

CRD-C 650-95

Standard Method for Density and Percent Voids of Compacted Bituminous Paving Mixtures*

1. Scope.

This method of testing is used on either laboratory-compacted samples or samples taken from in-place pavements.

2. Apparatus.

2.1 Balance, 2-kg capacity, sensitive to 0.1 g.

2.2 Wire basket for weighing samples suspended in water.

2.3 Tank or bucket of sufficient capacity to completely immerse the sample in water.

3. Preparation of Specimens.

All specimens shall be marked for identification. Each specimen shall be air dried prior to testing.

4. Testing Procedures.

4.1 Nonporous samples. Determine the mass of the samples in air and in water and record the values in the appropriate spaces on a form such as that shown in Figure 2. The density can be determined by the following formula:

Specific gravity = A / (A - B)

where

A = mass of specimen in air, g

B = mass of specimen in water, g

4.2 Porous samples. Samples having an open texture or porous surface (particularly the cut surface of some pavement cores and sawed samples) shall have their mass determined in air, then in water, and then in air again (after blotting excess water with cloth or paper towel) to correct for error in bulk volume caused by adsorption of the water. Record these values in the appropriate columns on a form such as Figure 1. The volume of the sample determined as shown in Figure 1 is then entered on a form similar to that shown in Figure 2 for use in the remaining calculations.

5. Calculations.

Before the voids can be calculated, the specific gravity of both the aggregate and asphalt cement and the percentage of each must be known. Then the voids are calculated as follows:

Voids = 100 - ((G/H) * 100)

where

G = specific gravity of compacted sample column G, Figure 2.

Table with columns: JOB NO., PROJECT, TYPICAL MIX, DATE, SPECIMEN NUMBER, BITUMEN CONTENT %, INITIAL WEIGHT IN AIR (A), WEIGHT IN WATER (B), SECOND WEIGHT IN AIR (C), ABSORPTION (D (C-A)), CORRECTED WEIGHT IN WATER (E (B-D)), VOLUME (F (A-E)). Includes a row for specimen L-10-7 and technician/signature lines.

Figure 1. Corrections for absorbed water in density calculation

*Formerly MIL-STD-620A, Method 101, 13 January 1966.

| COMPUTATION OF PROPERTIES OF BITUMINOUS MIXTURES | | | | | | | | | | | | | | | | | | | |
|--|---------------------|--------------|----------------|----------|-----------|------------------|--------|-----------------------|-----------|-----------------|-----------|-------------|----------|-----------|---|-------------|------|----|--|
| JOB NO.: | | PROJECT: | | | | | | | | | | DATE: | | | | | | | |
| SPECIMEN NO. | BITUMEN CONTENT - % | FINENESS NO. | WEIGHT - GRAMS | | VOLUME CC | SPECIFIC GRAVITY | | BITUMEN BY VOLUME - % | | VOIDS - PERCENT | | UNIT WEIGHT | | STABILITY | | FLOW 1/200" | | | |
| | | | IN AIR | IN WATER | | ACTUAL | THEOR. | TOTAL MIX | AGGREGATE | FIELD | TOTAL MIX | AGGREGATE | MEASURED | CONVERTED | | | | | |
| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | | |
| 1 | 5.0 | | 1231.0 | 712.4 | 513.6 | 2.397 | | | | | | | | | | 1610 | 1610 | 10 | |
| 2 | | | 1242.4 | 722.4 | 520.0 | 2.389 | | | | | | | | | | 1760 | 1760 | 12 | |
| 3 | | | 1223.5 | 710.5 | 513.0 | 2.385 | | | | | | | | | | 1670 | 1670 | 10 | |
| Avg | | | | | | 2.390 | 2.565 | 9.3 | 8.8 | 16.1 | 57.8 | 149.1 | | | | | 1880 | 11 | |
| 3 | 4.5 | | 1236.8 | 722.9 | 513.9 | 2.407 | | | | | | | | | | 2060 | 2060 | 12 | |
| 2 | | | 1232.0 | 712.6 | 508.4 | 2.402 | | | | | | | | | | 1990 | 2070 | 11 | |
| 3 | | | 1232.5 | 720.9 | 511.6 | 2.409 | | | | | | | | | | 1740 | 1740 | 10 | |
| Avg | | | | | | 2.406 | 2.565 | 10.5 | 5.5 | 16.0 | 65.6 | 150.1 | | | | | 1957 | 11 | |
| 1 | 5.0 | | 1185.1 | 685.3 | 489.8 | 2.420 | | | | | | | | | | 1890 | 2060 | 12 | |
| 2 | | | 1233.7 | 721.4 | 512.3 | 2.408 | | | | | | | | | | 1840 | 1840 | 11 | |
| 3 | | | 1239.9 | 727.0 | 512.3 | 2.412 | | | | | | | | | | 1990 | 1950 | 12 | |
| Avg | | | | | | 2.412 | 2.525 | 11.8 | 4.3 | 16.1 | 71.1 | 150.6 | | | | | 1963 | 12 | |
| 1 | 5.5 | | 1243.7 | 732.4 | 511.3 | 2.432 | | | | | | | | | | 2165 | 2165 | 13 | |
| 2 | | | 1245.3 | 734.4 | 510.9 | 2.437 | | | | | | | | | | 2100 | 2100 | 14 | |
| 3 | | | 1241.2 | 732.8 | 508.4 | 2.441 | | | | | | | | | | 2220 | 2329 | 16 | |
| Avg | | | | | | 2.437 | 2.506 | 13.0 | 2.8 | 15.8 | 82.3 | 152.1 | | | | | 2191 | 14 | |

** FROM CONVERSION TABLE
 WES FORM 883
 COMPUTED BY: KTC
 * P. GR. OF BITUMEN 1.028
 CHECKED BY: RJJ

Figure 2. Computation of properties of bituminous mixtures

H = theoretical maximum specific gravity as computed from Figure 3, column K, and recorded in column H, Figure 2.

Figure 3 shows typical data and calculations needed to compute the theoretical maximum specific gravity shown in Figure 2. Procedures for the specific gravity test on the individual components are given in ASTM C 127 for coarse aggregate, ASTM C 128 for fine aggregate, and ASTM D 70 for bituminous materials. The theoretical maximum specific gravity of the combined materials determined from test method ASTM D 2041 may also be used for the calculations of voids in the mixture. Method 105 or ASTM D 2041 is to be used for calculation of theoretical maximum specific gravity when the absorption of the entire blend of aggregate exceeds 2.5 percent.

6. Report.

A summary of computations, such as that shown in Figure 2, shall be prepared for all samples tested.

| THEORETICAL SPECIFIC GRAVITY | | | |
|--|------------------------------|------------------------------|-----------------------|
| JOB NO. | PROJECT | SYMBOL | DATE |
| | | WES | 4 Jun 1983 |
| OFF AGGREGATE FRACTIONS | PERCENT OF FRACTIONS | SPECIFIC GRAVITY OF FRACTION | FACTOR $\frac{1}{G}$ |
| Coarse Aggregate | 18 | 2.61 | 0.382 |
| Intermediate Aggregate | 35 | 2.752 | 0.365 |
| Fine Aggregate | 43 | 2.698 | 0.370 |
| Mineral Filler | 3 | 2.762 | 0.362 |
| | | | TOTAL Σ 16.628 |
| SPECIFIC GRAVITY OF DRY AGGREGATE = $\frac{100}{\Sigma \frac{P_i}{G_i}}$ = 2.730 | | | |
| PERCENT | SPECIFIC GRAVITY OF FRACTION | $\frac{100 - a}{100}$ | $\frac{1}{G}$ |
| a | P | G | H |
| 4.5 | 1.020 | 4.462 | 95.5 |
| | | | 36.388 |
| | | | 2.739 |
| ASTM METHOD BY RT. DECISION TIME FOR PROCESSED SAMPLES. | | | |
| SO. SE. OF MANUAL 1.028 | | | |
| COMPUTED BY: | | CHECKED BY: | |

Figure 3. Computation of theoretical maximum specific gravity