1807 MAXIMUM SPECIFIC GRAVITY (RICE VOIDS TEST) OF PAVING MIXTURES

AASHTO Designation T 209 (Mn/DOT Modified))

1807.1 SCOPE

This test method covers the determination of the theoretical maximum specific gravity and density of uncompacted bituminous mixtures. These densities are used to calculate values for percent air voids and they provide target values for the compaction of mixtures.

NOTE 1: Mn/DOT differs from AASHTO in this procedure by requiring the use of a cylindrical
screen within the container and that the temperature of the water bath be maintained at 25 ± 1 °C (77 ± 1.8 °F). Mn/DOT makes use of a vacuum desiccator or bell jar for a vacuum chamber.

1807.2 APPARATUS

A. Vacuum Container - In accordance with AASHTO T209, “Type A”. A 6.5” (diameter) x 7.7” (height) stainless steel pot for weighing in air and water is recommended.

B. Cylindrical Screen - A cylindrically formed mesh fabricated from an out-of-tolerance 4.75mm (#4) through 2.36mm (#8) sieve works well. The dimensions should be approximately one-half the diameter and height of the container (pot) with one end open.

C. Vacuum Desiccator or Bell Jar - Capable of withstanding the full vacuum applied and with an additional safety factor.

D. Vacuum Pump - Capable of evacuating air from the desiccator or bell jar to a residual pressure of 4.0 kPa (30mm Hg) or (30 Torr).

E. Water Trap - A suitable trap of one or more 1000ml flasks (or equivalent) shall be installed in-line to reduce the water vapor from entering the vacuum pump.

F. Vacuum Gauge - Suitable for measuring the vacuum being applied at the source. This device can be connected directly to the vacuum pump or be in the vacuum line close to the pump.

G Residual Pressure Manometer or Vacuum Gauge - Traceable to NIST, connected directly to the vacuum vessel and capable of measuring residual pressure down to 4.0 kPa (30mm Hg) or (30 Torr).

H. Balance - A balance conforming to the requirements of AASHTO M 231 (Class G2) with a minimum capacity of 5000g, a readability and sensitivity of 0.1g and an accuracy of 0.1g or 0.1%.

I. Suspension Apparatus - For the balance and suitable for weighing the specimen and container while suspended in water.

J. Water Bath - Equipped with an overflow outlet and an immersion heater/circulator capable of maintaining a constant temperature of 25 ± 1 °C (77 ± 1.8 °F).

K. Vibrating Table – Used with the vacuum container to keep sample material loose during the vacuum process.

Picture #1

CONTAINER AND CYLINDRICAL MESH BASKET

Picture #2

SAMPLE AND CONTAINER
IN THE VACUUM DESCCITATOR

1807.3PROCEDURE

A. Material obtained from lab-mixed samples must be cured in accordance with the appropriate mix design being used. Refer to Section 1805.4F (Marshall mix) or 1820.5G (gyratory mix). Do not cure bituminous mixture samples that have been produced in a hot-mix plant.

B. Mixtures that have not been prepared in a laboratory with oven-dried aggregates shall be dried to a constant weight at 110 ± 5 °C (230 ± 9 °F).

C. Obtain 2000 – 2050 grams of mixture and spread in a large pan. Refer to the appropriate Sections (1805, 1809, 1812 or 1820) for splitting or batching out a representative “Rice” sample from a submitted field or Trial Mix verification sample.

D. Bring the oven-dried mixture to a loose condition. Starting while the mixture is still workable and periodically while cooling to room temperature separate the particles carefully so that clumps of the fine aggregate portion are no larger than 6.4mm (1/4"). Be careful not to fracture the coarse aggregate.

E. Weigh the approved container and screen (a cylindrical sieve approximately one-half the diameter of the container) to the nearest 0.1g. Record on the worksheet as “Container in Air”.

F. Put the cooled, loose mixture into the container around the screen and weigh the container with the sample to the nearest 0.1g. Remember to place the open end of the cylindrical screen down. Use all of the material that was batched out. Record on the worksheet as “Container and Sample in Air”.

G. Fill the container with clean water at 25 ± 1 °C (77 ± 1.8 °F) to a level at least 13mm (1/2") above the top of the mix/screen. Submerge any floating particles with your finger and/or by adding 5-15 drops of Aerosol OT to the water.

NOTE 2: Do not use the entire 15 drops at this time. Additional drops may be needed at the end after the vacuum is applied. The use of Aerosol OT also facilitates the release of entrapped air.

H. Place the container, screen and sample into the vacuum apparatus (bell jar or a vacuum desiccator). Then make certain that the vacuum apparatus is securely affixed to the vibrating table.

I. Attach the vacuum hose, turn on the vacuum pump and remove the entrapped air by subjecting the container and contents to a gradually increasing vacuum until a residual pressure of 30mm Hg or less is reached. This targeted pressure is then maintained for the entire 15 minutes.

NOTE 3: When using a “Bennert” U-tube manometer start the vacuum pump and allow time for the system to be partially evacuated. Then slowly open the stopcock on the manometer. With the reduction in pressure the mercury in the left arm of the U-tube will drop while the mercury in the right arm rises. To find the actual degree of vacuum measure the difference between the menisci levels. This is achieved by moving the sliding scale upwards until the zero mark is aligned with the meniscus in the left arm. The degree of vacuum is then read directly on the right arm of the U-tube in millimeters of mercury.

J. Start the vibrating table and subject the container and sample to vibration the entire 15 minutes.

NOTE 4: The 15-minute time is measured from the point at which the vacuum level of 30mm Hg is achieved. For systems using the residual pressure manometer this moment is when the measured difference in height of mercury in the left leg of the manometer is 30mm from the height of the mercury in the right leg.

K. At the end of the 15 minutes shut off the vacuum pump and vibrating table. Slowly depressurize the vacuum chamber (desiccator or bell jar) and remove the container with sample from the test apparatus. Be careful not to expose any portion of the sample to air. Keep the sample submersed.

Picture #3

SAMPLE IN THE VACUUM DESICCATOR WITH VACUUM HOSES ATTACHED

L Note the clarity of the water and submerge any floating particles by gently agitating with a finger and/or by adding more Aerosol OT. (Maximum total of 15 drops from start to finish.)

M. Immerse sample, container and screen into the 25 ± 1 °C (77 ± 1.8 °F) water bath and place onto the suspension apparatus beneath the balance. Upon immersing be careful not to expose any portion of the sample to air.

N. Let stand in the water bath for 10 ± 1 minute. Record the immersed weight of the container and contents to the nearest 0.1g and record o the worksheet as “Container and Sample in Water”.

NOTE 5: AASHTO requires that the container be immersed immediately upon release from the vacuum. Delaying immersion for no longer than three minutes has been found acceptable.

O. To determine the calibrated weights of the container, rinse the container and screen clean, refill with 25 ± 1 °C (77 ± 1.8 °F) water 13mm (1/2") above the screen, add a few drops of Aerosol OT and submit to the same vacuum and gentle vibration for 3 minutes. Determine the immersed weight of the container with screen in the same manner (Steps "H" thru "N" but with the above 3 minute process.) that was used to determine the weight of them with the sample. Record on the worksheet as "Container in Water".

NOTE 6: Container weights (lines H & K in Section 1808.4 Worksheet)) may be pre-determined; however, the weight of the container with screen in air should be checked periodically and when that weight deviates from the established weight by more than 0.5 gram, establish new (calibrated) tare weights, both in air and in water.

1807.4 CALCULATION (See Example Worksheet in Section 1808)

G = Weight of sample and container with screen in air.

H = Weight of container with screen in air. (See note)

I = Dry weight of sample (G-H).

J = Weight of sample and container with screen in water.

K = Weight of container with screen in water. (See note)

L = Weight of sample in water (J - K).

M = Volume of Sample (I - L).

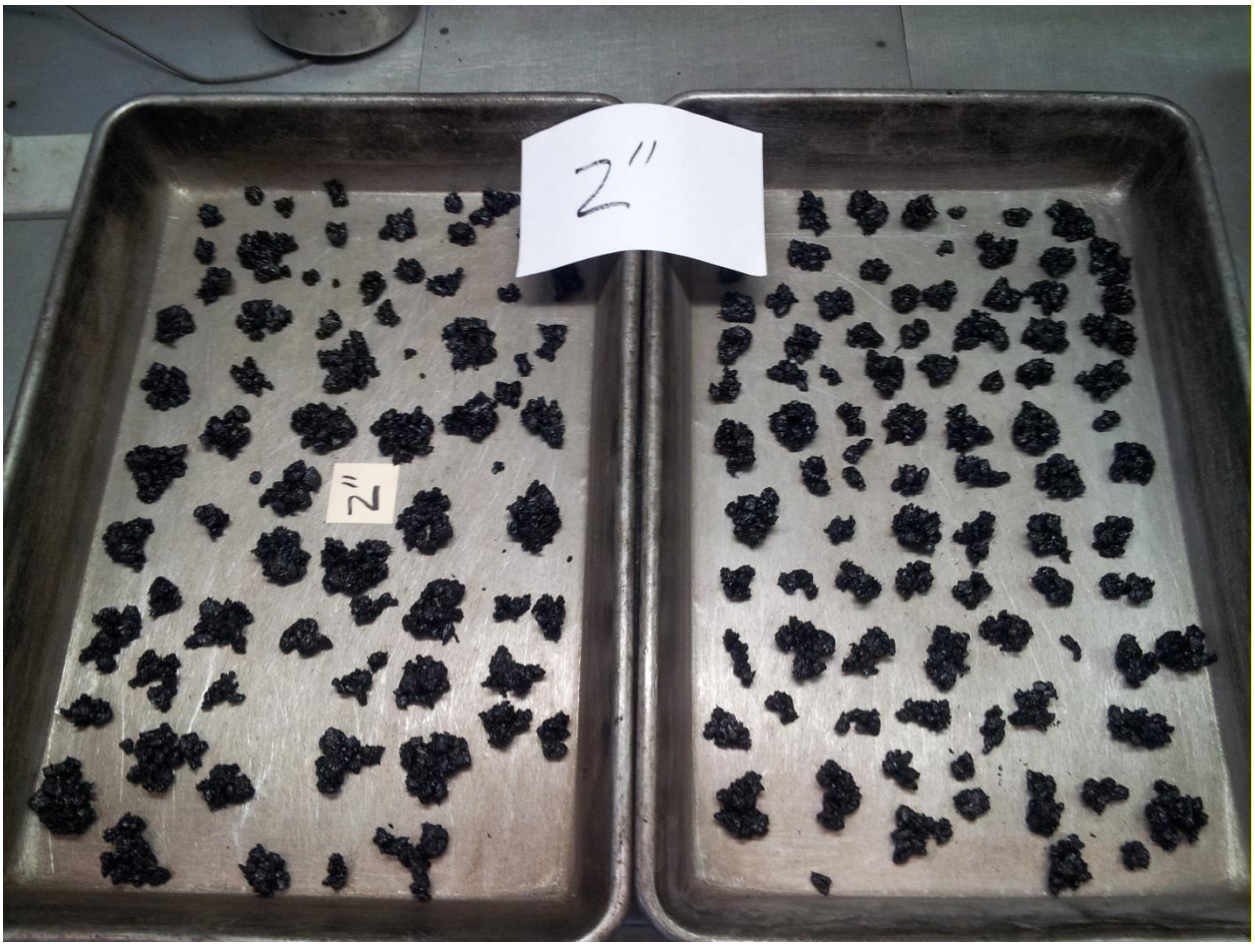
N = Maximum specific gravity (I/M). - Record to the nearest 0.001

NOTE 7: When this test is done for verification of a non-Mn/DOT mix design two separate tests must be run. The average result will be used in the calculation provided the individual results do not vary by more than 0.011. Should the two results vary by more than 0.011 additional testing must be done.

1807.5 MODIFICATIONS ADAPTING THIS PROCEDURE FOR USE WITH STONE MATRIX ASPHALT (SMA).

A. In Section 1807.3 D it is not necessary to separate the fine aggregate clumps to the 6.4mm (1/4") size requirement. The following process can be substituted. Bring the oven-dried mixture to a loose condition. Starting while the mixture is still workable and periodically while cooling to room temperature separate the particles carefully so that no clusters of the aggregate portion are larger than 2"x2" or, four (4) square inches, and no thicker than the largest aggregate particle. Be careful not to fracture the coarse aggregate. See picture #4.

Picture #4



It is not necessary for the clusters to be uniform in size however; NO cluster shall exceed 2"x 2", or four square inches.