T 84

SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE FOP FOR AASHTO T 84

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Scope

02 This field operating procedure (FOP) covers the
03 determination of bulk, bulk (SSD), and apparent
04 specific gravity, as well as absorption of fine aggregate after a prescribed soaking period in water.

Apparatus

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- **Balance:** A balance of sufficient capacity, sensitive to 0.1 g. (M 231, class G 2)
- **Pycnometer:** A flask or other suitable container into which the fine aggregate sample can be introduced, and in which the volume can be reproduced within ±0.1 ml. The volume of the flask shall be at least 50 percent greater than required for the test sample.

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- **Mold:** A metal mold in the form of a frustum of a cone 40 ±3 mm in diameter at the top, 90 ±3 mm in diameter at the bottom, and 75 ±3mm in height.
- **Tamper:** A metal tamper weighing 340 ±15 g and having a flat circular tamping face 25 ±3 mm in diameter

Sample

08 Obtain the sample and reduce to testing size according to AASHTO T 2 and T 248.

Sample Preparation

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1. Obtain approximately 1000 g. of fine aggregate passing the No. 4 sieve from the sample by use of a sample splitter or by quartering. Dry it in a suitable pan or vessel to constant mass at a temperature of 230 ±9° F.
2. After the sample has been allowed to cool to comfortable handling temperature, cover with water, and allow to stand for 15 to 19 hours.

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3. Carefully decant the water without losing fines, and spread the sample on a flat smooth surface exposed to a gently moving current of warm air. Stir frequently to secure uniform drying. Continue this operation until the test sample approaches a free flowing condition.
4. With the mold held firmly on a smooth non-

11 absorbent surface (large diameter down) fill the mold to overflowing with a portion of the partially dried fine aggregate. Lightly tamp the surface 25 times with the tamper, clean excess from around the base, and lift the mold vertically. (Allow the tamper to fall freely from approximately 0.2” above the top of the sample)

***Note 1*:** If the fine aggregate slumps on the first trial, it has already dried past the saturated surface-dry condition. Thoroughly mix a few milliliters of water with the aggregate and permit the sample to stand in a covered container for 30 minutes. The process of drying and testing for the free-flowing condition shall then be resumed.

12 5. Continue drying with constant stirring, and test at frequent intervals until the tamped fine aggregate slumps slightly upon removal of the mold. This indicates that it has reached a saturated surface-dry (SSD) condition.

Procedure

13 1. Record all masses to the nearest 0.1 g.

2. Partially fill the pycnometer with water. Immediately introduce into the pycnometer 500 ±10 g of fine aggregate and fill with water to approximately 90% capacity.

3. Roll, invert, and agitate the pycnometer to eliminate all air bubbles. Adjust its temperature to 73.4 ±3°F if necessary, by immersion in circulating water, and bring the water level to its calibrated capacity.

14 4. Dispel any foam, and record the total mass of the pycnometer, sample, and water to the nearest 0.1 g.

***Note 2*:** In lieu of weighing the sample that has been removed from the pycnometer, a second sample taken at the same time, within 0.2 g of the sample placed in the pycnometer, may be used to determine the oven-dry mass.

5. The sample shall then be dried to a condition of constant mass such that it will not lose more than 0.1% of moisture after drying at the specified temperature for 2 hours (more than one successive 2 hour drying period shall be required to achieve the constant mass).

6. Cool the sample to room temperature for 1.0 ±0.5 hours and determine final mass to the nearest 0.1 g.

Calculation

15 Calculate specific gravities and absorption of the sample according to the following formulas:

Bulk Specific Gravity Oven Dry, G_{sb}(OD)

$$G_{sb}(OD) = \frac{A}{B + S - C}$$

Bulk Specific Gravity Saturated Surface-Dry, G_{sb}(SSD)

$$G_{sb}(SSD) = \frac{S}{B + S - C}$$

Apparent Specific Gravity, G_{sa}

$$G_{sa} = \frac{A}{B + A - C}$$

16 **Absorption, Percent**

$$\text{Absorption, percent} = \frac{S - A}{A} \times 100$$

where:

A = mass of oven-dry specimen in air, g

B = mass of pycnometer filled with water, g

C = mass of pycnometer with specimen and water to calibration mark, g

S = mass of saturated surface-dry specimen, g

Calculation Examples

Using the following data, specific gravity and absorption calculations may be completed as in the following examples (Formulas are also shown for clarity):

A	B	C	S
499.0 g.	**666.1 g.**	**979.1 g.**	**502.3 g.**

Bulk Specific Gravity, G_{sb}:

$$G_{sb}(OD) = \frac{A}{B + S - C}$$ 17

$$G_{sb}(OD) = \frac{499.0}{666.1 + 502.3 - 979.1} = 2.636$$

Bulk Specific Gravity Saturated Surface-Dry, G_{sb} (SSD):

$$G_{sb}(SSD) = \frac{S}{B + S - C}$$

$$G_{sb}(SSD) = \frac{502.3}{666.1 + 502.3 - 979.1} = 2.653$$

Apparent Specific Gravity, G_{sa}:

$$G_{sa} = \frac{A}{B + A - C}$$

$$G_{sa} = \frac{499.0}{666.1 + 499.0 - 979.1} = 2.683$$

Absorption, Percent:

$$\text{Absorption, (\%)} = \frac{S - A}{A} \times 100$$ 18

$$\text{Absorption, (\%)} = \frac{502.3 - 499.0}{499.0} \times 100 = 0.661, \text{ say } 0.7\%$$

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Report

- Report on standard agency forms.
- Report specific gravity to nearest 0.001
- Report percent absorption to nearest 0.1.

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Tips!

- To assure uniform drying of the sample, frequent stirring or rolling of the fine aggregate is required during the process of drying from the wet to saturated surface-dry condition.
- Weigh the test sample immediately when it reaches the saturated surface-dry condition to avoid undue evaporation loss from the sample.
- Exercise care to eliminate all air bubbles from the test sample in the pycnometer before making the final volume determination.

REVIEW QUESTIONS

1. From the sample that was obtained according to the FOP for AASHTO T 2, how much material is generally required to perform this test?

2. According to this FOP, when is soaking required? For how long must material be soaked?

3. Describe the SSD condition and how it is determined.

PERFORMANCE EXAM CHECKLIST

SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE FOP FOR AASHTO T 84

Participant Name _____ Exam Date _____

Record the symbols "P" for passing or "F" for failing on each step of the checklist.

Sample Preparation	**Trial 1**	**Trial 2**
1. Sampled according to AASHTO T 2?	_____	_____
2. Sample reduced according to AASHTO T 248 to approximately 1000 g?	_____	_____
3. Dried to a constant mass at 230 ±9º F, cooled to a comfortable handling temp?	_____	_____
4. Covered with water?	_____	_____
5. Allowed to stand 15 – 19 hours?	_____	_____
6. Excess water decanted without loss of fines?	_____	_____
7. Sample spread on flat, non-absorbent surface?	_____	_____
8. Uniformly dried by a current of warm air, with frequent stirring?	_____	_____
9. Mold placed on flat, non-absorbent surface and filled to over-flowing?	_____	_____
10. Sample compacted with 25 light drops of tamper from 0.2" above top of sample?	_____	_____
11. Tamper allowed to fall freely under gravitational attraction?	_____	_____
12. Loose sand removed from around bases and mold lifted vertically?	_____	_____
13. Sample fails to slump on the first test?	_____	_____
14. If it does slump, is water added, sample covered and allowed to stand 30 minutes?	_____	_____
15. Drying continued, and test repeated at frequent intervals until sample slumps slightly?	_____	_____
Testing Procedure		
1. Pycnometer partially filled with water and 500 ±10 g sample added?	_____	_____
2. Pycnometer filled to 90 % of calibrated capacity and agitated to eliminate air bubbles?	_____	_____
3. Temperature adjusted to 73.4 ±3º F.?	_____	_____
4. Water level brought to calibrated capacity and agitated to eliminate air bubbles?	_____	_____

5. Sample removed and dried to constant mass at 230 ±9º F? _____ _____
6. Sample cooled in air at room temperature for 1.0 ±0.5 hr. and weighed? _____ _____
7. Pycnometer calibrated mass determined? _____ _____
8. All masses determined to nearest 0.1 g? _____ _____
9. Calculations performed and values rounded correctly? _____ _____

Formulas for Specific Gravities and Absorption

Bulk Specific Gravity $\boxed{\dfrac{A}{B+S-C}}$

Bulk Specific Gravity (SSD) $\boxed{\dfrac{S}{B+S-C}}$

Apparent Specific Gravity $\boxed{\dfrac{A}{B+A-C}}$

Absorption, percent $\boxed{\dfrac{(S-A)}{A}\times 100}$

where:

A = mass of oven-dry specimen in air, g;
B = mass of pycnometer filled with water, g;
C = mass of pycnometer with specimen and water to calibration mark, g; and
S = mass of saturated surface-dry specimen, g.

Comments: First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

_____
_____
_____
_____
_____
_____

Signature of Examiner _____