

Recycled Asphalt Pavement (RAP) and Asphalt Shingles

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1. SCOPE

1.1 Use the following specifications for preparing and constructing asphalt pavements using recycled asphalt pavements (RAP) and asphalt shingles. NOTE: The 2007 Standard Specifications sections **401.2.2.6** and **401.2.2.8** have been deleted and rewritten for this specification and will be used for all projects herein.

2. REFERENCED DOCUMENTS

- 2.1 SCDOT Standard Specifications
 - 2.1.1 Division 300, Division 400, SC-M-402
- 2.2 AASHTO Standards
 - 2.2.1 T27, T315, T316
- 2.3 SCDOT Test Methods
 - 2.3.1 SC-T-75, SC-T-80, SC-T-95

3. RECYCLED ASPHALT PAVEMENT MATERIALS

- 3.1 RAP Stockpiles
 - 3.1.1 Perform extraction tests at a rate of 1 per 1000 tons of RAP, with a minimum of 3 tests per stockpile. Process the RAP in such a manner that all particles pass a 2-inch screen before entering the plant, and are free of foreign matter or other contaminations. RAP particles retained on the 2-inch screen may be re-crushed in a manner that does not result in further degradation of the aggregates. Erect and maintain a sign satisfactory to the **AME** on each stockpile for proper identification. Ensure that no deleterious material is allowed in any stockpile.
- 3.2 Records
 - 3.2.1 Maintain at the plant site a record system for all RAP stockpiles. Include at a minimum the following:
 - 3.2.1.1 Stockpile identification and a sketch of all stockpile areas at the plant site.
 - 3.2.1.2 Extraction test results for each stockpile.
 - 3.2.1.3 At the plant site, make available to the **RCE** and **AME** the RAP stockpile records. The **RCE** or **AME** may reject by visual inspection any stockpiles that are not kept clean and free of foreign materials.

- 3.3 Composition of Recycled Mixture
 - 3.3.1 Use recycled HMA meeting all applicable requirements contained in the specifications, except as indicated herein. Submit samples of RAP and additives proposed for use in the recycled HMA to the **AME** at least 30 days prior to the beginning of the work. Submit a minimum of 50 pounds of representative milled/processed material along with the RAP stockpile records and the asphalt mix design approval request on forms approved by the **AME**.
 - 3.3.2 If milled material from a project is not available, submit at least 10 cores that are between 6 and 8 inches in diameter, sliced at the proposed milling depth that is representative of the material to be milled. In addition, perform a minimum of 6 extraction tests on cored roadway samples from random locations before submitting an asphalt mix design approval request. Submit extraction test results and cores representing the material to be milled with the asphalt mix design request. Ensure that the number of roadway cores obtained is sufficient to represent the entire length of roadway to be milled taking into consideration the length of the project, changing roadway conditions, etc. (This procedure may only be used on Non-Fractionated RAP)
 - 3.3.3 Do not use softening agents, asphalt modifiers, rejuvenators, or recycling agents.
 - 3.3.4 The **AME** will make random project inspections so that samples of recycled HMA can be obtained for checking the recovered properties of the asphalt binder. *This may be deemed necessary if problems exist with field production or placement of the finished HMA mixture.* Recovery of asphalt binder will be performed by **SC-T-95**, and binder tests will be done to determine the stiffness and viscosity of the recovered asphalt binder using **AASHTO T315** and **AASHTO T316**. In the event that the binder is determined to be too stiff or viscosity is too high as determined by the **AME**, production will be suspended, and the contractor will be required to redesign the asphalt mix.
- 3.4 Fractionation
 - 3.4.1 Non-Fractionated RAP
 - 3.4.1.1 In addition to the limits below, further limit RAP to 15% maximum when introduced in the hot elevator.
 - 3.4.1.2 RAP stockpiles may not be replenished once initially approved.
 - 3.4.2 Fractionated RAP
 - 3.4.2.1 Mechanically separate RAP materials into appropriate sizes using a high frequency separation device acceptable to the **AME**.
 - 3.4.2.2 Provide a Quality Control plan accepted by the **AME**, a fractionation device accepted by the **AME**, and sufficient cold feed bins (one per RAP fractionation size *if running both RAP sizes simultaneously*) to handle the fine (passing No. 4 or ¼-inch sieve) and coarse material(s) generated during the fractionation process.
 - 3.4.2.3 In addition to the limits indicated in the table in subsection 3.5, further limit RAP to 15% maximum when introduced in the hot elevator.
 - 3.4.2.4 RAP stockpiles may contain RAP from multiple sources and may be replenished.

3.5

Recycled Asphalt Pavement (RAP) – Maximum Amount Permitted

Type of Mix	Maximum % RAP	
	Non Fractionated RAP	Fractionated RAP
Surface A	-	10
Surface B	15	20
Surface C	20	25
Surface CM	20	25
Surface D	20	25
Surface E	-	25*
Intermediate A	-	10
Intermediate B	20	25
Intermediate C	25	30
Base A	30	30
Base B	30	30
Base C	-	30*
Base D	-	30*

*Fractionated Fine Rap only

4.0 RECYCLED ASPHALT SHINGLE MATERIALS

4.1 Shingles are permitted in HMA Aggregate Base Types A, B, C, and D, Intermediate Type C, and Surface Types C, D, and E.

4.2 If shingles are used, produce a uniform and reacted asphalt mixture of compatible paving grade binder, quality fine and coarse aggregates, anti-strip additive, and shredded shingles.

4.3 Amount of Shingles in the Mixture

4.3.1 Limit the amount of the shingles used in each mix in accordance with the job mix formula requirements for that mix. When used, utilize a maximum of 5.0% shingles by the total weight of the aggregate.

4.4 Quality Control of Shingles

4.4.1 Utilize shredded shingles that are produced primarily from a shingle manufacturer-processing facility or recycled from the construction of residential or commercial roofing sites. All shingles must be processed using an ambient temperature grinding methods. It may be necessary to blend shingles together from multiple sources to ensure that the combined shingles conform to the gradation requirements. Ensure that all roofing shingles have no debris or particle size of greater than 1/2 inch. Provide delivered material at least 99.7% (by weight) free of any debris.

4.5 Gradation

4.5.1 Use shingles that meet the requirements in the following table when tested in accordance with **AASHTO T 27** (prior to extraction process).

Sieve Size	% Passing
1/2-inch	100.0
No. 4	70.0 – 95.0
No. 100	15.0 max.
No. 200	7.00 max.

- 4.5.2 Use shingles that are sufficiently dry to be free flowing and to prevent foaming when blended with the hot binder. Ensure that the shingles are free of all chemicals, oils, or any other hazardous materials (e.g., asbestos). Only accept shredded shingles with a certification from the shingle supplier that the material conforms to these specifications.
- 4.6. Extraction
- 4.6.1 Perform the extraction process in accordance with the requirements described in these specifications. Follow the testing procedures described in **SC-T-75** to obtain the binder content of the mixture. (200 to 300 grams are typically needed for extraction testing)
- 4.7 Mix Design
- 4.7.1 Use the method of mix design described in **SC-T-80** for the design of HMA containing shingles. After heating the aggregates to the proper temperatures and approximately 1 hour before the addition of the binder, add the proper amount of the shingles (e.g., 5% of total weight of the aggregate or $0.050 \times$ total weight of aggregate), mix thoroughly, and place the mix back in the oven. After approximately an additional 1-hour, add the required amount of the binder and mix. Check the temperature of the mixture to ensure that it has reached the compaction temperature before applying the compaction effort with a gyratory compactor.
- 4.8 Field Acceptance
- 4.8.1 The **AME** will make random project inspections so that samples of recycled HMA can be obtained for checking the recovered properties of the asphalt binder. *This may be deemed necessary if problems exist with field production or placement of the finished HMA mixture.* Recovery of asphalt binder will be performed by **SC-T-95**, and binder tests will be done to determine the stiffness and viscosity of the recovered asphalt binder using **AASHTO T315** and **AASHTO T316**. In the event that the binder is determined to be too stiff or viscosity is too high as determined by the **AME**, production will be suspended, and the contractor will be required to redesign the asphalt mix.