



**INDIANA DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS**

**ALTERNATIVE METHOD FOR DETERMINING BULK
SPECIFIC GRAVITY OF
RECLAIMED ASPHALT PAVEMENT
ITM No. 596-17**

1.0 SCOPE.

- 1.1** This test method outlines the alternative method for estimating bulk specific gravity (Gsb) for Reclaimed Asphalt Pavement (RAP). This test method can also be used for determining the maximum specific gravity (Gmm) of pavement cores taken for forensic investigations.
- 1.2** This procedure may involve hazardous materials, operations and equipment and may not address all of the safety problems associated with the use of the test method. The user of this ITM is responsible for establishing the appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

2.0 REFERENCES.

2.1 AASHTO Standards.

M 231 Weighing Devices Used in the Testing of Materials
T 209 Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt Paving Mixtures

2.2 ITM Standards.

207 Sampling Stockpiled Materials
572 Drying HMA Mixtures
580 Sampling HMA
584 Bulk Specific Gravity of Aggregate Blends in HMA Mixtures
587 Reducing HMA Samples to Testing Size
802 Random Sampling

3.0 TERMINOLOGY. Definitions for terms and abbreviations will be in accordance with the Department's Standard Specifications Section 101 and the following:

- 3.1** RAP – Reclaimed Asphalt Pavement
- 3.2** New Asphalt Binder –typically PG 64-22 binder that is added additionally to a mix being prepared for Gmm testing.

4.0 SIGNIFICANCE AND USE.

- 4.1 The bulk specific gravity (G_{sb}) of the aggregate in the reclaimed asphalt pavement can be estimated. This estimate is determined by calculating the effective specific gravity (G_{se}) using maximum specific gravity (G_{mm}) and binder content (P_b).
- 4.2 This test method outlines the alternative method for determining G_{mm} for RAP. This also can include determining G_{mm} on forensic cores. AASHTO T 209 requires the supplemental procedure to determine G_{mm} for mixtures containing porous aggregate. The supplemental procedure (dry-back) can be time consuming and may introduce unnecessary error. To prevent intrusion of the water into the sample, add a measured quantity of asphalt binder as need to fully coat all particles.

5.0 APPARATUS.

- 5.1 Balance, Class G2, in accordance with AASHTO M 231
- 5.2 Mixing bowls, spatulas, pans, trowels, and wire brushes as required
- 5.3 Oven, capable of maintaining the temperature at $250 \pm 9^\circ\text{F}$

6.0 SAMPLING.

- 6.1 Sampling shall conform to the requirements of ITM 207 when sampling stockpiled RAP
- 6.2 Sampling shall conform to the requirements of ITM 580 when obtaining RAP core samples from the pavement

7.0 PREPARATION OF TEST SPECIMEN.

- 7.1 The approximate minimum sample size of the two samples shall be in accordance with the following:

Mixture Designation	Minimum Weight (mass) of Sample, g
4.75 mm	1000
9.5 mm	1500
12.5 mm	2000
19.0 mm, OG 19.0 mm	3000
25.0 mm, OG 25.0 mm	4000

- 7.2 Dry the sample to a constant weight in accordance with ITM 572.
- 7.3 Place the sample in a large flat pan and heat to a maximum of $221 \pm 9^{\circ}\text{F}$ only until the sample may be handled. Separate the sample as uniformly as possible, using care not to fracture the mineral aggregate.
- 7.4 Pre-heat the additional new asphalt binder to the temperature recommended by the manufacturer.

8.0 PROCEDURE

8.1 Asphalt Content Sample. Determine and record the asphalt content of the reclaimed asphalt pavement in accordance with ITM 571

8.2 Maximum Specific Gravity Sample.

8.2.1 Mix the heated RAP sample thoroughly in a mixing bowl with a spatula or trowel to allow the old RAP binder to coat the uncoated aggregate particles

8.2.2 Add new asphalt binder at 1% of the total sample weight. Mix the sample thoroughly to coat the mixture. Thoroughly coat the sample, but not excessively to where drain-down may occur. Add new asphalt binder as needed at 1% increments, up to 3%, to fully coat all particles.

$$N = S \times \frac{1}{100}$$

Where:

N = new asphalt binder at 1% of the total sample weight, g

S = weight of oven dry sample in air, g

8.2.3 Once the sufficient amount of new asphalt binder is thoroughly mixed, determine Maximum Specific Gravity (Gmm), mass determined in water, in accordance with AASHTO T 209 with the following exception:
-the samples shall be conditioned in the oven for a minimum of 4 hours.

9.0 CALCULATIONS.

9.1 Maximum Specific gravity. When Gmm testing is completed, use the following equation to compensate for the added new asphalt binder.

$$\text{Max Sp. Gr. (Gmm)} = \frac{A - E}{A + C - (B + V)}$$

$$V = \frac{E}{1.03}$$

Where:

- A = weight of oven dry sample in air, g
- B = weight of container and sample in water, g
- C = weight of container in water, g
- E = total mass of the added new asphalt binder, g
- V = volume of the added new asphalt binder, ml

9.2 Bulk Specific Gravity.

9.2.1 Calculate and record the effective specific gravity of the recycled aggregate as follows:

$$(G_{se})_{RAP} = \frac{100 - Pb}{\frac{100}{Gmm} - \frac{Pb}{1.03}}$$

Where:

- $(G_{se})_{RAP}$ = effective specific gravity of the recycled aggregate
- Pb = percent binder of the reclaimed asphalt pavement
- Gmm = maximum specific gravity of the reclaimed asphalt pavement

9.2.2 Calculate and record the bulk specific gravity of the recycled aggregate as follows:

$$(G_{sb})_{RAP} = [0.9397 \times (G_{se})_{RAP}] + 0.0795$$

Where:

- $(G_{sb})_{RAP}$ = bulk specific gravity of the recycled aggregate
- $(G_{se})_{RAP}$ = effective specific gravity of the recycled aggregate

10.0 REPORT. $(G_{sb})_{RAP}$ of the HMA is reported to the nearest 0.001