

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

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STANDARD METHOD OF TEST FOR DETERMINING THE PERCENTAGE OF  
COAL AND LIGHTWEIGHT PARTICLES IN AGGREGATE

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**1. PURPOSE**

- 1.1 To provide a standard method of testing for coal and lightweight particles in aggregates by means of a sink-float separation in a heavy liquid with a designated specific gravity.
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**2. SCOPE**

- 2.1 This procedure is applicable to fine and coarse aggregates.
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**3. APPLICABLE DOCUMENTS**

- 3.1 ASTM E 11  
3.2 ASTM E 100  
3.3 ASTM C 702 OR AASHTO R 76  
3.4 MATERIALS PROCEDURE (MP) 700.00.06  
3.5 ASTM C 127 OR AASHTO T 85  
3.6 ASTM C 128 OR AASHTO T 84  
3.7 ASTM E 617 OR AASHTO M 231
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**4. APPARATUS**

- 4.1 *Sieves*—The following sieve sizes conforming to ASTM E 11; 4.75 mm (No. 4) and 300  $\mu\text{m}$  (No. 50).
- 4.2 *Balance*—The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of AASHTO M 231.
- 4.3 *Oven*—An oven capable of maintaining a temperature of  $110^{\circ}\text{C} \pm 5^{\circ}\text{C}$  ( $230^{\circ}\text{F} \pm 9^{\circ}\text{F}$ ).
- 4.4 *Containers*—Large vat/tank for storage of heavy liquid with compatible mesh bucket for immersion of coarse aggregate into heavy liquid, buckets for soaking test portion, Pans for surface drying the aggregates, 600 ml Pyrex beakers for containing fine aggregate test portions.
- 4.5 *Skimmers*—Made of 300  $\mu\text{m}$  (No. 50) sieve cloth conforming to ASTM E 11. Fitting one with a handle for scooping floating particles from heavy liquid. The other must be capable of fitting over 600 ml Pyrex beakers.

- 4.6 *Stirring Rods*—A glass rod for stirring fine aggregates, a large metal rod for stirring coarse aggregates.
- 4.7 *Heavy Liquid*—Consisting of a mixture of zinc bromide and water in such proportions so that a designated specific gravity of  $2.00 \pm 0.01$  can be maintained at all times during the test.
- 4.8 *Hydrometer*—Conforming to the requirements of ASTM E 100 and capable of measuring the liquid specific gravity to within  $\pm 0.01$ .
- 4.9 *Safety Equipment*—Industrial type rubber gloves, face shield or goggles.

*Note:* Although there is no particular hazard from the fumes of zinc bromide solution, precautions shall be taken to avoid inhalation of fumes and contact with eyes and skin. Goggles and gloves shall be worn, and the solution should only be used in a laboratory exhaust hood.

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## 5. SAMPLE PREPARATION

- 5.1 Secure a field sample of the aggregate in accordance with MP 700.00.06. Samples shall be representative of the sources from which they are obtained and shall be reduced to an appropriate size by use of a sample splitter or by quartering in accordance with ASTM C 702 or AASHTOR 76.
- 5.2 The samples shall be dried in an oven to a constant mass at a temperature of  $110 \pm 5^{\circ}\text{C}$  ( $230 \pm 9^{\circ}\text{F}$ ).
- 5.2.1 In the following minimum test portions, the oven-dried sample shall be weighed to the nearest one gram and that weight recorded.

Nominal Maximum Size of Aggregate (Sieve Openings)	Minimum Weight of Test Sample (Grams)
No. 4 (4.75 mm)	200 grams
$\frac{3}{4}$ in (19.0 mm)	3,000 grams
1 $\frac{1}{2}$ in (37.5 mm)	5,000 grams
3 in (75.0 mm)	10,000 grams

- 5.3 The fine aggregate oven dry sample shall be cooled to room temperature and sieved over a  $300 \mu\text{m}$  (No. 50) sieve until less than one percent of the retained material passes through the sieve in one minute of continuous sieving. Discard the minus  $300 \mu\text{m}$  (No. 50) sieve material.
- 5.3.1 Bring the plus  $300 \mu\text{m}$  (No. 50) test portion to a saturated-surface-dry condition as specified in ASTM C 128 or AASHTO T 84. (See Note 1 and Note 2).

Note 1 – If material undergoes degradation in water, the material does not have to be brought to an SSD condition.

Note 2 – Pit derived silica sand commonly contains soft and easily degradable aggregations of sub-bituminous coal. Because of this possible degrading constituent, pit sand shall not be subjected to SSD condition under this procedure.

- 5.4 Coarse aggregates shall be sieved over a 4.75 mm (No. 4) sieve. The plus 4.75 mm (No. 4) material shall be thoroughly washed and oven dried to a constant mass at a temperature of  $110^{\circ}\text{C} \pm 5^{\circ}\text{C}$  ( $230 \pm 9^{\circ}\text{F}$ ).
- 5.4.1 Allow oven dry sample to cool to room temperature and weigh a test portion to a minimum test size, to the nearest 1 gram and record weight.
- 5.4.2 Bring sample to a saturated-surface-dry condition as specified in ASTM C 127 or AASHTO T 85. (See Note 1 and Note 2).

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## 6. PROCEDURE

- 6.1 Under a ventilation hood or in adequately ventilated area, check the heavy liquid (zinc bromide) for correct specific gravity ( $2.00 \pm 0.01$ ).
- 6.2 Fine Aggregate - weigh a test portion to a minimum of 200 grams to the nearest 0.1 gram and record weight. This test portion shall be placed in a 600 ml beaker and a volume of heavy liquid poured into the beaker until the liquid level is at least 1 inch above the sample level.
  - 6.2.1 Agitate the test portion by means of a glass-stirring rod allowing the lightweight particles to float to the surface.
  - 6.2.2 Pour the liquid and floating lightweight particles into a second beaker, passing through a  $300\ \mu\text{m}$  (No. 50) skimmer, making sure that only the floating particles are poured off with the liquid.
  - 6.2.3 Repeat procedure in section 6.2.2 until test portion is free from floating particles, then drain heavy liquid from test portion back into vat. Rinse test portion with water to remove heavy liquid from sample and discard.
  - 6.2.4 Wash the decanted particles retained on the  $300\ \mu\text{m}$  (No. 50) skimmer with water until all the zinc bromide is removed.
  - 6.2.5 Dry decanted particles to a constant weight and weigh to the nearest 0.1 gram.
- 6.3 Coarse Aggregate - Place sample into mesh bucket and place into vat of zinc bromide solution.
  - 6.3.1 NOTE: If test portion is sufficiently large, two or more runs may be necessary to complete testing.
  - 6.3.2 Agitate test portion by means of a large metal stirring rod allowing the lightweight particles to float to the surface.
  - 6.3.3 Remove floating pieces from heavy liquid by scooping with a  $300\ \mu\text{m}$  (No. 50) skimmer. Repeat process until test portion is free of floating particles.

- 6.3.4 Raise mesh bucket to drain heavy liquid from test portion into vat. Rinse test portion with water to remove heavy liquid from sample and discard.
- 6.3.5 Wash lightweight particles with water until all the zinc bromide is removed.
- 6.3.6 Dry lightweight particles to a constant weight and weigh to the nearest 1.0 gram.
- 6.4 Slag: Due to the manufacturing process, there is entrapped air in the aggregate. The procedure for slag is the same for any other coarse aggregate; however, a greater number of pieces will come to the surface than with other types of aggregates. The floating particles must be friable before they are considered as deleterious.

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**7. CALCULATION**

- 7.1 Calculate the percentage of lightweight particles as follows:

Fine Aggregates

$$L = \frac{W_1}{W_2} \times 100$$

$L$  = Percentage of lightweight particles

$W_1$  = Oven dry mass of lightweight particles

$W_2$  = Oven dry mass of test portion

- 7.2 Report results to nearest 0.1 percent.



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