

Plastic Fines in Graded Aggregates And Soils by Use of the Sand Equivalent Test

AASHTO T176 -08 \_\_\_\_\_

ASTM D2419-14 \_\_\_\_\_

APPARATUS

1. GRADUATED PLASTIC CYLINDERS:

Outside diameter: 38.1 mm (1.5 in.)?									
Inside diameter: 31.5±0.5 mm (1.25 in.)?									
Inside height: 430 mm (17 in.)?									
Graduations at: 2.54 mm (0.1 in.)?									
Rubber stopper?									

2. IRRIGATOR TUBE:

- (a) Outside diameter 6.4 mm (1/4 in.)? .....
- (b) Length approximately 510 mm (20 in.)?.....
- (c) Pinched end? .....
- (d) No. 60 holes (1.0 mm diameter) drilled in two places on end?.....
- (e) AASHTO only: Handle for irrigation tube (optional)? .....

3. SATISFACTORY SIPHON ASSEMBLY? .....

4. WEIGHTED FOOT ASSEMBLY:

- (a) Weighs 1000±5 g?.....
  - (b) Guide fixed to shaft?.....
- Note:** Older (1969) model of weighted foot assembly with guide cap that fits over upper end of graduated cylinder is acceptable.

5. TIN MEASURE:

- (a) Diameter approximately 57 mm (2 1/4 in.)? .....
- (b) Capacity of 85±5 mL?.....

6. WIDE-MOUTH FUNNEL? .....

- (a) AASHTO only: Diameter approximately 100 mm (4 in.) at the mouth?.....

7. CLOCK OR WATCH, readable in minutes and seconds? .....

8. SHAKER (One of the following):

**Note** (AASHTO only): Mechanical shaker required for referee testing. Note if mechanical shaker is not presented - informational note only.

- (a) Mechanical? .....
- (1) Operates at 175 ± 5 cycles per minute?.....
- (2) Securely fastened to firm and level mount? .....
- (b) Manually operated? .....
- (1) Securely fastened to firm and level mount? .....
- (c) Hand method?.....

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APPARATUS (CONTINUED)

9. STOCK CALCIUM CHLORIDE SOLUTION (One of the following):
  - (a) 454 g (1 lb) technical grade anhydrous calcium chloride, 2050 g (1640 mL) USP glycerin, and 47 g (45 mL) formaldehyde (40% by volume solution); diluted to 3.78L (1 gallon) with distilled or demineralized water?..... \_\_\_\_\_  
or
  - (b) 577 g (1.27 lb) A.C.S. grade calcium chloride dihydrate, 2050 g (1640 mL) USP glycerin, and 59 g (53 mL) 1,5-pentanedial (glutaraldehyde) (50% solution in water); diluted to 3.78L (1 gallon) with distilled or demineralized water?..... \_\_\_\_\_  
or
  - (c) 577 g (1.27 lb) A.C.S. grade calcium chloride dihydrate, 2050 g (1640 mL) USP glycerin, and 63 g (53 mL) kathon CG/ICP; diluted to 3.78L (1 gallon) with distilled or demineralized water? ..... \_\_\_\_\_  
**Note:** Stock solution may be made without using any biocide (formaldehyde, glutaraldehyde, or kathon), provided the storage time of the stock solution is not sufficient to promote fungi growth.
10. WORKING CALCIUM CHLORIDE SOLUTION:
  - (a) One measuring tin full (85±5 mL) of stock calcium chloride solution diluted to 3.78 L (1 gallon) with water? ..... \_\_\_\_\_
  - (b) Stored in 3.78 L (1 gallon) bottle on shelf 915±25 mm [36±1 in.] (ASTM: 91±5 cm 36±2 in.) above work surface? ..... \_\_\_\_\_  
Note: Solution may be stored in larger glass or plastic vat, provided the liquid level is maintained between 915 to 1170 mm (36 and 46 in.)..... \_\_\_\_\_  
[ASTM: 36 and 48 in]. (90 to 120 cm)] above work surface..... \_\_\_\_\_
  - (c) Temperature of solution is 22±3°C (72±5°F)?..... \_\_\_\_\_
  - (d) Solution is free of biological growth (ASTM: fungus)?..... \_\_\_\_\_
  - (e) AASHTO only: Solution discarded if it is not clear and transparent and shall not be over 30 days old?..... \_\_\_\_\_
  - (f) ASTM only: Solution discarded if more than 2 weeks old, and fresh solution not added to old solution (Sections 6.6 to 6.8)? ..... \_\_\_\_\_
11. STRAIGHTEDGE OR SPATULA (AASHTO only)? ..... \_\_\_\_\_
12. QUARTERING OR SPLITTING CLOTH (AASHTO ONLY)? ..... \_\_\_\_\_
13. OVEN, maintains 110±5°C (230±9°F)? ..... \_\_\_\_\_
14. WORK SURFACE free of vibration and not exposed to direct sunlight? ..... \_\_\_\_\_
15. 4.75 mm (No. 4) sieve (ASTM only)? ..... \_\_\_\_\_
16. Flat pan (ASTM only), for mixing? ..... \_\_\_\_\_

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PROCEDURE

SAMPLE PREPARATION

AASHTO only:

1. Sample pulverized and passed through 4.75-mm (No. 4) sieve? ..... \_\_\_\_\_
2. All fines cleaned from retained No. 4 particles and included with passing No. 4 material? \_\_\_\_\_
3. Sample split or quartered to yield 500 to 750 g of passing No. 4 material? \_\_\_\_\_

**Note:** If necessary, material may be dampened before splitting or quartering to avoid segregation or loss of fines.

ASTM only:

1. Sample mixed and reduced according to C702 (splitting or quartering)? ..... \_\_\_\_\_
2. Sample sieved on No. 4 (4.75-mm) sieve until not more than one weight percent of residue passes the sieve during one minute? ..... \_\_\_\_\_
3. Any retained No. 4 lumps pulverized to pass No. 4 sieve? ..... \_\_\_\_\_
4. All fines cleaned from retained No. 4 particles and included with pass No. 4 material? \_\_\_\_\_
5. Sample is at least 1500 g of pass No. 4 material? ..... \_\_\_\_\_

METHOD 1 - AIR DRY

AASHTO only:

1. Enough passing No. 4 material split or quartered to fill the 85-mL (3-oz) tin slightly rounded above brim? ..... \_\_\_\_\_
2. While filling, bottom edge of tin tapped on hard surface to consolidate material? ..... \_\_\_\_\_
3. Tin struck off level full with spatula or straightedge? ..... \_\_\_\_\_
4. If using referee method (mechanical shaker), sample dried to constant mass at 110±5°C (230±9°F) and cooled to room temperature before testing? ..... \_\_\_\_\_

ASTM only (Procedure A):

1. If necessary, material dampened to avoid segregation or loss of fines during splitting or quartering? ..... \_\_\_\_\_
2. Measuring tin filled 4 times by dipping from sample? ..... \_\_\_\_\_
3. Each time a measure full is dipped, bottom edge tapped on hard surface at least 4 times to consolidate material? ..... \_\_\_\_\_
4. Measure level full or slightly rounded above the brim? ..... \_\_\_\_\_
5. Amount of material in 4 measures determined by weight or by volume, using plastic cylinder? ..... \_\_\_\_\_
6. This material returned to sample? ..... \_\_\_\_\_
7. Sample quartered or split according to C702 to obtain the predetermined weight or volume? ..... \_\_\_\_\_
8. Sample split or quartered 2 more times to obtain specimens? ..... \_\_\_\_\_
9. Each specimen dried at 230±9°F (110±5°C) and cooled to room temperature before testing? ..... \_\_\_\_\_

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METHOD 2 - PRE-WET (AASHTO AND ASTM PROCEDURE B)

ASTM only:

1. Material dampened sufficiently to prevent segregation or loss of fines? ..... \_\_\_\_\_
2. 1000 to 1500 g of material split or quartered out?..... \_\_\_\_\_
3. Material mixed thoroughly with hand trowel in circular pan by scooping toward middle of pan while rotating it horizontally? ..... \_\_\_\_\_
4. Mixing continued for at least 1 minute? ..... \_\_\_\_\_
5. Moisture condition checked by tightly squeezing small portion in palm of hand, forming a cast?..... \_\_\_\_\_
6. Sample at proper water content (cast permits careful handling without breaking)?  
 (a) If too dry (cast crumbles easily), water added and remixed?..... \_\_\_\_\_  
 (b) If too wet (shows free water), sample drained and air dried, mixing frequently?.. \_\_\_\_\_
7. If either (a) or (b) above occurred, sample placed in pan, covered with lid or damp cloth (not touching sample), and allowed to stand for at least 15 minutes?..... \_\_\_\_\_
8. AASHTO:  
 Sample placed on splitting cloth and mixed by alternately lifting each corner of cloth and pulling it over sample toward diagonally opposite corner, causing material to be rolled? \_\_\_\_\_  
 ASTM:  
 Sample remixed for 1 minute after minimum curing time, without water, and formed into a cone with a trowel? ..... \_\_\_\_\_
9. AASHTO only: When material appears to be homogeneous, mixing finished with sample in a pile near center of cloth? ..... \_\_\_\_\_
10. Tin measure pushed through base of pile with free hand against pile opposite the measure? ..... \_\_\_\_\_
11. Material fills tin to overflowing? ..... \_\_\_\_\_
12. Material compacted into tin with palm of hand? ..... \_\_\_\_\_
13. Tin struck off level full with spatula or straightedge (ASTM: with trowel)? ..... \_\_\_\_\_
14. AASHTO only: If using referee method (mechanical shaker), sample dried to constant mass at 110±5°C (230±9°F) and cooled to room temperature before testing?..... \_\_\_\_\_

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PROCEDURE

1. 102±3 mm (4±0.1 in.) of working calcium chloride solution siphoned into plastic cylinder? \_\_\_\_\_
2. Using a pen cup push hard in your hands - Prepared sample poured from measuring tin into cylinder, using funnel to avoid spillage? ..... \_\_\_\_\_
3. Bottom of cylinder tapped sharply on heel of hand several times to release air bubbles? . \_\_\_\_\_
4. Wetted sample allowed to stand undisturbed for 10±1 minutes? ..... \_\_\_\_\_
5. Stopper placed in cylinder and material loosened from bottom by shaking? ..... \_\_\_\_\_
6. Mechanical Shaker Method (Referee Method):
  - (a) Stoppered cylinder placed in mechanical shaker and timer set? ..... \_\_\_\_\_
  - (b) Cylinder and contents shaken for 45±1 seconds? ..... \_\_\_\_\_

MANUAL SHAKER METHOD- MACHINE SEMI AUTOMATIC

- (a) Stoppered cylinder secured in hand shaker and stroke counter reset to zero? ..... \_\_\_\_\_
- (b) Fingertips pushed against right hand spring steel strap, and smooth oscillating motion maintained? ..... \_\_\_\_\_
- (c) Tip of pointer reverses direction within marker limits? ..... \_\_\_\_\_
- (d) Shaking action continued for 100 strokes in 45±5 seconds? ..... \_\_\_\_\_

HAND METHOD

- (a) Cylinder held in horizontal position and shaken vigorously in horizontal linear motion from end to end? ..... \_\_\_\_\_
- (b) Cylinder shaken 90 cycles (1 cycle is a complete back and forth motion) in approximately 30 seconds, using throw of 23±3 cm (9±1 in.)? ..... \_\_\_\_\_
7. Following shaking, cylinder set upright on work table and stopper removed? ..... \_\_\_\_\_
8. Irrigator tube inserted in cylinder and material rinsed from cylinder walls as irrigator is lowered? ..... \_\_\_\_\_
9. **Irrigator forced through material to bottom of cylinder by gentle stabbing and twisting action while solution flows from tip?** ..... \_\_\_\_\_
10. **Stabbing and twisting motion applied until cylinder filled to 381-mm (15-in.) [ASTM: 38.0-cm] mark?** ..... \_\_\_\_\_
11. Irrigator raised slowly without shutting off flow so liquid level is maintained at about 15 in.? \_\_\_\_\_
12. Final level adjusted to 15 in. before irrigator is removed from cylinder ..... \_\_\_\_\_  
(AASHTO only: between top 2 graduations, but not above the 381-mm level)? ..... \_\_\_\_\_
13. Cylinder and contents allowed to stand undisturbed for 20 minutes±15 seconds? ..... \_\_\_\_\_
14. Timing started immediately after withdrawal of irrigator? ..... \_\_\_\_\_
15. After sedimentation, level at top of clay suspension (clay reading) recorded? ..... \_\_\_\_\_
16. If no clear line of demarcation, sample allowed to stand undisturbed until clay reading can be obtained, and total sedimentation time recorded? ..... \_\_\_\_\_
17. If sedimentation time exceeds 30 minutes, test rerun using 3 individual samples of same material, and clay reading requiring shortest sedimentation time recorded? ..... \_\_\_\_\_

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PROCEDURE (CONTINUED)

- 18. Weighted foot assembly gently lowered into cylinder, without hitting mouth of cylinder? ... \_\_\_\_\_
- 19. When foot comes to rest on sand, assembly tipped toward cylinder graduations until indicator touches cylinder? ..... \_\_\_\_\_
- 20. 254 mm (10 in.) subtracted from level indicated by extreme top edge of indicator, and this value recorded as sand reading? ..... \_\_\_\_\_
- 21. If clay/sand readings fall between 2.5-mm (0.1-in.) graduations, is level of higher graduation recorded? ..... \_\_\_\_\_

CALCULATIONS

- 1. Sand equivalent calculated to 0.1 using following equation? ..... \_\_\_\_\_

$$\frac{\text{Sand Reading}}{\text{Clay Reading}} \times 100$$

- 2. If sand equivalent is not a whole number, reported as next higher whole number? ..... \_\_\_\_\_
- 3. If desired to average sand equivalent values, and average is not a whole number, reported as next higher whole number? ..... \_\_\_\_\_

COMMENTS: