
Standard Practice for Design Considerations When Using Reclaimed Asphalt Shingles (RAS) in Asphalt Mixtures

AASHTO Designation: R 114-22¹

Adopted: 2022

**Technical Subcommittee: 2d, Proportioning
of Asphalt–Aggregate Mixtures**



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1. SCOPE

- 1.1. This recommended practice provides guidance for designing asphalt mixtures that incorporate reclaimed asphalt shingles (RAS) from manufactured waste or tear-off sources. Specific guidance includes design considerations, how to determine the shingle aggregate gradation, and how to determine binder quantity requirements for effective asphalt and binder quality requirements for binder embrittlement.

Note 1—Refer to M 350 for baseline information (source requirements, shingle gradation, and deleterious requirements) to consider when using RAS in asphalt mixtures.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards:*

- < M 323, Superpave Volumetric Mix Design
- < M 350, Reclaimed Asphalt Shingles for Use in Asphalt Mixtures
- < R 28, Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
- < R 35, Superpave Volumetric Design for Asphalt Mixtures
- < T 27, Sieve Analysis of Fine and Coarse Aggregates
- < T 164, Quantitative Extraction of Asphalt Binder from Asphalt Mixtures
- < T 209, Theoretical Maximum Specific Gravity (G_{mm}) and Density of Asphalt Mixtures
- < T 308, Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method
- < T 319, Quantitative Extraction and Recovery of Asphalt Binder from Asphalt Mixtures

2.2. *ASTM Standard:*

- < D7643, Standard Practice for Determining the Continuous Grading Temperatures and Continuous Grades for PG Graded Asphalt Binders

2.3. *Referenced Documents:*

- < Anderson, R. M., G. N. King, D. I. Hanson, and P. B. Blankenship. Evaluation of the Relationship between Asphalt Binder Properties and Non-Load Related Cracking. *Journal of the Association of Asphalt Paving Technologists*, Vol. 80, 2011, pp. 615–663.
- < Bennert, T. Asphalt Binder and Mixture Properties Produced with REOB Modified Asphalt Binders. Presented at the FHWA Asphalt Binder Expert Task Group, Fall River, Massachusetts, April 9–10, 2015. Available from

http://www.asphaltpavement.org/PDFs/Engineering_ETGs/Binder_201504/07%20Bennert-REOB%20-%20Rutgers%20Study.pdf

- < M 320, Performance-Graded Asphalt Binder
- < R 30, Laboratory Conditioning of Asphalt Mixtures

3. INTRODUCTION

- 3.1. RAS has been used as a component in asphalt mixtures for more than 20 years, but it remains as a relatively new application for many agencies as a cost effective tool in the production of asphalt mixtures. The use of RAS brings with it the need to address design considerations to ensure a well-designed mixture is achieved. Four separate areas are addressed by this recommended practice, with each elaborating on and providing recommendations relative to the following:
- < Design Considerations When Using RAS in Asphalt Mixtures
 - < Determining the Shingle Aggregate Gradation and Specific Gravity
 - < Determining Binder Quantity Requirements for Effective Asphalt
 - < Determining Binder Quality Requirements for Binder Embrittlement

4. DESIGN CONSIDERATIONS WHEN USING RAS IN ASPHALT MIXTURES

- 4.1. The introduction of aggregate from RAS can have an effect on the gradation properties of the asphalt mixture. The designer must determine the particle size and percentage of shingle aggregate present and adjust the new aggregate composition accordingly.
- 4.2. The introduction of RAS may affect the asphalt binder content requirements of a mixture. The designer must determine the new asphalt binder content of the asphalt mixture as part of the volumetric design procedure.
- 4.3. Although the amount of RAS in an asphalt mixture design is generally small, typically 3 to 5 percent by weight of aggregate, the non-asphalt components (aggregates and fibers) can have a significant effect on the mixture. Voids in the mineral aggregate (VMA) will generally increase due to the hard angular properties of the RAS granules as well as the presence of the fibers. Dust content of the RAS causes a reduction in VMA that is generally less than the increase from granules and fibers, resulting in a net VMA increase. Other properties influenced by the shingles include fine aggregate angularity and dust to binder ratio.
- Note 2**—The properties of RAS binder are much stiffer than paving asphalt binder. As a result, agencies typically limit the use of RAS to a maximum of 5 percent by weight of aggregate.

5. DETERMINING THE RAS AGGREGATE GRADATION AND SPECIFIC GRAVITY

- 5.1. Collect a representative sample of RAS and proceed in accordance with T 164 or T 319 to extract the RAS asphalt binder or T 308 to ignite and remove the RAS asphalt binder and recover the RAS aggregate. The size of the sample should be such that the amount of RAS aggregate material recovered will meet the size requirements of the gradation procedure.
- Note 3**—Generally, 400 g of RAS is sufficient to provide the 300 g of aggregate needed for T 27. For T 319, extracting 400 g of RAS will meet the minimum sample size requirements. T 308 recommends a sample size of 1200 g, however, the test should be run with 400 g of RAS. If the ignition oven ventilation system cannot handle the exhaust, the sample may need to be run in two parts and the results combined.