MAXIMUM THEORETICAL SPECIFIC GRAVITY AND DENSITY OF FIELD PRODUCED BITUMINOUS MIXTURES (RICE TEST)

(A Modification of AASHTO T 209)

1. SCOPE

1.1 This method of test is intended for determining the maximum specific gravity and density of uncompacted bituminous mixtures that have been field produced.

Note: Two methods are provided for determining the maximum specific gravity. The method given in Section 6 is for determining results without fan drying the samples. Section 7 describes the procedure which is used when fan drying is necessary. For the first four samples taken at the beginning of production on a project the maximum specific gravity shall be determined in accordance with Section 6 and also shall be fan dried and maximum specific gravity determined in accordance with Section 7. If the difference in resultant air voids, when determined as described in Arizona Test Method 424 is greater than 0.2% subsequent samples will be subjected to fan drying. During the course of the project comparisons should be made on approximate 10 sample intervals to determine need for fan drying. In case of dispute, fan drying shall be used.

1.2 This test method may involve hazardous material, operations, or equipment. This test method does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user to consult and establish appropriate safety and health practices and determine the applicability of any regulatory limitations prior to use.

1.3 See Appendix A1 of the Materials Testing Manual for information regarding the procedure to be used for rounding numbers to the required degree of accuracy.

2. APPARATUS

2.1 Requirements for the frequency of equipment calibration and verification are found in Appendix A3 of the Materials Testing Manual.

2.2 Balance - A balance capable of measuring the maximum weight to be determined and conforming to the requirements of AASHTO M 231, except the readability and sensitivity of any balance utilized shall be at least 0.1 gram.

2.3 Container - A heavy walled Erlenmeyer flask having a capacity of at least 1500 mL and strong enough to withstand a partial vacuum; the cover shall consist of a rubber stopper with a tight hose connection. A small piece of No. 200 wire mesh covering the hose opening shall be used to minimize the possibility of loss of fine material.

Note: If a procedure which subjects multiple flasks to a vacuum simultaneously is used, the vacuum gauge shall be placed beyond the last bottle to insure that all the bottles are being subjected to the same amount of vacuum.

2.4 Flat glass plate large enough to cover mouth of the flask.

2.5 Vacuum pump for evacuating air from the container.

2.6 All water used in this procedure shall be distilled or de-mineralized water.

3. CALIBRATION OF FLASK

3.1 Record the weight of the flask and flat glass plate separately to the nearest 0.1 gram on the work card. Using water at a temperature of 77 ± 1 °F, fill the flask with water to approximately one inch below the top of the flask. Using a long narrow rod, remove air bubbles adhering to the walls of the flask. Confirm that the temperature of the water is at 77 ± 1 °F. Fill to the top and slide the flat glass plate over the mouth of the flask. Verify that no air is trapped under the flat glass plate. Dry the outside of the flask and glass plate and weight to the nearest 0.1 gram. Subtract the weight of the glass plate and record the weight of the “flask and water” as "B".

4. PREPARATION OF SAMPLES

4.1 Obtain 3 representative 1050 ± 50 gram samples of the material, as described in Arizona Test Method 416.

Note: If necessary, heat the sample for not more than one hour at a maximum temperature of 285 °F ONLY until it is pliable enough to allow separation of the coated aggregate.

4.2 Spread each sample on a sheet of heavy paper or in a large flat bottom pan. Before the samples are completely cooled, separate the particles of the mixture, taking care not to fracture the coarse aggregate particles, so that the particles of the fine aggregate portion are not larger than 1/4 inch. Allow the samples to cool to room temperature.

5. PROCEDURE

5.1 Place the sample in the flask and determine the weight to the nearest 0.1 gram. Subtract the weight of the flask and record the “weight of sample in air" as "Wmm".

5.2 Add sufficient water to cover the sample. The water shall be at a temperature of approximately 77 °F and shall have been treated with a wetting agent.

Note: Aerosol OT in a concentration of 0.01%, or one mL of 10% solution per 1000 mL of water, has been found to be a suitable wetting agent and shall be used to facilitate the release of entrapped air.

5.3 Remove entrapped air by subjecting the contents of the flask to a partial vacuum with a minimum of 20 inches of mercury (gauge) for 15 ± 2 minutes, agitating the contents of the flask four times at evenly spaced intervals throughout this period.

CAUTION: Do not agitate the sample too frequently or vigorously, as that can cause stripping of the asphalt film from some particles, resulting in erroneous specific gravities.

5.4 After the evacuation period, fill the flask with water to approximately one inch below the top of the flask. Gently stir the sample with a long narrow rod in such

a way to release any trapped air bubbles, avoiding breakage of the aggregates. Using the long narrow rod, carefully remove any air bubbles adhering to the walls of the flask. Fill completely to the top and confirm that the temperature is at 77 ± 2 °F. Slide the pre-weighed flat glass plate over the mouth of the flask. Verify that no air is trapped under the flat glass plate. Dry the outside of the flask and glass plate and weigh immediately to the nearest 0.1 gram. Subtract the weight of the glass plate and record the weight of the "flask + water + sample" as "C".

6. CALCULATIONS

6.1 The Volume of Voidless Mix, "Vvm", in mL, and Maximum Specific Gravity, “Gmm” is determined for each sample by the following:

$$Vvm = Wmm + B - C$$

$$Gmm = \frac{Wmm}{Vvm}$$

Where: Wmm = Wt. of Sample in Air
B = Wt. of Flask + Water + Glass Plate
C = Wt. of Flask + Water + Sample + Glass Plate

6.2 Compare the three individual values for maximum specific gravity. If the range of the three is within 0.024, all are used to determine the average maximum specific gravity as shown in Subsection 6.4. If the range is greater than 0.024, the average of two may be used if they are within a range of 0.012. If values are not achieved within the above criteria, the samples shall be discarded and a set of three new samples shall be tested. If material is not available, results should be used cautiously in the analysis of the bituminous mix. If results are used for specification compliance, additional material must be obtained for retesting.

6.3 The average maximum specific gravity of the bituminous mix is determined for the samples with acceptable maximum specific gravity values, and recorded to the nearest 0.001.

6.4 To determine the maximum density, the average maximum specific gravity is multiplied by 62.3 lbs./cu. ft.

7. PROCEDURE FOR FAN DRYING SAMPLES

7.1 The entire contents of the flask shall be poured into a nest of sieves consisting of a No. 40 and a No. 200 screen.

Note: If stripping has occurred, as evidenced by discoloration of water in the flask, significant loss of Minus No. 200 material may be expected. Provisions for the recovery and addition of this material to the Plus No. 200 material shall be made.

7.2 Allow the mix to drain through the sieves until excess moisture is removed from the mix. Separate the sieves and place both sieves in a tared pan. Place the pan in front of a fan (see Note below) and dry the material retained on the No. 40 and No. 200 sieves until the material can be easily removed from the sieves. Remove the material from the sieves and spread it in the pan. Determine and record the initial weight of the pan and the material.

Note: The air through the fan shall be at room temperature and no heat shall be used to dry the material.

7.3 Continue fan drying the material, determining and recording the weight of the pan and the material at 15 minute intervals. When the weight loss is 0.5 gram or less for a 15 minute interval, the mix is considered to be surface dry. Record the surface dry weight as "Wsd". Intermittent stirring of the sample is required during the drying period. Conglomerations of the mix shall be broken by hand. Care must be taken to prevent loss of particles of the mixture.

Note: If the "Wsd" weight for any of the three samples is less than its corresponding "Wmm" weight, the samples shall be discarded and a set of three new samples shall be tested. If material is not available, the maximum specific gravity shall be determined utilizing the "Wmm" weight and results should be used cautiously in the analysis of the bituminous mix. If results are used for specification compliance, additional material must be obtained for retesting.

7.4 To calculate the fan dried "Vvm" and maximum specific gravity, "Gmm", of each sample, the surface dry weight, "Wsd", is substituted for "Wmm" in the equation given for "Vvm" in Subsection 6.1, as shown in the example below.

$$Vvm = Wsd + B - C$$

$$G_{mm} = \frac{W_{mm}}{V_{vm}}$$

Where: Wmm = Wt. of Sample in Air
Wsd = Wt of Fan Dried Sample
B = Wt. of Flask + Water + Glass Plate
C = Wt. of Flask + Water + Sample + Glass Plate

8. EXAMPLE

8.1 An example of the completed form is shown in Figure 1 and an example of the blank form is shown in Figure 2.

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ARIZONA TEST METHOD 417

Lab#: 15-3456 Date: 08/05/2015 Project #: F-111-1(1) TRACS#: H999901C
Project Name: Big Gulch - Bug Mountain Material Type: 3/4" AC
Lot#: 1 Sample #: 4 Maximum Specific Gravity Range: 0.003
Tested By: Lisa Tester Checked By: A. A.

If samples were fan dried, the maximum density is determined utilizing the "Wsd" weight as shown below:

Flask Number or I. D.	"Wf" Wt. of Flask	"Wmm" Wt. of Sample in Air Wfs - Wf	"B" Wt. of Flask + Water	"C" Wt. of Flask + Sample + Water Wa - Wp	Vvm" Volume of Voidless Mix Wmm + B - C	"Gmm" Maximum Specific Gravity Wmm / Vvm	Maximum Density (lbs./cu. ft.) Gmm X 62.3	"Wsd" Surface Dry Weight (See Below)	Vvm" Volume of Voidless Mix Wsd + B - C	"Gmm" Maximum Specific Gravity Wmm / Vvm	Maximum Density (lbs./cu. ft.) Gmm X 62.3
1	998.7	1064.9	3215.7	3848.7	431.9	2.466		1067.7	434.7	2.450	
2	977.6	1076.5	3178.7	3819.2	436.0	2.469		1080.5	440.0	2.447	
3	~~994.3~~	~~1067.4~~	~~3194.1~~	~~3825.1~~	~~436.4~~	~~2.446~~		~~1071.2~~	~~440.2~~	~~2.425~~	
AVERAGE						*2.468*	*153.8*			*2.449*	*152.6*

Remarks: *Flask #3 eliminated from the average due to Specific Gravity being outside specified 0.024 allowable range*

Flask Number or I. D.	1	2	3
Wt. of Flask + Sample, "Wfs"	2063.6	2054.1	2061.7
Wt. of Flask + Sample Water + Glass Plate, "Wa"	3931.1	3901.6	3907.5
Wt. of Glass Plate, "Wp"	82.4	82.4	82.4

Specific Gravity Range:	Range of 3:	Range of 2:
Non Fan Dried:	0.020	0.003
Fan Dried:	0.025	0.003

Maximum Specific Gravity (Rice) Fan Dry Weigh backs

Flask Numer or I.D.	1	2	3
Tare weight of Pan	453.7	502.4	499.6
Weight of Pan and Sample	1536.3	1597.8	1585.7
Weight of Pan and Sample	1529.2	1590.7	1578.6
Weight of Pan and Sample	1523.2	1584.7	1572.6
Weight of Pan and Sample	1522.5	1584.0	1571.9
Weight of Pan and Sample	1521.9	1583.4	1571.2
Weight of Pan and Sample	1521.4	1582.9	1570.8
Weight of Pan and Sample			
Weight of Pan and Sample			
Surface Dry Weight (Wsd)	*1067.7*	*1080.5*	*1071.2*

Air Voids Calculations

$$\left[1 - \frac{\text{A.C.Mix Bulk Density}}{\text{Maximum Density From Rice Test}}\right] \times 100 =$$

Non Fan Dried $\left[1 - \frac{145.5}{153.8}\right] \times 100 =$ 5.4 %

Fan Dried $\left[1 - \frac{145.5}{152.6}\right] \times 100 =$ 4.6 %

Difference in Air Voids = [Air Voids (Sample Not Fan Dried)] - [Air Voids (Sample Fan Dried)] = 0.8 %

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FIGURE 1

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ARIZONA TEST METHOD 417

Lab#: _____ Date: _____ Project #: _____ TRACS#: _____
Project Name: _____ Material Type: _____
Lot#: _____ Sample #: _____ Maximum Specific Gravity Range: _____
Tested By: _____ Checked By: _____

If samples were fan dried, the maximum density is determined utilizing the "Wsd" weight as shown below:

Flask Number or I. D.	"Wf" Wt. of Flask	"Wmm" Wt. of Sample in Air Wfs - Wf	"B" Wt. of Flask + Water	"C" Wt. of Flask + Sample + Water Wa - Wp	Vvm" Volume of Voidless Mix Wmm + B - C	"Gmm" Maximum Specific Gravity Wmm / Vvm	Maximum Density (lbs./cu. ft.) Gmm X 62.3	"Wsd" Surface Dry Weight (See Below)	Vvm" Volume of Voidless Mix Wsd + B - C	"Gmm" Maximum Specific Gravity Wmm / Vvm	Maximum Density (lbs./cu. ft.) Gmm X 62.3
AVERAGE											

				Remarks:
Flask Number or I. D.				
Wt. of Flask + Sample, "Wfs"				Specific Gravity Range: Range of 3: Range of 2:
Wt. of Flask + Sample Water + Glass Plate, "Wa"				Non Fan Dried:
Wt. of Glass Plate, "Wp"				Fan Dried:

Maximum Specific Gravity (Rice) Fan Dry Weigh backs

Flask Numer or I.D.			
Tare weight of Pan			
Weight of Pan and Sample			
Weight of Pan and Sample			
Weight of Pan and Sample			
Weight of Pan and Sample			
Weight of Pan and Sample			
Weight of Pan and Sample			
Weight of Pan and Sample			
Weight of Pan and Sample			
Surface Dry Weight (Wsd)			

Air Voids Calculations

$$\left[1 - \frac{\text{A.C.Mix Bulk Density}}{\text{Maximum Density From Rice Test}}\right] \times 100 =$$

Non Fan Dried $\left[1 - \_\_\_\_\_\right] \times 100 =$ _____ %

Fan Dried $\left[1 - \_\_\_\_\_\right] \times 100 =$ _____ %

Difference in Air Voids = [Air Voids (Sample Not Fan Dried)] - [Air Voids (Sample Fan Dried)] = _____ %

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FIGURE 2