1</td>
</tr>
</tbody>
</table>

Data indicating the loose and dry-rotted unit weight for the aggregate in lbs./ft³ as per AASHTO T 19 and all aggregate tests in Subsection 703.10 shall be included in the asphalt rubber mix design.

The aggregate shall be heated to a temperature of 250ºF (121ºC) to 325ºF (163ºC) at a hot plant and pre-coated with 0.5 ±/-0.25 percent paving asphalt cement. The pre-coated aggregate should have a “salt and pepper” appearance. Pre-coating acceptance shall be under Subsection 106.02.

Aggregates will be sampled from hauling units and tested for acceptance in lots relative to the number of Tons placed each production day. Only those sieves designated in the specified grading will be considered for purpose of acceptance. Normally, five acceptance samples will be taken for each day’s production for gradation, except, less than five acceptance samples may be taken when inclement weather, equipment breakdown, or for other reasons production stoppage occurs. For small projects and low production days ranging from 10 tons to 400 tons, a minimum of three (3) acceptance samples will be taken.

(2) Crumb Rubber Modifier (CRM).

The CRM shall be produced primarily from the processing of automobile and/or truck tires by ambient grinding methods.
The gradation of the CRM when tested in accordance with ASTM C-136 (dry sieve only) and using 50 gram sample, shall meet the following requirements:

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 8 (2.36 mm)</td>
<td>100</td>
</tr>
<tr>
<td>No. 10 (2.00 mm)</td>
<td>95 – 100</td>
</tr>
<tr>
<td>No. 16 (1.18 mm)</td>
<td>40 – 100</td>
</tr>
<tr>
<td>No. 30 (600 µm)</td>
<td>0 – 60</td>
</tr>
<tr>
<td>No. 50 (300 µm)</td>
<td>0 – 20</td>
</tr>
<tr>
<td>No. 200 (75 µm)</td>
<td>0 – 5</td>
</tr>
</tbody>
</table>

The use of rubber 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 than 0.20 inches in length.

CRM shall have a specific gravity of 1.15 ± 0.05 (ASTM D-297). The rubber shall be substantially free from contaminants, including fabric, metal, mineral, and other non-rubber substances. The rubber shall be sufficiently dry to be free flowing and not produce a foaming problem when added to hot asphalt cement.

Not more than 4 percent (by weight of rubber) calcium carbonate or talc may be added to prevent rubber particles from sticking together.

Fiber content in the rubber shall be less than 0.1% by weight. The moisture content in the rubber shall be less than 0.75% by weight. Mineral contaminant amount in the rubber shall not be greater than 0.25% by weight, as determined after water separating a 50 gram rubber sample in a 1 liter glass beaker filled with water. The rubber shall contain no visible metal particles, as indicated by thorough stirring of a 50 gram sample with a magnet.

The rubber manufacture shall ship, along with the rubber, Certificates of Compliance which certify that all requirements of this specification are complied with for each production lot number or shipment.

(3) Asphalt Cement.

The asphalt cement required in the hot asphalt rubber binder shall be PG64-16 as per AASHTO Provisional Standard MP-1.
(4) Asphalt Rubber Binder.

The asphalt rubber binder shall consist of a properly proportioned mixture of paving grade asphalt cement, crumb rubber modifier (CRM) and other additives, if required. The asphalt rubber binder shall meet the physical parameters listed in Table 418-2, when reacted at $350^\circ$F ($177^\circ$C) for 60 minutes.

<table>
<thead>
<tr>
<th>Table 418-2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asphalt-Rubber Properties</strong></td>
</tr>
<tr>
<td>(1) Rotational Viscosity, $350^\circ$F</td>
</tr>
<tr>
<td>Penetration, $39.2^\circ$F ($4^\circ$C), 200 g, 60 sec (ASTM D-5); 1/10 mm</td>
</tr>
<tr>
<td>Penetration, $77^\circ$F ($25^\circ$C), 100 g, 5 sec (ASTM D-5); 1/10 mm</td>
</tr>
<tr>
<td>Resilience, $77^\circ$F ($25^\circ$C) (ASTM D-3407)</td>
</tr>
<tr>
<td>Softening Point (ASTM D-36)</td>
</tr>
<tr>
<td>Ductility, $39.2^\circ$F ($4^\circ$C) (ASTM D-113), 1 CPM</td>
</tr>
</tbody>
</table>

(1) The viscometer used must be correlated to Rion (formerly Haake) Viscometer, Model VT-04, Rotor No. 1.

418.03 Construction.

(1) Asphalt-Rubber Binder Mix Design.

A copy of the mix design for the asphalt rubber surface treatment must be submitted 15 days prior to production. The mix design must include all tests and product certification specified in his section.

(2) Pre-qualification of Asphalt-Rubber Applicator.

The contractor will be required to pre-qualify with the COR the asphalt-rubber applicator process and/or subcontractor and 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 over existing pavements that have been in place at least three years under traffic.
(3) **Asphalt Rubber Binder Formulation.**

The Contractor shall submit three (3) copies of an asphalt-rubber binder mix design for approval to the COR 15 days prior to production. The asphalt rubber mix design shall be prepared by the Independent Testing Laboratory. The mix design shall include the properties listed in **Table 418-2** for the interaction periods of 60, 90, 135, 360, and 1440 minutes.

The mix design shall also include the following information:

**Asphalt Cement:**
- source of asphalt cement
- grade of asphalt cement
- percentage of asphalt cement by total weight of the asphalt rubber mixture

**Crumb Rubber Modifier:**
- 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, the above information will be required for each CRM used.

(4) **Asphalt-Rubber Mixing and Reaction.**

The percentage of CRM shall be 20 percent plus or minus 3 percent by weight of total asphalt rubber mixture, the exact CRM content shall be as determined by the mix design prepared by the Independent Testing Laboratory and submitted by the Contractor. During membrane placement the CRM percentage shall not fluctuate more than 1 percent by weight of total asphalt-rubber mixture.

The temperature of the asphalt cement shall be between 375°F (190°C) and 450°F (232°C) at the addition of the CRM. The asphalt and rubber shall be combined and mixed together in the asphalt rubber blending unit and reacted in the distributor for a minimum period of 30 minutes from the time the CRM is added to asphalt cement. The temperature of the asphalt rubber mixture shall be above 350°F (177°C) during the reaction period, but shall not exceed 450°F (232°C) at any time. Exceeding the 450°F (232°C) limit will be grounds for rejection of the effected material.

When a job delay occurs after full reaction, the asphalt-rubber may be allowed to cool. The asphalt rubber shall be reheated slowly just prior to application to a temperature between 350°F (177°C) and 400°F (202°C). An additional quantity of asphalt cement and/or CRM may be added as required to produce a material with the appropriate viscosity.
The viscosity of asphalt rubber binder shall be measured by the Asphalt Rubber Supplier and monitored by the Independent Testing Laboratory from samples taken from each distributor truck prior to spreading the asphalt rubber binder on the roadway. One sample shall be tested daily by the independent testing laboratory in accordance with Table 418-2.

418.04 Equipment.

(1) General.

The equipment used by the contractor shall include a self propelled rotary power broom and a mobile pickup (i.e. vacuum) broom for pavement cleaning and excess cover material removal.

(2) Asphalt-Rubber Equipment.

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

A. Heat Tank.

An asphalt heating tank with a hot oil heat transfer system or retort heating system shall be capable of heating asphalt cement to the necessary temperature for blending with CRM. This unit shall be capable of heating a minimum of 2,500 gallons of asphalt cement.

B. Blender.

The asphalt rubber mechanical blender shall be capable of producing a homogenous mixture of asphalt cement and granulated rubber at the specified mix design ratios. This unit shall be equipped with a granulated rubber feed system capable of supplying the asphalt cement without interruption to the continuous blending process. The maximum capacity of the primary blending vessel shall be 500 gallons. 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 both an asphalt cement totalizing meter in gallons and a flow rate meter in gallons per minute.

C. Distributor Truck.

A truck or trailer mounted self powered distributor truck shall be equipped with a heating unit and an internal mixing device capable of maintaining a uniform mixture of the asphalt-rubber binder. It shall be equipped with a full circulating spreader bar and pumping system capable of applying asphalt rubber binder within ±0.05 gallons per square yards tolerance of the specified application rate and must give a uniform covering of the surface to be treated.
Distributors shall be equipped with a full circulating adjustable spray bar capable of spraying various widths to 13 feet. Bar extensions shall be full circulating. The spray bar shall be adjustable to permit positioning at various heights and shall maintain the set height within 0.80 inches during each spray run.

Spray bar nozzle shall provide a uniform unbroken spread of asphalt rubber binder to the surface being treated, and shall be operated by positive acting control valves that quickly open or close in one operation.

The distributor truck shall be equipped with a hand hose and nozzle attachment to be used for spotting areas inaccessible to the distributor.

The distributor shall also be equipped with devices and charts to provide for accurate and rapid determination and control of the amount of asphalt rubber binder being applied:

1. A bitumeter that registers rate of travel in feet per minute and trip and total distance in feet;

2. A pump for circulating the asphalt rubber material in the spray bar and tank, and that sprays the material through the spray bar or hand spray;

3. A pressure gage, pump, tachometer or other approved device for controlling the application rate of asphalt rubber material;

4. A gage or other approved means of accurately determining the quantity of asphalt rubber material in the tank.

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 spray bar tips are in full view and readily accessible for unplugging if a plugged tip should occur.

Distributor and booster tanks shall be so maintained that no dripping of asphalt rubber material will occur from any part of the equipment.

The COR may order the use of any distributor truck discontinued that does not comply with the requirements or that fails to produce a satisfactory application of asphalt rubber material as specified herein.

D. Pneumatic Rollers.
When cover aggregates are applied, a minimum of three pneumatic rollers rated at 15 tons or more shall be furnished. Pneumatic tire rollers shall be operated at a maximum speed of 5 miles per hour. If so directed by the COR, a steel tandem roller shall also be used at speeds not to exceed 5 miles per hour.
Pneumatic rollers shall be self-propelled of the oscillating wheel type consisting of not less than seven, smooth tread pneumatic-tire wheels revolving on two axles, and capable of being ballasted to the weight required.

The rollers shall be equipped with a means of increasing or decreasing the air pressure in the tires while the rollers are in operation. The tires on the front and rear wheels shall be staggered to produce a slight overlap of the tire tracks. Each tire shall be equipped with an adequate scraping or cleaning device to prevent the accumulation of material on the tires.

The roller shall operate smoothly and be capable of turning, stopping, or reversing direction without scuffing, marring, or displacing the materials. The contractor shall furnish the COR with a copy of the roller manufacturer’s charts or with tables showing the contact areas and average contact pressures for the full range of wheel loadings for each roller furnished. The contractor shall also furnish the COR with a copy of the calibration table or chart for the ballast box that indicates the volume of the ballast box in cubic feet, each 6 inch increase in the depth of ballast, and the empty or tare weight of the roller.

The contractor shall furnish sufficient rollers to cover the entire width of the treated surface in one pass. The average contact pressure of each roller shall be not less than 90 lbs. per square inch (psi). The first pass shall be made immediately behind the spreader and if the spreading is stopped for any reason, the spreader shall be moved ahead so all cover material spread may be immediately rolled. **The rolling shall be continuous until a minimum of four (4) complete coverages have been made while the asphalt rubber binder is still tacky enough for the aggregate to adhere.** Final rolling shall be completed within one hour after the application of the cover material.

E. **Aggregate Cover Material Spreader.**
The cover aggregate (chip) spreader shall be a self-propelled machine with an aggregate receiving hopper in the rear, belt conveyors to carry the aggregate to the front, and a spreading hopper equipped with a full width distribution auger and spread roll. The spreader shall be in good mechanical condition and be capable of applying the cover material uniformly across the spread at the specified rate.

F. **Hauling Equipment.**
Trucks for hauling cover material shall have a tailgate discharge and shall be equipped with a device to lock onto the hitch at the rear of the cover aggregate 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 nor have a short bed that would result in aggregate spillage while dumping into the receiving hopper.
418.05 Surface Preparation.

The Contractor shall be responsible for removing all vegetation, dirt, and all other foreign material from the roadway surface prior to seal coating.

418.06 Weather Limitations.

Hot asphalt rubber seal coat shall be applied only when the surface temperature and the ambient air temperature is 77°F (25°C) or higher. The final fog seal shall be applied only when the ambient air temperature is 40°F (4°C) or higher. The wind condition shall not exceed 10 miles per hour, nor shall rain be imminent, and the pavement surface is clean and dry.

Materials for the bituminous treatment shall not be applied prior to MAY 15 nor shall they be applied to the roadway after OCTOBER 15 unless directed by the COR.

418.07 Construction Methods.

A control strip shall be constructed on the first day of production in order to determine the rates of asphalt rubber binder and cover aggregates. The control strip shall be a minimum of 1000 feet. A total of 4 control strips may be ordered by the COR in order to determine the spread rates. No further work may be performed until the COR has approved the control strip.

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

The Contractor shall be responsible for removing all vegetation, dirt, and all other foreign material from roadway surface and in dip sections prior to seal coating. The material removed from the road shall not be wind rowed along the roadway in such a manner so as to impede the drainage in any manner nor be unsightly.

Unless specifically eliminated in writing by the COR, all adjoining pavements and driveways shall be chip sealed by the same method described herein.

418.08 Asphalt-Rubber Binder Application.

The surface to be seal coated shall be broomed and cleaned of all loose blotter sand, vegetation, and other deleterious material prior to the application of the asphalt rubber binder.

The asphalt rubber binder shall be applied at an approximate rate of 0.55 to 0.65 gallons per square yard. The exact rate of application will be determined by the COR. All longitudinal joints shall be overlapped but the overlaps shall not exceed 6 inches.
All asphalt rubber treated areas shall have a final fog seal applied in accordance with Section 409.

All transverse joints shall be made by placing building paper over the end of the previous application, and the joining application shall start on the building paper. Once the application process has progressed beyond the paper, the paper shall be disposed.

Unused asphalt rubber material shall be disposed of only at an approved landfill site and copies of receipts for the disposal shall be delivered to the COR prior to final inspection.

Traffic will not be allowed on asphalt rubber material until the cover aggregate material has been applied and rolled in accordance with these specifications.

418.09 Aggregate Application.
The cover material shall be applied at the approximate rate of 26 to 35 pounds per square yard; the COR will determine the exact rate to be applied. The Quality Control Laboratory shall make the necessary weighing to assist in the determination of the spread rate.
The chip spreader shall not be operated at speeds which cause the aggregate to bounce or roll over after striking the asphalt-rubber surface.

Traffic will not be allowed on until the cover aggregate material has been applied and rolled in accordance with these specifications.

Application of the cover aggregate shall begin immediately following the application of the asphalt rubber binder and shall be maintained within a distance of approximately 100 feet of the asphalt rubber distributor and in no case shall the application of the cover aggregate lag more than 200 feet behind the application of the asphalt rubber binder, unless approved by the COR.

After the cover material has been applied to the asphalt rubber binder, and prior to rolling, any ridges, piles, or uneven distribution of cover aggregate shall be carefully removed to insure against permanent ridges, bumps or depressions in the completed surface.
The speed of all hauling equipment shall not exceed 10 miles per hour when traveling over the chip seal where the rolling has not been completed.

Loose cover aggregate shall be removed from the treated surface by brooming in not less than 3 hours nor more than 48 hours after application. After brooming and before allowing traffic back on the roadway, place temporary pavement markers.

All asphalt rubber treated areas shall have a fog seal applied in accordance with Section 409. The fog seal shall be emulsified asphalt, grade SS-1h with an application rate of 0.1 to 0.15 gallons per square yard, diluted 1:1. The COR will determine the exact rate to be applied. The fog seal must be applied within two days after the asphalt rubber surface
treatment has been completed. The CO may change the grade of the emulsified asphalt without any change in unit price.

Maintenance of the final surface shall continue until the final fog seal is applied and shall include brooming and distribution of cover aggregate over the surface to absorb any free bitumen and cover any areas deficient in aggregate. The maintenance shall be conducted so as not to displace imbedded aggregate. Excess material shall be swept from the entire surface at a time determined by the COR.

418.10 Fog Seal.

Final fog seal shall be in accordance with Section 409.

418.13 Acceptance.

Asphalt rubber binder, asphalt cement and emulsified asphalt will be accepted under Subsection 106.04 and 702.09.

Aggregate for asphalt rubber treatment will be evaluated under Subsections 106.02 and 106.04.

Pre-coating of the cover aggregate shall be accepted under Subsection 106.02.

Construction of asphalt rubber surface treatment course will be evaluated under Subsections 106.02 and 106.04.

If the arithmetic mean of the tested samples meets the gradation requirement of the specification, the aggregate will be assigned a pay factor of 1.00. If the arithmetic mean of the samples tested fails to meet the gradation specifications on any sieve size, a pay factor of less than 1.00 will be assigned as described below.

Aggregate that is not assigned a pay factor of 1.00 will be considered to be in substantial compliance provided (a) that the average of each specified sieve fraction does not exceed the specifications band by more than 2% for all sieves except the No. 200 (75 µm) sieve which shall not exceed 1% and (b) no single value is more than 5% beyond the specification band except for the No. 200 (75 µm) sieve which shall not exceed 2%. Aggregates that are in substantial compliance (see beginning of paragraph) may be accepted at an adjusted unit price based on a pay factor of 0.85.

The asphalt rubber surface treatment will not be accepted under the acceptance provisions if the aggregate pay factor is less than 0.85 or the asphalt-rubber binder or the emulsified asphalt do not meet specifications. If the CO accepts the asphalt rubber surface treatment, it will be paid for at a pay factor of 0.50. The CO may also reject the asphalt rubber surface treatment. If the CO rejects the asphalt rubber surface treatment, it must be reconstructed.
418.14 Measurement.

Asphalt rubber binder shall be measured for payment by the ton. All field testing data sheets showing the blending and application of each batch of asphalt rubber binder shall be delivered to the COR at the end of each day production.

Emulsified asphalt, Grade SS-1h, shall be measured as per Section 409.

The cover aggregate shall be measured for payment by the ton and shall be measured in the hauling vehicle immediately prior to the placement on the roadway to receive the surface treatment.

The cover aggregate must be weighed and the weigh tickets delivered to the COR prior to application.

418.15 Payment.

Payment for Item 41801 and 41802 are limited to 80% of the quantity placed until all test results are received by the COR.

Surface preparation including blotter sand and all materials, equipment and labor required to apply the blotter sand will not be measured directly for payment but will be considered a subsidiary obligation of the contract.

The accepted quantities, measured as provided above, will be paid at the contract unit price per unit of measurement according to Subsection 418.13 for the pay items listed below that are shown in the bid schedule. Payments will be full compensation for the work prescribed in the Section.

Payment will be made under:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>41801 Hot asphalt rubber binder</td>
<td>Ton</td>
</tr>
<tr>
<td>41802 Pre-coated cover aggregate, ½” grading special, seal coat</td>
<td>Ton</td>
</tr>
</tbody>
</table>