

Method of Test for Fine Aggregate Angularity

1. Scope:

The fine aggregate angularity test determines the loose uncompact void content of a fine aggregate sample.

2. Apparatus:

- 2.1 Cylinder dimensions: Capacity of approximately 3.38 oz., inside diameter 1.5 in., inside height 3.4 in., and base will be 0.24 in. thick and securely sealed to the cylinder. The cylinder will be made of drawn copper meeting ASTM B 88 Type M or C specifications. Calibration needs to be completed before starting procedure as to use the correct cylinder volume.
- 2.2 Funnel having a smooth inside with at least 1.5 in high sides. The funnel opening needs to be 0.5 ± 0.2 in. diameter with the right frustum of a cone sloped at $60 \pm 4^\circ$ from the horizontal. The required volume is 200 mL. If the funnel does not support this capacity, use an additional container on the top of the funnel to reach the specified volume.
- 2.3 Funnel stand supported by three or four legs holding the funnel firmly in position. The axis of the funnel collinear needs to be inline with the cylindrical measure axis. The funnel opening will be placed 4.5 ± 0.07 in. above the cylinder top.
- 2.4 Glass plate with approximate dimensions of 2.4 in. x 2.4 in. and a thickness of 0.15 in. that will be used to calibrate the cylinder.
- 2.5 Spatula with a blade 0.8 in. wide and 4 in. long with straight edges and the end cut off at a 90° angle to the edges.
- 2.6 Metal or plastic pan large enough to contain the funnel stand and retain all material during and after completion of the procedure.
- 2.7 Balance accurate and readable to 0.1 grams capable of weighing the cylindrical measure and its contents.

3. Calibration of Cylinder:

- 3.1 Calibrate the cylinder to be used for the fine aggregate angularity tests.
 - A. Weigh the measuring cylinder and glass plate to the nearest 0.1g.
 - B. Fill the cylinder with distilled water at a temperature of 64.4 to 75.2°F.
 - C. Record the actual temperature of the water in the cylinder and place the glass plate on top of the filled cylinder while making sure that no air bubbles remain.

- D. Completely dry the outside of the glass plate and cylinder filled with water and record the weight to the nearest 0.1 gram.
- E. Use the temperature conversion table and volume formula to calculate the volume of the cylinder using the density of water in kg/m³ to the nearest 0.1mL:

| Temperature (°F) | Density of Water (kg/m ³) |
|------------------|---------------------------------------|
| 65° | 998.54 |
| 66° | 998.43 |
| 67° | 998.31 |
| 68° | 998.20 |
| 69° | 998.08 |
| 70° | 997.97 |
| 71° | 997.84 |
| 72° | 997.71 |
| 73° | 997.58 |
| 74° | 997.45 |
| 75° | 997.32 |
| 76° | 997.17 |
| 77° | 997.03 |
| 78° | 996.88 |
| 79° | 996.74 |
| 80° | 996.59 |

$V = 1000 M/D$

Weight of measure and glass plate
 weight of measure, glass plate & water
 M = net mass of water
 D = density of water at test temp.
 V = volume of cylinder, mL

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4. Procedure:

- 4.1 Obtain the sample from the fine (- #4) washed gradation in SD 202. After the - #4 gradation has been completed in SD 202 test procedure, keep individual sieves separate so that the following sieve amounts are obtained:

Passing the #8 and retained on the #16 = 44 grams
 Passing the #16 and retained on the #30 = 57 grams
 Passing the #30 and retained on the #50 = 72 grams
 Passing the #50 and retained on the #100 = 17 grams

Total = 190 grams

The tolerance for the sample is ± 0.2 grams per sieve.

- 4.2 Mix together thoroughly the 190 ± 0.8 gram sample.
- 4.3 Pour test sample into funnel while blocking the opening with your finger. Level the material in the funnel with a spatula.
- 4.4 Release the material into the cylinder, using something small like a pencil to unblock the opening should it become blocked. Once all the material has flowed from funnel and the cylinder is full, strike-off excess material with a single pass using the spatula with the width of the blade vertical, keeping the straight part of the blade horizontal and in light contact with the top of the measure. Make sure not to tap or move the cylinder. When strike-off is completed, lightly tap the cylinder to settle material. Brush off any loose material clinging to the cylinder. Weigh the cylinder with the material to the nearest 0.1 gram.
- 4.5 Repeat steps 4.3 and 4.4 with same sample for 2nd trial.

5. Report:

- 5.1 Calculate the uncompacted voids (Us) for each trial as follows:

$$U = \frac{\text{Volume of cylinder} - (\text{Mass of aggr.} / \text{- \#4 Gsb of aggr.})}{\text{Volume of cylinder}} \times 100$$

To perform these calculations you will need the G_{sb} of the - #4 aggregate which can be obtained from the mix design report (Mix designers use SD 209) and the weight of the cylinder to obtain aggregate mass. Average the two test results to get the uncompacted voids (Us) for the sample.

| Sample ID | 1st trial | 2nd trial | |
|---|-----------|-----------|---------|
| Dry -#4 bulk specific gravity (Gsb) | | | |
| (from calibration) Volume of cylinder, mL (V) | | | |
| Weight of cylinder, g (A) | | | |
| Wt. of cylinder + aggregate, g (B) | | | |
| Wt. of aggregate, g (F=B-A) | | | Average |
| Uncompacted voids, (nearest 0.1%) $U = \frac{(V - (F/Gsb))}{V} * 100$ | | | |

- 5.2 Report the test results for uncompacted voids (Us) on form DOT-69. Report the average test result to the nearest 0.1 percent.

6. References

AASHTO T 304
SD 202
DOT-69