METHOD OF TEST FOR VOLUME OF VOIDS (RIGDEN VOIDS) IN COMPACTED FILLER OR FINES

I. SCOPE

This test procedure describes a method for determining the void volume in a dry-compacted mineral filler or fines (the so-called Rigden voids). The test method is based upon the assumption that the densest packing maximum bulk density of fines can be obtained by compacting the dry fines in a mold. This method is modified from that presented in NAPA Information Series 127. This test requires further development. Comments and suggestions from users should be forwarded to Chris Rogers, Soils and Aggregates Section, Room 220, Building C, 1201 Wilson Avenue, Downsview, Ontario M3M 1J8.

2. APPLICABLE DOCUMENTS

ASTM C 188 Specific Gravity of Hydraulic Cement

ASTM D 422 Particle Size Analysis of Soils

ASTM D 854 Specific Gravity of Soils

ASTM E 11 Specification for Wire-Cloth Sieves for Testing Purposes

NAPA Information Series 127, Evaluation of Baghouse Fines for Hot Mix Asphalt

3. SUMMARY OF METHOD

In this test method, the volume of the voids in a dry-compacted bed of mineral dust (the so-called Rigden voids) is determined by compacting the dust in a small mold.

4. DEFINITIONS

4.1 Maximum packing occurs when the particles are packed together in their minimum volume with a minimum void volume. Maximum packing results in a maximum bulk density.

4.2 The bulk density of the compacted fines is defined as the dry weight of the fines divided by the bulk volume of the compacted fines. The bulk volume includes the sum of the solid volume of the fines particles and the volume of the voids between the particles.

4.3 The density of the fines is defined as the dry weight of the fines divided by the solid volume of the fines particles. This density can be obtained from ASTM Test Method C 188 or D 854, or another appropriate test method.

5. SIGNIFICANCE

The void volume in dry compacted fines (Rigden voids) is sensitive to changes in gradation and other properties of the fines and, therefore, the dry compaction test has been proposed as a test for monitoring the uniformity of the fines collected in HMA facilities. Rigden voids can also be used to estimate the stiffening effect of the fines when mixed with asphalt cement.

6. APPARATUS

6.1 Compaction Hammer: A compaction hammer, as shown in Figure A-1, is required to compact the fines into the test mold. The fines are compacted in one layer, using 25 blows of the hammer.

6.2 Test Mold: A test mold or sample holder, as shown in Figure A-1, is required for measuring the volume of the compacted bed of fines.

6.3 CompactIon Pedestal: A circular steel block, 25.4 ± 2 mm thick, 100-130 mm diameter, is used as a base for placing the test mold.

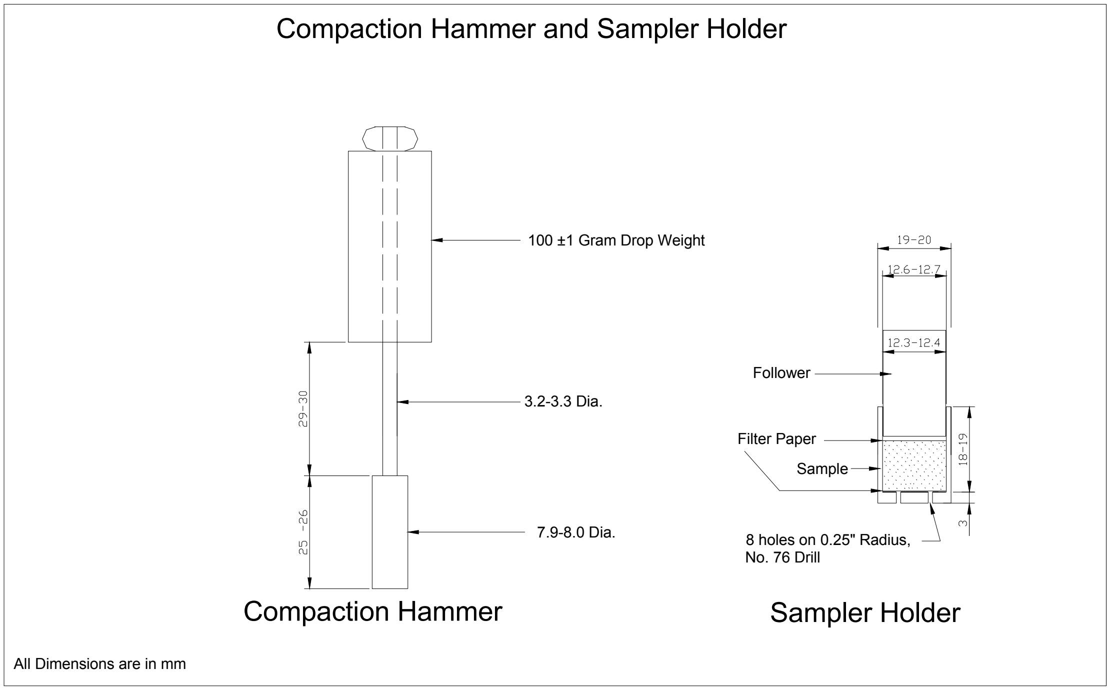
6.4 Thickness Measuring System: A dial gauge with 0.002 mm gradations is required for measuring the thickness of the compacted bed of fines.

6.5 Filter Membrane: Small 12.7 mm diameter disks cut from a medium grade filter paper. A round cutting tool can be used for this purpose.

6.6 Tweezers: Tweezers are needed for handling the filter disks.

6.7 75 µm Sieve: A 75-µm sieve meeting the requirements of ASTM E 11 is needed to remove the particles larger than 75 µm.

6.8 Balance or Scale: A balance or scale rated to 200 grams and readable to 0.01 gram is required.



7. Sampling and Sample Preparation

The fines may be obtained from a primary or secondary dust collector, the coarse or fine aggregate, or the aggregate extracted from a mixture. Obtain a 2-kg sample and reduce by suitable means to a specimen of 10 g. Particles larger than 75 µm should be removed by sieving. Dry sieving is usually adequate if several sieves coarser than the 75-µm sieve are placed above the No. 200 sieve during the sieving operation to avoid overloading the 75-µm sieve. Wet sieving should be avoided because the fine particles tend to stick together after they are dried.

8. Procedure

8.1 Use the cutting tool to cut a number of 12.7 mm diameter filter disks. Place two of these disks in the bottom of the sample cup, place the follower over the top of the disks, and seat the follower on the filter disks using firm finger pressure. Insert the entire assembly under the dial gauge. Record the dial gauge reading as t_1.

8.2 Weigh the empty mold, two filter disks, and the follower, and record the mass as W_1. Remove the follower and the two filter disks.

8.3 Place a filter disk in the bottom of the sample cup, making certain that it is centered and firmly in place at the bottom of the mold. Select a representative sample of minus 75 µm fines that weighs approximately 1.0–1.3 grams. Carefully place the fines in the sample cup over the top of the filter disk. Place a second filter disk over the top of the fines and use the follower and firm hand pressure to seat the disk on top of the fines. This procedure will result in some initial compaction of the fines and is to be expected.

8.4 Remove the follower, place the sample cup on the steel base plate, and apply 25 blows with the compaction hammer. Use caution during the compaction process to be certain that the mold is seated firmly on the compaction pedestal, the drop weight falls its full height, and the drop weight falls freely.

8.5 Remove the compaction hammer and insert the follower on top of the compacted fines and filter disk. Insert the entire assembly under the dial gauge and record the dial gauge reading, t_2. Weigh the entire mold assembly and record as the mass W_2.

8.6 The specific gravity of the fines solids is required to complete the calculations. If the specific gravity of the fines solids is not known, it will be necessary to measure it using ASTM procedure C188 or D854. Caution: The specific gravity of the fines solids may not be the same as for the other aggregate fractions. Although kerosene has been used as a liquid for determining specific gravity, water can also be used without adversely affecting the accuracy of the results.

9. Calculations

9.1 Notation

r	=	Radius of mold (mm)
G_{fs}	=	Specific gravity of the fines solids
t	=	Thickness of compacted sample (mm)
t_1	=	Initial dial gauge reading (mm)
t_2	=	Final dial gauge reading (mm)
V_{fB}	=	Bulk volume of compacted fines sample (cm^3)
V_{fS}	=	Volume of fines solids (cm^3)
RV	=	Volume of voids in compacted fines or Rigden voids (cm^3)
$\% RV$	=	Volume of voids in compacted fines expressed as percentage of bulk volume
W_{fs}	=	Mass of dry fines solids to nearest 0.01g (g)
γ_w	=	Density (unit weight) of water (1.00 g/cm^3)

9.2 Compacted Dust

9.2.1 Calculate the bulk volume of the compacted fines V_{fB}, as follows:

$$V_{fB} = \pi \times r^2 \times t$$

where:

r = radius of mold (mm)

t = $t_2 - t_1$ sample thickness (mm)

9.2.2 Calculate the volume of the fines solids V_{fS}, as follows:

$$V_{fS} = \frac{W_{fs}}{y x G_{fs}} \quad cm^3$$

where:

W_{fs} = $W_2 - W_1$, mass of compacted fines (grams)

γ = unit weight of water ($1.000 g/cm^3$)

G_{fs} = specific gravity of the fines solids as determined from the ASTM C 188 or D 854, or another suitable test method

9.2.3 Calculate the volume of the voids in compacted fines, RV (Rigden voids), as follows:

$$RV = V_{fB} - V_{fS}$$

9.2.4 Calculate the percentage of voids in the compacted fines (Rigden voids) as follows:

$$\% RV_{fs} = \frac{V_{fB} - V_{fS}}{V_{fB}} \times 100$$

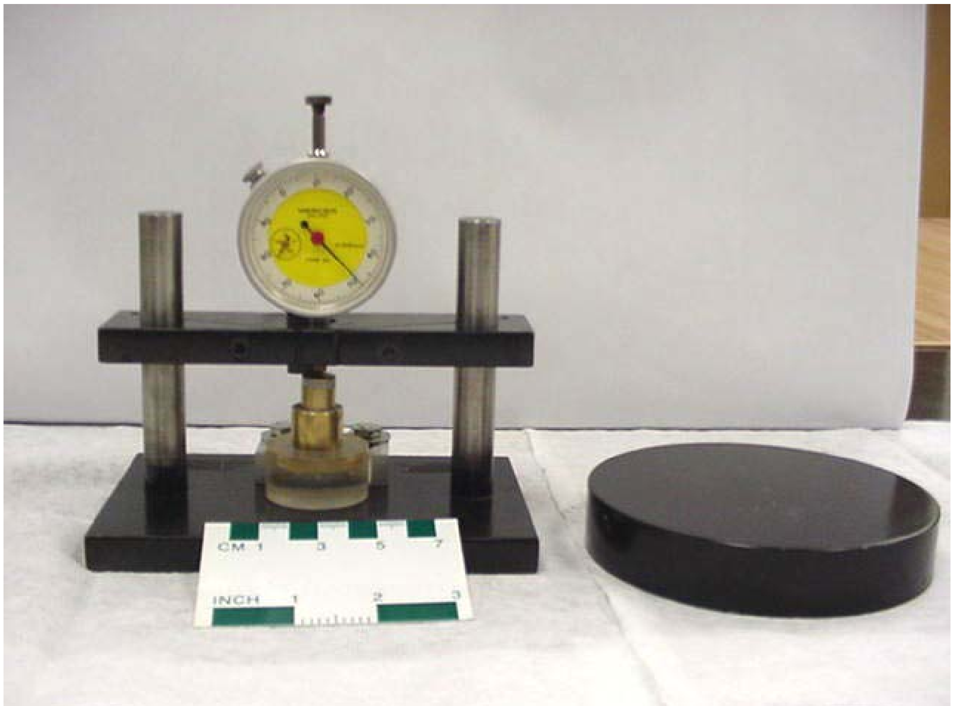


Figure 1 Rigden Voids Apparatus

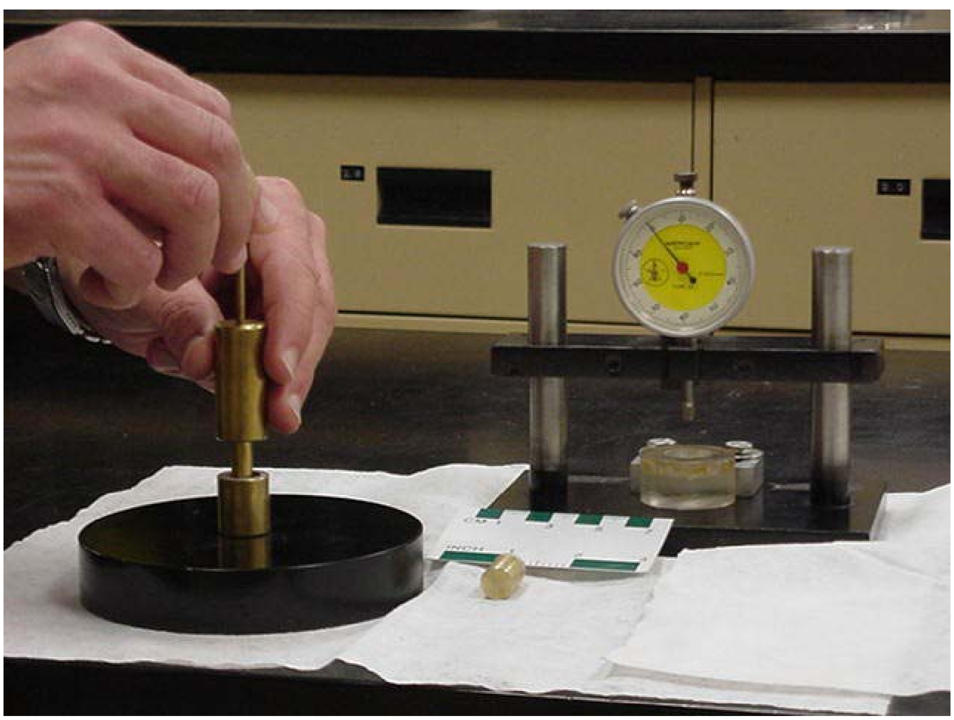


Figure 2 Compaction of Baghouse Fines

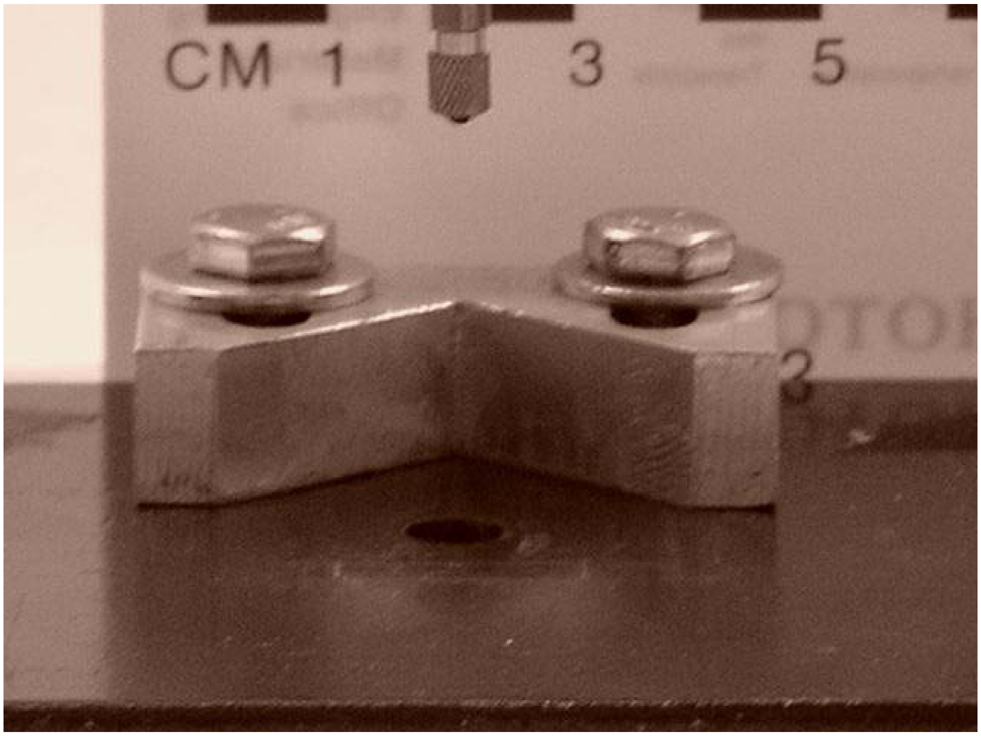


Figure 3 V Notch on Base