AMRL #:_____

AGGREGATE WORKSHEET INDEX REPORT #: _____

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****** NP for Not Presented

★ - Indicates the line has been modified since the version of the worksheets dated 2013-09-13.

## SAMPLING AGGREGATES

(T2) _____
**(D75)** _____

Date: _____

**Sampling Method (complete applicable sections):**

1. Flowing Aggregate Stream (Bins or Belt Discharge)
   (a) Each increment taken from entire cross-section of the material as it is discharged? ..... _____
   **Note:** *It is usually necessary to have a special device constructed for use at each particular plant, consisting of a pan of sufficient size to intercept the entire cross section of the discharge stream and hold the required amount of material without overflowing.*
2. Conveyor Belt Sampling
   (a) Conveyor belt stopped while the sample increments are being obtained? ..... _____
   (b) Two templates placed on the belt so that the material between them will yield one increment? ..... _____
   (c) All material between templates carefully scooped into container including any fines? ..... _____
   **Note** – *automatic belt samplers may be used if properly maintained and if regular inspection ensures all material is being removed from the belt.* ★
3. Stockpiles
   (a) Every effort made to sample from stockpiles using appropriate power equipment, using it to create a separate small sampling pile following the instructions and diagrams in the test method? ..... ★_____
   (b) Where power equipment is not available, samples from stockpiles made of at least three increments of material from the top third, mid-point, and bottom third of the stockpile? ..... ★_____
   (c) If sampling fine material without power equipment, outside layer of pile removed before sampling? ★_____
   (d) Bias in test results due to segregation of materials avoided? ..... _____
4. Transportation Units (trucks, rail cars, barges, etc.) , typically avoided
   (a) If sampling of these transportation units cannot be avoided, sampling plan for specific case created? . _____
   (b) Sampling plan defines number of samples necessary to represent lots of specific sizes? ..... _____
5. Roadways (Bases and Sub-bases)
   (a) All increments taken from roadway for full depth of material? ..... _____
   (b) Specific area of increment to be taken clearly marked (such as by a metal template)? ..... _____

**All Methods:**

1. Samples obtained from finished product (when practicable)? ..... _____
2. Sample for abrasion testing not subjected to further crushing or reduction in particle size (unless the sample is of such a size that it requires further reduction for testing purposes)? ..... _____
3. Material to be sampled visually inspected for variations and if any variations are noted, corrective action take to establish homogeneity in the material prior to sampling? ..... ★_____
4. At least three approximately equal increments selected at random from the material and combined to form a field sample (see table below for recommended size)? ..... _____
   **Note to assessors:** *For stockpiles and transportation units, number of increments should be based on the sampling plan.*

| Aggregate size | Recommended Min. Mass (kg) | Recommended Min. Mass (lb) | Recommended Min. Volume (L) | Recommended Min. Volume (Gal) |
|---|---|---|---|---|
| ≤ 9.5 mm (3/8 in.) | 10 | 22 | 8 | 2 |
| 12.5 mm (1/2 in.) | 15 | 35 | 12 | 3 |
| 19.0 mm (3/4 in.) | 25 | 55 | 20 | 5 |
| 25.0 mm (1 in.) | 50 | 110 | 40 | 10 |
| 37.5 mm (1 ½ in.) | 75 | 165 | 60 | 15 |
| 50 mm (2 in.) | 100 | 220 | 80 | 21 |
| 63 mm (2 ½ in.) | 125 | 275 | 100 | 26 |
| 75 mm (3 in.) | 150 | 330 | 120 | 32 |
| 90 mm (3 ½ in.) | 175 | 385 | 140 | 37 |

**Note:** *For combinations of coarse and fine aggregate, recommended size is coarse aggregate mass plus 10 kg (22 lb).*

5. Field samples reduced to testing size in accordance with standard procedures (T248/C702)? ..... _____
6. Aggregate transported in bags or other containers to prevent loss, contamination, or damage? ..... _____
7. Aggregate shipping containers clearly marked with suitable identification of field samples? ..... _____

COMMENTS (T2 / D75): (T2 / D75)

**MATERIALS FINER THAN 75-µm (No. 200) SIEVE IN MINERAL AGGREGATES BY WASHING** (T11) _____ **(C117) _____**

APPARATUS Date: _____

1. Balance: AASHTO: Readable to 0.1% of sample mass? ..... _____
   ***ASTM: Readable to 0.1 g or 0.1% of test load?*** ..... _____
2. Sieves (Nest of two): (a) 75-µm (No. 200)? ..... _____
   (b) *AASHTO: Protective sieve 2.36 mm (No. 8) to 1.18 mm (No. 16)?* ..... _____
   ***ASTM: Protective sieve is 1.18 mm (No. 16)?*** ..... _____
3. Container, size and condition OK? ..... _____
4. Oven, maintains 110±5°C (230±9°F)? ..... _____
5. Wetting agent (Method B only)? ..... _____
6. Mechanical washing apparatus (optional):
   (a) Results are consistent with those obtained using manual methods? ..... _____
   (b) Degradation of the sample is avoided? ..... _____

PROCEDURE

1. Test sample obtained by (T248 / C702)*?* ..... _____
2. Test sample mass conforms to following table: ..... _____

*AASHTO Only: If the nominal maximum size of the aggregate to be tested is not listed below, the next larger size listed shall be used to determine sample size.*

| Nominal Maximum Size | Minimum Mass, g |
|---|---|
| No.4 or finer | 300 |
| 9.5 mm (3/8 in.) ***ASTM: Greater than No. 4 to 3/8 in*** | 1000 |
| 19.0 mm (3/4 in.) ***ASTM: Greater than 3/8 to 3/4 in*** | 2500 |
| 37.5 mm (1 ½ in.) or larger ***ASTM: Greater than 3/4 in.*** | 5000 |

**Note:** If same sample is to be tested as in T27 ***(C136)***, minimum mass should conform to requirements of that method.

3. Test sample dried to constant mass at 110±5°C (230±9°F)? ..... _____
4. Test sample mass determined to 0.1%? ..... _____
5. Placed in container and covered with water? ..... _____
6. **Optional:** Wetting agent added? (Method B only) ..... _____
7. Contents of container vigorously agitated? ..... _____
8. Complete separation of coarse and fine particles? ..... _____
9. Wash water poured through sieve nest? ..... _____
10. Wash water free of coarse particles? ..... _____
11. Operation continued until wash water is clear? ..... _____
12. Material on sieves returned to washed sample? ..... _____
13. Excess water decanted from washed sample only through the 75-µm (No. 200) sieve? ..... _____
14. Washed aggregate dried to constant mass at 110±5°C (230±9°F)? ..... _____
15. Washed aggregate mass determined to 0.1%? ..... _____
16. Calculation: % less than 75 µm = $\frac{\text{Orig. dry mass - Final dry mass}}{\text{Original dry mass}} \times 100$? ..... _____

COMMENTS (T11 / C117): (T11 / C117)

## BULK DENSITY ("UNIT WEIGHT") AND VOIDS IN AGGREGATE (T19) _____ **(C29) _____**

APPARATUS Date: _____

1. Unit weight measure:
   - (a) Top rim is smooth, watertight, and plane to 0.25 mm (0.01 in) when measure with feeler gauge? ..... _____
   - (b) Interior wall of measure is a smooth and continuous surface (no open seams, large welds, etc)? ..... _____
   - (c) Height is 80 to 150% of diameter? ..... _____
   - (d) Measure recalibrated at least annually or whenever the accuracy is called into question? ..... _____

     **Note to Assessors:** *The standardization requirements are included here because they are listed in the test method. If the laboratory is seeking accreditation, these issues will be covered in the R18 evaluation and the notes should be written under the quality system section. Only if they are not seeking R18 accreditation would you write a note here.*
   - (e) Capacity and design of measure conforms to requirements in table below? ..... _____

| Capacity of measure | Nominal Max. size of Aggregate | Min. thickness bottom | Min. thickness top 38 mm (1.5 inches) of wall | Min. thickness remainder of wall |
|---|---|---|---|---|
| 2.8 L (1/10 $ft^3$) ____ | 12.5 mm (1/2 in.) ____ | 5.0 mm ____ | 2.5 mm ____ | 2.5 mm ____ |
| 9.3 L (1/3 $ft^3$) ____ | 25.0 mm (1 in.) ____ | 5.0 mm ____ | 2.5 mm ____ | 2.5 mm ____ |
| 14 L (1/2 $ft^3$) ____ | 37.5 mm (1.5 in.) ____ | 5.0 mm ____ | 5.0 mm ____ | 3.0 mm ____ |
| 28 L (1 $ft^3$) ____ | 75 mm (3 in.) ____ | 5.0 mm ____ | 5.0 mm ____ | 3.0 mm ____ |

2. Tamping rod? ..... _____
   - (a) Round, straight steel rod approximately 600 mm (24 in.) [AMRL: ± 4 in] long.
   - (b) 16 mm (5/8 in.) in diameter with hemispherical tip.
3. Shovel or scoop? ..... _____
4. Piece of plate glass (larger than the measure's diameter)? ..... _____
5. Grease, such as chassis or water pump grease suitable for forming a water-tight seal? ..... _____
6. Balance, graduated to at least 0.05 kg (0.1 lb) increments:
   - (a) *AASHTO: Readable to 0.1% of sample mass?* ..... _____
   - ***ASTM: Accurate to 0.1% of test load?*** ..... _____
7. Thermometer, with a range of at least 10 to 32°C (50 to 90°F) and that is readable to at least 0.5°C (1°F)? ..... _____

Sample Preparation

1. Sample obtained by (T248 / C702), approx. 125 to 200% of quantity needed to fill the measure? ..... _____
2. Sample dried to essentially constant mass or at 110±5°C (230±9°F)? ..... _____

COMMENTS (T19 / C29): (T19 / C29)

**BULK DENSITY ("UNIT WEIGHT") AND VOIDS IN AGGREGATE** (T19) _____
**(C29)** _____

PROCEDURE Date: _____

Observe one of the following:

Rodding Procedure (up to 37.5-mm [1 ½-in.] particles)

1. Measure filled 1/3 full and leveled with fingers? ..... _____
2. Aggregate rodded with 25 evenly distributed tamping strokes? ..... _____
3. Tamping rod does not forcibly strike the bottom of the measure? ..... _____
4. Tamping strokes limited to layer being tamped? ..... _____
5. Measure filled with two more similar layers and third layer filled to overflowing (before tamping)? ..... _____
6. Surface leveled with the fingers or the straightedge (tamping rod)? ..... _____
7. Average level surface obtained (aggregate projections above the rim balance the voids below the rim)? ..... _____
8. Net mass determined to the nearest 0.05 kg (0.1 lb)? (*G*) ..... _____
9. Bulk density reported to the nearest 10 kg/m$^3$ (1 lb/ft$^3$)? {Bulk density = $(G - T) / V$ **or** $= (G - T) \times F$} ..... _____
10. Void content (if determined) reported to the nearest 1 percent? ..... _____

Jigging procedure (37.5 to 150-mm [1 ½ to 5-in.] particles):

1. Measure filled 1/3 full and leveled with fingers? ..... _____
2. Layer compacted by raising alternate sides about 50 mm (2 in.) and dropping on floor 25 times on each side (a total of 50)? ..... _____
3. Measure filled with two more similar layers and third layer filled to overflowing (before compaction)? ..... _____
4. Surface leveled with the fingers or the straightedge (tamping rod)? ..... _____
5. Average level surface obtained (aggregate projections above the rim balance the voids below the rim)? ..... _____
6. Net mass determined to the nearest 0.05 kg (1 lb)? ..... _____
7. Net mass of aggregate multiplied by calibration factor or divided by volume of the measure? ..... _____
8. Bulk density reported to the nearest 10 kg/m$^3$ (1 lb/ft$^3$)? ..... _____
9. Void content (if determined) reported to the nearest 1 percent? ..... _____

Shoveling procedure (up to 150-mm [6-in.] particles): **Note:** This method only used when specified.

1. Measure filled to overflowing with scoop or shovel? ..... _____
2. Aggregate discharged from height not exceeding 50 mm (2 in.) above top of measure? ..... _____
3. Care taken to prevent segregation of the particle sizes? ..... _____
4. Surface leveled with the fingers or the straightedge (tamping rod)? ..... _____
5. Average level surface obtained (aggregate projections above the rim balance the voids below the rim)? ..... _____
6. Net mass determined to the nearest 0.05 kg (0.1 lb)? ..... _____
7. Net mass of aggregate multiplied by calibration factor or divided by volume of the measure? ..... _____
8. Bulk density reported to the nearest 10 kg/m$^3$ (1 lb/ft$^3$)? ..... _____
9. Void content (if determined) reported to the nearest 1 percent? ..... _____

COMMENTS (T19 / C29): (T19 / C29)

**ORGANIC IMPURITIES IN FINE AGGREGATES FOR CONCRETE** (T21) _____
**(C40) _____**

APPARATUS Date: _____

1. Glass bottles:
   (a) Clear (colorless) glass with outside dimension **[*ASTM: thickness*]** between 40 and 60 mm **[*ASTM: 38.1 to 63.5 mm*]** (1.5 to 2.5 in.)? ..... _____
   (b) Approximately 240 to 470-mL (8 to 16 oz) nominal capacity? ..... _____
   (c) Graduation lines in milliliters or ounces? ..... _____
   ***Note:*** *If bottle is unmarked, lines may be scribed onto the bottle and are required only at the 75, 130 & 200-mL (2 ½, 4 ½, & 7-oz) levels. (Lines at 2 ½ oz only necessary when using the standard color solution.)*
   (d) Stoppers or caps which are not soluble in specified reagents? ..... _____

2. Reagent, 3 parts NaOH (sodium hydroxide) to 97 parts water by mass **[*ASTM: weight*]**? ..... _____

3. Reference color standards (One of the following):
   (a) Standard solution: ..... _____
   ***Note to assessor:*** *The standard color solution is a hazardous material and should not be handled without the proper safety equipment and training. Consult the SDS document for details.*
   (1) Reagent grade Potassium Dichromate dissolved in concentrated sulfuric acid? ..... _____
   (2) Equal to Organic Color No. 3? ..... _____
   (3) Solution is freshly made (less than 2 hours old)? ..... _____
   or (b) Glass color plate with Organic Color Nos. 1-5 (Gardener Color Nos. 5, 8, 11, 14, & 16)? ..... _____

PROCEDURE

1. Sample obtained by Method (T248 / C702)? ..... _____
2. *AASHTO only: If sample is dried prior to testing, is it dried only by air drying?* ..... _____
3. Sample mass about 450 g (1 lb)? ..... _____
4. Sand added to the 130-mL (approximately 4 ½-ozs) level in the bottle? ..... _____
5. NaOH solution added until volume of fine aggregate and liquid, after shaking, is 200 mL (approx. 7 oz) level? _____
6. Bottle stoppered and shaken vigorously? ..... _____
7. Allowed to stand for 24 hours? ..... _____
8. Color comparison made against color standards? ..... _____
9. If color is darker than organic plate No. 3 (Gardner Color Standard No. 11) or darker than the standard color solution, is the material considered to possibly contain injurious organic compounds and further tests conducted before the aggregate is used in concrete? ..... _____

COMMENTS (T21 / C40): (T21 / C40)

## SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (T27) _____ **(C136)** _____

APPARATUS Date: _____

1. *AASHTO: Balance, readable to 0.1% of sample mass?* ..... _____
   ***ASTM: Fine agg: Balance, readable to 0.1 g, accurate to 0.1 g or 0.1% of test load (greater)?*** ..... _____
   ***Coarse agg: Balance, readable & accurate to 0.5 g or 0.1% of test load (greater)?*** ..... _____
2. Oven, maintains 110±5°C (230±9°F)? ..... _____
3. **Optional**: Mechanical Shaker, Manufacturer / ID #:_____ ★
   (a) Continually reorients the particles on the sieving surface? ..... _____
   (b) Shaker runs for correct amount of time (determined during annual standardization)? ..... _____
   **Note to assessors:** *The time set on the dial may not be the same amount of time that the shaker will operate. Check that either the set time and the actual time run are the same, or that the laboratory is aware of any offset.*
   Elapsed time during assessment:_____ Time on calibration record:_____
   (c) Sieving accuracy met in a reasonable time period? ..... _____
   **Note:** *Time in excess of approx. 10 minutes may result in degradation of the sample.*
4. Sieves: circle which type(s) were used: **8-in. sieves** **12-in. sieves** **Other** (such as square sieves)

PROCEDURE

**Note to Assessors**: *Please evaluate procedure(s) and sieving efficiency for both fine and coarse sieve shakers, if applicable.*

**Coarse Aggregate Gradation OR Mixtures of Coarse and Fine Aggregate Gradation:**

Initial Mass: _____ Final Mass: _____

1. Sample obtained by (T248 / C702) or whole field sample used? ..... _____
2. Minimum sample mass: 3/8 in. - 1 kg; 1/2 in. - 2 kg; 3/4 in. - 5 kg; 1 in. - 10 kg; 1 ½ in. - 15 kg; 2 in. - 20 kg; 2 ½ in. - 35 kg; 3 in. - 60 kg; 3 ½ in. - 100 kg? ..... _____
3. Sample dried to constant mass at 110 ± 5°C (230 ± 9°F) or sieved surface dry (coarse agg. only)? ..... _____
4. *AASHTO only: Mass determined to nearest 0.1% (unless already determined in (T11 / C117) )?* ..... _____
5. If hand sieving, particles not forced to pass through openings? ..... _____
6. *AASHTO: Sieving continued until not more than 0.5% by mass of the total specimen passes a given sieve during one minute of continuous hand sieving (check by hand with 8-in. diameter sieve)?* ..... _____
   ***ASTM: Sieving continued until not more than one mass % of the residue on any individual sieve passes that sieve during one minute of continuous hand sieving (check by hand with 8-in. diameter sieve)?*** ..... _____

| *AASHTO: Sieve Size* | *Initial specimen mass* | *Mass passing sieve* | *% Passing* |
|---|---|---|---|
| | | | |
| ***ASTM: Sieve Size*** | ***Mass on sieve before hand-check*** | ***Mass passing sieve*** | ***% Passing*** |
| | | | |

7. Residue on each sieve weighed to 0.1% of original dry mass? ..... _____
8. Fine sieves: mass of residue on each sieve [finer than 4.75-mm (No. 4) sieves] does not exceed 7 kg/m$^2$ of sieving surface (200 g for 8-in. diameter sieve; 469 g for 12-in. diameter sieve)? ..... _____
9. Coarse sieves: mass of residue on each sieve [for 4.75-mm (No. 4) sieves and larger] does not exceed 2.5 * (sieve opening, mm) * (effective sieving area [*which is smaller than its nominal diameter*], m²)? ..... _____
   **Note to Assessors:** *This is not identical to (T30/D5444), they are calculated differently.*

| Sieve | Opening (mm) | Mass (g) – 8 in. dia. | Mass (g) – 12 in. dia. |
|---|---|---|---|
| < #4 | < 4.75 | 200 | 469 |
| #4 | 4.75 | 338 | 796 |
| 1/4 in. | 6.3 | 449 | 1055 |
| 3/8 in. | 9.5 | 677 | 1592 |
| 1/2 in. | 12.5 | 891 | 2094 |
| 3/4 in. | 19.0 | 1354 | 3183 |

10. Total mass of material after sieving agrees with mass before sieving to within 0.3% (If not, do not use for acceptance testing)? ..... _____
11. Percentages calculated to the nearest 0.1% and reported to the nearest whole number (except 75-µm (No. 200) - if less than 10%, percentage -200 reported to nearest 0.1%)? ..... _____
12. Percentage calc. based on original dry sample mass, including the passing 75-µm fraction from (T11 / C136)? _____

COMMENTS (T27 / C136): (T27 / C136)

**SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES** (T27) _____
**(C136) _____**

PROCEDURE (Continued) Date: _____

**Fine Aggregate Gradation (materials primarily passing the No. 4 sieve):**

Initial Mass: _____ Final Mass: _____

1. Sample obtained by (T248 / C702) or whole field sample used, minimum sample mass 300 g? ..... _____
2. Sample dried to constant mass at 110 ± 5°C (230 ± 9°F)? ..... _____
3. *AASHTO only: Mass determined to nearest 0.1% (unless already determined in (T11 / C117) )?* ..... _____

4. *AASHTO: Sieving continued until not more than 0.5% by mass of the total specimen passes a given sieve during one minute of continuous hand sieving (check by hand with 8-in. diameter sieve)?* ..... _____
***ASTM: Sieving continued until not more than one mass % of the residue on any individual sieve passes that sieve during one minute of continuous hand sieving (check by hand with 8-in. diameter sieve)? .....*** _____

| *AASHTO: Sieve Size* | *Initial specimen mass* | *Mass passing sieve* | *% Passing* |
|---|---|---|---|
| | | | |
| ***ASTM: Sieve Size*** | ***Mass on sieve before hand-check*** | ***Mass passing sieve*** | ***% Passing*** |
| | | | |

5. Residue on each sieve weighed to 0.1% of original dry mass? ..... _____
6. Sieves not overloaded:
   (a) Mass of residue on each sieve [finer than 4.75-mm (No. 4) sieves] does not exceed 7 kg/m$^2$ of sieving surface (200 g for 8-in. diameter sieve; 469 g for 12-in. diameter sieve)? ..... _____
   (b) Mass of residue on each sieve [for 4.75-mm (No. 4) sieves and larger] does not exceed 2.5 * (sieve opening, mm) * (effective sieving area *(which is smaller than its nominal diameter)*, m²)? _____

**Note to Assessors:** *This is not identical to (T30/D5444), they are calculated differently.*

| Sieve | Opening (mm) | Mass (g) – 8 in. dia. | Mass (g) – 12 in. dia. |
|---|---|---|---|
| < #4 | < 4.75 | 200 | 469 |
| #4 | 4.75 | 338 | 796 |
| 1/4 in. | 6.3 | 449 | 1055 |
| 3/8 in. | 9.5 | 677 | 1592 |
| 1/2 in. | 12.5 | 891 | 2094 |
| 3/4 in. | 19.0 | 1354 | 3183 |

7. Total mass of material after sieving agrees with mass before sieving to within 0.3% (If not, do not use for acceptance testing)? ..... _____
8. Percentages calculated to the nearest 0.1% and reported to the nearest whole number (except 75-µm (No. 200) - if less than 10%, percentage -200 reported to nearest 0.1%)? ..... _____
9. Percentage calculations based on original dry sample mass, including the passing 75-µm fraction if (T11 / C117) was used? ..... _____

COMMENTS (T27 / C136): (T27 / C136)

**SIEVE ANALYSIS OF MINERAL FILLER FOR ROAD AND PAVING MATERIALS** (T37) _____
(D546)_____

APPARATUS Date: _____

1. Sieves: 600 µm (No. 30), 300 µm (No. 50), and 75 µm (No. 200) and **[*ASTM Only: 1.18 mm (No. 16)*]**?..... _____
2. Satisfactory water spray or rubber hose? ..... _____
3. Oven, maintains 110±5°C (230±9°F)?..... _____
4. Balance: *AASHTO: Class G2?* ..... _____
   ***ASTM: Class GP-1, readable to 0.01 g, capacity at least 200 g?*****.....** _____

PROCEDURE

1. Sample obtained by (T248 / C702)? ..... _____
2. Sample mass at least 100 g?..... _____
3. AASHTO: Sample dried to constant mass at 110±5°C (230±9°F) and mass determined to nearest 0.1 g?..... _____
   ***ASTM: Sample dried to constant mass at 110±5°C (230±9°F) and mass determined to nearest 0.01 g***? ..... _____
4. Sample placed on specified nest of sieves: **[*ASTM Only: No 16*]**, No. 30, No. 50, No. 200?..... _____
5. Material washed with stream of water until water coming through sieves is clear? ..... _____
6. Velocity of water not sufficient to splash sample over side?..... _____
7. Care taken to avoid clogging of 75-µm sieve?..... _____
8. Residue on each sieve dried to constant mass at 110±5°C (230±9°F) and mass determined?..... _____
9. *AASHTO only: Excess water decanted (if necessary) from washed samples only through the 75-µm sieve (prior to drying)?* ..... _____
10. Masses of material retained on each sieve calculated as a percentage of the original sample mass?..... _____
11. Results reported as total percent passing each sieve to nearest 0.5%?..... _____

COMMENTS (T37 / D546): (T37 / D546)

**SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE** (T84) _____
**(C128) _____**

APPARATUS Date: _____

1. Pycnometer:
   - (a) Volume content can be reproduced to ±100 $mm^3$?..... _____
   - (b) Volume of container filled to mark at least 50% > space required to accommodate test sample?..... _____
   - (c) One of the following types of containers:
     - (1) Volumetric flask, capacity 500 mL (or more)?..... _____
     - **or** (2) Fruit jar fitted with pycnometer top?..... _____
     - **or** (3) Le Chatelier flask as in (T133 / C188):..... _____
       - (a) Made of glass with space of at least 10 mm between highest graduation mark and lowest point of grinding for glass stopper?..... _____
       - (b) Neck graduated from 0 to 1 mL and from 18 to 24 mL?..... _____
       - (c) Bottle and stopper have identical permanent identification markings?..... _____
       - (d) Standard temperature marked on flask?..... _____
       - (e) Unit of capacity marked above highest graduation line (mL)?..... _____
2. Conical mold
   - (a) Made of metal, 0.8 mm minimum thickness, with a height of 75±3 mm?..... _____
   - (b) Inside diameter at top 40±3 mm and inside diameter at bottom 90±3 mm?..... _____
3. Tamper, flat, circular tamping face 25±3 mm in diameter and tamper mass of 340±15g?..... _____
4. Oven, maintains 110±5°C (230±9°F)?..... _____
5. Balance, *AASHTO: Class G2*..... _____
   ***ASTM: Capacity at least 1 kg, accurate to 0.1% of sample mass, sensitive to 0.1 g?*****.....** _____
6. ***Optional*** *AASHTO only: Burette, readable to 0.15 mL?*..... _____

PROCEDURE

Sample Preparation
1. Sample obtained by (T248 / C702), approximately 1000 g [AMRL: 1000 to 1200 g] in size?..... _____
2. Dried to constant mass at 110±5°C (230±9°F)?..... _____
   **Note:** Oven drying not necessary if naturally moist condition is desired.
3. Allowed to cool to comfortable handling temperature **[*ASTM: approximately 50°C*]**?..... _____
4. Covered with water or at least 6% moisture added?..... _____
5. Allowed to stand 15-19 hours **[*ASTM 20-28 hours*]**, or naturally moist?..... _____
6. Excess water decanted (if necessary) without loss of fines?..... _____
7. Sample spread on flat, nonabsorbent surface, and uniformly dried by current of warm air?..... _____
8. Mold placed on flat, nonabsorbent surface and filled to overflowing?..... _____
9. Tamper allowed to fall freely under gravitational attraction, 25 times with a 5 mm drop?..... _____
   **Note**: See Provisional Tests 1-4 for materials that do not readily slump.
10. Loose sand removed from around base and mold lifted vertically?..... _____
11. Sample fails to slump on first test?..... _____
12. If it does slump on the first test, is water added, sample covered and allowed to stand 30 minutes?..... _____
13. Drying continued and slump test repeated at frequent intervals until sample slumps slightly?..... _____

COMMENTS (T84 / C128): (T84 / C128)

**SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE** (T84) _____
**(C128)** _____

PROCEDURE (Continued) Date: _____

Procedure:

1. Pycnometer partially filled with water, 500±10 g sample added, and SSD sample mass recorded? (*S*) ..... _____
2. Pycnometer filled to 90% of total capacity and agitated to eliminate air bubbles? ..... _____
3. Mechanical agitation permitted if performed in a manner that will not degrade the sample and comparison to manual agitation on the same material performed every 6 m, and the two results fall within the Table 1 range? _____
4. Temperature of contents adjusted to 23.0±1.7°C (73.4±3°F) **[*ASTM: 23.0± 2.0 ℃*]**? ..... _____
5. Water level adjusted to calibrated capacity and mass of pycnometer and contents determined? (*C*) ..... _____
   **Note:** *Paper towel or isopropyl alcohol may be used to disperse foam on the water surface.*
6. Sample removed and dried to constant mass at 110±5°C (230±9°F)? ..... _____
   **Note**, **AASHTO only:** *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.*
7. Sample cooled in air at room temperature for 1.0±0.5 hour and dry specimen mass determined? (*A*) ..... _____
8. Empty pycnometer filled to its calibration capacity with water at 23.0±1.7°C (73.4±3°F) **[*ASTM: 23.0± 2.0 ℃*]** and mass determined (pycnometer may be previously calibrated)? (*B*) ..... _____
9. All masses determined to nearest 0.1 g? ..... _____
10. Bulk specific gravity calculated as follows {Bulk sp gr = $A / (B + S - C)$} and reported to nearest 0.001 (or reported to nearest 0.01 for fine aggregate meeting M6 requirements)? ..... _____
11. If sample tested in a naturally moist condition, source of the sample and the procedures used to prevent drying prior to testing reported? ..... _____

*Burette Method (AASHTO only)*
*(Alternate method to determine weight of pycnometer, specimen, & water)*

1. *Mass of saturated surface-dry specimen determined? (S)* ..... _____
2. *Mass of empty pycnometer determined? (W)* ..... _____
3. *Specimen added to pycnometer as in Step 1 of Procedure?* ..... _____
4. *Water at 23.0±1.7 ℃ (73.4±3 ℉) added to pycnometer from burette, quantity of water read from burette? ($V_a$)* . _____
5. *Total mass of pycnometer, specimen, and water (C) calculated from equation{ $C = 0.9975\ V_a + S + W$ }?* ..... _____
6. *Specific gravity reported to nearest 0.001 (or reported to nearest 0.01 for fine agg. meeting M6 reqs.)?* ..... _____

Le Chatelier Method
(Alternate procedure)

1. Le Chatelier flask filled with water to point on stem between 0 and 1 mL marks and initial volume recorded? .. _____
2. Temperature of flask and contents at 23.0±1.7°C (73.4±3°F) **[*ASTM: 23.0± 2.0 ℃*]**? ..... _____
3. Approximately 55±5 g (other masses acceptable) of saturated surface dry fine aggregate added to flask? ..... _____
4. Separate 500±10 g sample of saturated surface-dry material taken for absorption determination? ..... _____
   **Note:** This sample must be obtained at the same time as the sample is introduced into the Le Chatelier flask.
   **Note**, *AASHTO only: 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. Stopper placed in flask, and flask and contents agitated to remove entrapped air? ..... _____
6. Flask and contents check to be within 1°C (1.8°F) of temperature in Step 3, water level read and recorded? ..... _____
7. *AASHTO: aggregate removed from flask and dried to constant mass at 110±5 ℃ (230±9 ℉)?* ..... _____
   *ASTM: separate 500 g sample used to determine absorption?* ..... _____
8. Lab says proper book formulas used in calculations and specific gravity reported to nearest 0.001 (or reported to nearest 0.01 for fine aggregate meeting M6 requirements)? ..... _____
   *Note to assessor: M6 specifically refers to fine aggregates used in hydraulic cement and concrete applications.*

COMMENTS (T84 / C128): (T84 / C128)

**SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE** (T85) _____
**(C127)** _____

APPARATUS Date: _____

1. Sample container, Wire basket of 3.35-mm (No. 6) mesh or finer? ..... _____
   **Note:** *the following containers can be used if needed: a bucket of approximately equal breadth and height, capacity 4 to 7 L, for up to 37.5-mm (1 ½-in.) material OR a larger container that prevents trapping air when submerged for plus 37.5-mm (1 ½-in.) material.*
2. Water tank:
   (a) Capable of completely submerging the sample container? ..... _____
   (b) *AASHTO only: Watertight tank equipped with overflow outlet?* ..... _____
3. Suspension apparatus:
   (a) Of suitable design and in good condition? ..... _____
   (b) Center of suspension apparatus properly located with respect to center of balance pan or other point of contact with balance? ..... _____
   (c) *AASHTO only: Wire suspending the container is of smallest practical size?* ..... _____
4. Immersion water, temperature is 23.0±1.7°C (73.4±3°F) **[*ASTM: 23±2.0°C*]**? ..... _____
5. Large absorbent cloth (paper towels or several small cloths NOT acceptable)? ..... _____
6. Balance: *AASHTO: Class G5?* ..... _____
   ***ASTM: Sensitive, readable, and accurate to 0.05% of sample weight or 0.5 g (greater)?*** ..... _____
7. Sieves, 4.75 mm (No. 4) or other sizes as needed? ..... _____
8. Oven, maintains 110±5°C (230±9°F)? ..... _____

PROCEDURE

Procedure:
1. Sample obtained by (T248 / C702)*?* ..... _____
2. Screened on 4.75-mm (No. 4 sieve) [or 2.36-mm (No. 8) sieve if sample contains lots of –No.4 material]? ..... _____
3. Sample mass as follows: 1/2 in. or less - 2 kg; 3/4 in. - 3 kg; 1 in. - 4 kg; 1 ½ in. - 5 kg? ..... _____
4. Washed to clean surfaces of particles? ..... _____
5. Dried to constant mass at 110±5°C (230±9°F) and cooled to room temperature for 1 to 3 hours (for up to 1 ½-in. nominal maximum size, longer for larger sizes)? ..... _____
   **Note:** *Oven drying not necessary if naturally moist condition is desired.*
6. Covered with water for 15 to 19 hours **[*ASTM 20 to 28 hours*]**? ..... _____
7. Rolled in cloth to remove visible films of water? *(A moving stream of air may be used to assist in the drying operation.)* ..... _____
8. Larger particles wiped individually and evaporation avoided? ..... _____
9. *AASHTO: If sample dries past SSD, sample immersed in water for 30 minutes and drying re-started?* ..... _____
10. SSD sample mass in air determined? (*B*) ..... _____
    (a) *AASHTO: All masses determined to nearest 1 g or 0.1% of sample mass (whichever is greater)?* ..... _____
    (b) ***ASTM: All masses determined to nearest 0.5 g or 0.05% of sample weight (whichever is greater)?*** .. _____
11. Sample immediately placed in sample container? ..... _____
12. Entrapped air removed before weighing by shaking container while immersed? ..... _____
13. Mass determined in water at 23.0±1.7°C (73.4±3°F) **[*ASTM: 23±2.0°C*]?** (*C*) ..... _____
14. Dried to constant mass at 110±5°C (230±9°F) and cooled to room temperature for 1 to 3 hours (or until aggregate has cooled to comfortable handling temperature, approximately 50°C)? ..... _____
15. Oven dried sample mass determined? (*A*) ..... _____
16. *AASHTO: Bulk specific gravity calculated using the following formulas and reported to the nearest 0.001 (or nearest 0.01 for coarse aggregate meeting M80 requirements)?* ..... _____
    ***ASTM: Bulk specific gravity calculated to nearest 0.01?*** ..... _____

*Note to assessor: M80 specifically applies to coarse aggregates used in concrete applications.*

Bulk specific gravity = $A / (B - C)$
Bulk sp gr (by SSD mass) = $B / (B - C)$
Apparent specific gravity = $A / (A - C)$
Absorption = $[(B - A) / A] \times 100$

COMMENTS (T85 / C127): (T85 / C127)

**RESISTANCE TO DEGRADATION OF SMALL-SIZE COARSE AGGREGATE (T96) _____**
**BY ABRASION AND IMPACT IN THE LOS ANGELES MACHINE (C131) _____**

APPARATUS Date: _____

1. Los Angeles machine
   (a) Horizontal cylindrical drum, inside diameter 711±5 mm (28±0.2 in.), inside length 508±5 mm (20±0.2 in.), and wall thickness 12.7±3.2 mm (½±1/8 in.) **[*ASTM: 12.7 mm, no tolerance*]**?..... _____
   (b) Opening in drum side about 508 x 152 mm (20 in. x 6 in.)? ..... _____
   (c) Cover for opening has dust-tight gasket and is securely fastened to drum? ..... _____

   Interior Shelf requirements:
   (d) Shelf projects inward 89±2 mm (3.5±0.1 in.) or 152 x 102 x 12.7 mm (6 x 4 x ½in.)? ..... _____
   (e) ***ASTM only: Interior surface of the cylinder free of protrusions disrupting the path of sample and steel spheres (except for the shelf)?*****.....** _____
   (f) Shelf firm, rigid, and in good physical condition?..... _____
   (g) Shelf extends [*AASHTO only: to within 5 mm (0.2 in.) of*] full length of the cylinder? ..... _____
   (h) Shelf located such that the charge does not impact near the opening and its cover? ..... _____
   (i) ***ASTM only: Distance from shelf to the opening is 1270 mm (50 in.) or more in the direction of rotation?*****.....** _____

   Rotation requirements:
   (j) Uniform peripheral speed ( ± 1.5 RPM from the average suggested)?..... _____
   (k) *AASHTO only: Machine equipped with counter?*..... _____
   (l) Cylinder rotates at 30 to 33 revolutions per minute over 5 minutes period? ..... _____

   Counter reading (Start): _____ Counter reading (End): _____
   Elapsed time (minutes and seconds): _____ Elapsed time (seconds): _____
   Average speed = 60 * (# of revolutions) / time in seconds: _____ RPM

2. Charge:
   (a) Number of spheres tested: _____ Number of spheres having a mass of 390-445 g: _____

| | Mass of charge: | Range | | | Charge available? |
|---|---|---|---|---|---|
| A | 12 spheres | 4975 | to | 5025 g ? | _____ |
| B | 11 spheres | 4559 | to | 4609 g ? | _____ |
| C | 8 spheres | 3310 | to | 3350 g ? | _____ |
| D | 6 spheres | 2485 | to | 2515 g ? | _____ |

   (b) All grading charges possible? ..... _____

3. Sieves, 1.70 mm (No. 12) and other sizes as needed?..... _____

4. Balance, *AASHTO: Class G5,* ***ASTM: Accurate to 0.1% of test load?*****.....** _____

5. Oven, maintains 110 ± 5°C (230 ± 9°F)?..... _____

COMMENTS (T96 / C131): (T96 / C131)

**RESISTANCE TO DEGRADATION OF SMALL-SIZE COARSE AGGREGATE (T96) _____**
**BY ABRASION AND IMPACT IN THE LOS ANGELES MACHINE (C131) _____**

PROCEDURE Date: _____

1. Sample obtained by (T248 / C702)? ..... _____
2. Sample washed and oven-dried to constant mass at 110±5°C (230±9°F)? ..... _____
3. Mass determined to nearest 1.0 g? ..... _____
4. Specimen masses conform to the table below? ..... _____

| SIEVE SIZE | GRADING A | GRADING B | GRADING C | GRADING D |
|---|---|---|---|---|
| 1 to 1 ½ in | 1250 ± 25 g | | | |
| 3/4 to 1 in | 1250 ± 25 g | | | |
| ½to 3/4 in | 1250 ± 10 g | 2500 ± 10 g | | |
| 3/8 to ½in | 1250 ± 10 g | 2500 ± 10 g | | |
| 1/4 to 3/8 in | | | 2500 ± 10 g | |
| No. 4 to 1/4 in | | | 2500 ± 10 g | |
| No. 8 to No. 4 | | | | 5000 ± 10 g |
| | | | | |
| Total Mass | 5000 ± 10 g | 5000 ± 10 g | 5000 ± 10 g | 5000 ± 10 g |

5. Sample and spheres put in machine and tumbled 500 times? ..... _____
   **Note:** *Loss after 100 revolutions may be determined, and then entire sample returned to drum for final 400 revolutions.*
6. Contents of drum separated on a sieve coarser than a 1.70 mm (No. 12) according to T27/C136?..... _____
7. Finer material separated on a No. 12 sieve?..... _____
   ***Note to assessors:*** *Mechanical sieving or hand sieving is acceptable for this test.*
8. Material coarser than No. 12 washed and dried to constant mass at 110±5°C (230±9°F)? (**See Note**) ..... _____
   **Note:** *If material is essentially free of adherent coatings and dust, the requirement for washing is optional. For referee testing, the washing procedure must be performed.*
9. Mass of material coarser than No. 12 determined to nearest 1 g?..... _____
10. Percentage of wear calculated as: % wear = (original - final mass) / original mass?..... _____

COMMENTS (T96 / C131): (T96 / C131)

**SOUNDNESS OF AGGREGATE BY USE OF SODIUM SULFATE OR MAGNESIUM SULFATE** (T104) _____ **(C88) _____**

APPARATUS Date: _____

1. Oven, maintains 110 ± 5°C (230 ± 9°F) for drying samples? ..... _____
2. Oven, evaporation rate has been checked in accordance with the method? ..... _____
   **Note to Assessors:** *A finding can be written here if the oven was checked incorrectly or if it has never been checked. Please write all record interval notes under R18 (if applicable).*

3. Sieves:

| | | |
|---|---|---|
| 63.0 mm (2 ½ in.)? ..... _____ | 16.0 mm (5/8 in.)? ..... _____ | 2.36 mm (No. 8)? ..... _____ |
| 50.0 mm (2 in.)? ..... _____ | 12.5 mm (½ in.)? ..... _____ | 1.18 mm (No. 16)? ..... _____ |
| 37.5 mm (1 ½ in.)? ..... _____ | 9.5 mm (3/8 in.)? ..... _____ | .600 mm (No. 30)? ..... _____ |
| 31.5 mm (1 1/4 in.)? ..... _____ | 8.0 mm (5/16 in.)? ..... _____ | .300 mm (No. 50)? ..... _____ |
| 25.0 mm (1 in.)? ..... _____ | 4.75 mm (No. 4)? ..... _____ | .150 mm (No. 100)? ..... _____ |
| 19.0 mm (3/4 in.)? ..... _____ | 4.00 mm (No. 5)? ..... _____ | |

   (a) Is the laboratory presenting both coarse and fine methods? ..... _____
   ***Note to assessor:*** *Write an informational Observation if the lab only performs one method.*

4. Sample containers:
   *(a) AASHTO: 203.2-mm (8-in.) diameter sieves in good physical condition?* ..... _____
   ***Note:*** *Other containers are acceptable if they permit free access of solution to the sample and drainage of solution without loss of aggregate. Sieves are required for referee testing.*
   *(b) AASHTO: Coarse agg – 2.36 mm (No. 8) size sieves, Fine agg - 250 μm (No. 60) size sieves?* ..... _____
   ***(c) ASTM: Containers are perforated to allow solution access and drainage of solution without sample loss?*** ..... _____

5. Sulfate solution:
   (a) Solution containers:
      (1) Have suitable covers or protected from evaporation and foreign material? ..... _____
      (2) Holds volume of solution to cover samples to a depth of at least 12.5 mm (½ in.)? ..... _____
      (3) Are solutions clear prior to use (not discolored, discolored solutions should be filtered)? ..... _____
      (4) Volume of solution at least 5 times the solid volume of all samples immersed at one time? ... _____
   (b) Temperature regulation:
      (1) Method for controlling temperature of sulfate solution during a test: _____
      (2) Solution temperature 20.3 to 21.9°C (68.5 to 71.5°F) **[*ASTM: 21±1°C (68 to 71.6*°F)]**?..... _____
   (c) Suitable device for measuring specific gravity of solution to within ±0.001:..... _____
   (d) For Sodium Sulfate, specific gravity is 1.154 to 1.171 **[*ASTM: 1.151 to 1.174*]**? ..... _____
   (e) For Magnesium Sulfate, specific gravity is 1.297 to 1.306 **[*ASTM: 1.295 to 1.308*]**? ..... _____

6. Balance:
   *(a) AASHTO: readable to 0.1% of sample mass, or better?* ..... _____
   (b) ***ASTM: For fine aggregate, accurate to 0.1 g?*** ..... _____

7. Barium chloride solution:
   *(a) AASHTO: 0.2 molar (41.6 g $BaCl_2$ per liter of solution)?* ..... _____
   (b) ***ASTM: 100 mL of 5% barium chloride solution prepared by dissolving 5 g of $BaCl_2$ in 100 mL distilled water?*** ..... _____

8. Temperature recorder:
   (a) *AASHTO: records solution temperature a minimum of once every 10 minutes for duration of test and accurate to 0.3 ℃ (0.5 ℉)?* ..... _____
   (b) ***ASTM: accuracy of at least 1°F (0.5°C) and can record temperature at least every 15 minutes?*** ..... _____

9. *AASHTO only: Thermometer, covers temperature range of solution and readable to 0.1 ℃ (0.2 ℉)?* ..... _____

COMMENTS (T104 / C88): (T104 / C88)

**SOUNDNESS OF AGGREGATE BY USE OF SODIUM SULFATE OR MAGNESIUM SULFATE** (T104) _____ **(C88) _____**

SAMPLE PREPARATION Date: _____

Fine Aggregate:

1. Passed through a 9.5-mm (3/8-in.) sieve? ..... _____
2. Washed on a 300-µm (No. 50) sieve? ..... _____
3. Dried to constant mass at 110±5°C (230±9°F)? ..... _____
4. Sample rough graded to obtain 110 g or more of each of the following sizes, if possible:
   - 9.5 to 4.75 mm (3/8 in. to No. 4)? _____
   - 4.75 to 2.36 mm (No. 4 to No. 8)? _____
   - 2.36 to 1.18 mm (No. 8 to No. 16)? _____
   - 1.18 to 0.600 mm (No. 16 to No. 30)? _____
   - 0.600 to 0.300 mm (No. 30 to No. 50)? _____
5. If sample contains less than 5% of any specified size, that size not tested? ..... _____
6. Each size sieved a second time to refusal? ..... _____
7. Aggregates sticking in sieve openings discarded? ..... _____
8. 100±0.1 g of each size weighed out and put in separate containers? ..... _____

Coarse Aggregate:

1. Material finer than 4.75 mm (No. 4) removed? ..... _____
2. Aggregate thoroughly washed and dried to constant mass at 110±5°C (230±9°F)? ..... _____
3. By sieving to refusal, sample separated into the following sizes:
   - 63 to 37.5 mm (2 ½to 1 ½ in.)? _____
   - 37.5 to 19.0 mm (1 ½ to 3/4 in.)? _____
   - 19.0 to 9.5 mm (3/4 to 3/8 in.)? _____
   - 9.5 to 4.75 mm (3/8 in. to No. 4)? _____
4. Weight of each fraction present as follows:

| | | | |
|---|---|---|---|
| 63 to 37.5 mm : (2 ½ to 1 ½ in.) | 63 to 50 mm (2 ½ to 2 in.) | 3000±300 g? | _____ |
| | 50 to 37.5 mm (2 to 1½in.) | 2000±200 g? | _____ |
| 37.5 to 19.0 mm : (1 ½ to 3/4 in.) | 37.5 to 25.0 mm (1 ½ to 1 in.) | 1000±50 g? | _____ |
| | 25.0 to 19.0 mm (1 to 3/4 in.) | 500±30 g? | _____ |
| 19.0 to 9.5 mm : (3/4 to 3/8 in.) | 19.0 to 12.5 mm (3/4 to 1/2 in.) | 670±10 g? | _____ |
| | 12.5 to 9.5 mm (1/2 to 3/8 in.) | 330±5 g? | _____ |
| 9.5 to 4.75 mm : (3/8 in. to No. 4) | | 300±5 g? | _____ |

5. If sample contains less than 5% of any specified size, that size not tested? ..... _____

COMMENTS (T104 / C88): (T104 / C88)

**SOUNDNESS OF AGGREGATE BY USE OF SODIUM SULFATE OR MAGNESIUM SULFATE** (T104) _____ **(C88) _____**

PROCEDURE Date: _____

Procedure

1. Salt cake in bottom of solution container broken up and stirred? ..... _____
2. Specific gravity of solution checked? ..... _____
3. Each sample immersed in depth at least 12.5 mm (½ in.) above its top? ..... _____
4. Samples kept immersed for 16 to 18 hours? ..... _____
5. After removal from solution, each sample drained 10 to 20 minutes? ..... _____
6. Dried to constant mass at 110±5°C (230±9°F)? ..... _____
7. Cooled to room temperature [*AASHTO only: 20 to 25°C (68 to 77°F)*]? ..... _____
8. *AASHTO only: Temperature of aggregate checked by thermometer or other acceptable means before placement in sulfate solution?* ..... _____
9. Re-immersed and process continued until required number of cycles is completed? ..... _____

   **Note**, *AASHTO only: If test must be interrupted, samples should be left in oven at 110±5°C until resuming the test.*
10. *AASHTO only: Temperature records from recording unit reviewed to verify solution temperature limits were not exceeded?* ..... _____
11. After final cooling, sample washed by circulating water at 43±6°C (110±10°F) through the samples inside their containers? ..... _____
12. Hot water introduced near bottom and allowed to pass through samples and overflow? ..... _____
13. Impact or abrasion of samples avoided during washing operation? ..... _____
14. Barium chloride used to check completeness of washing? ..... _____

    **Note:** *If barium chloride reacts with lab water, completeness of washing must be determined by other means.*
15. Each fraction dried to constant mass at 110±5°C (230±9°F)? ..... _____
16. Fine Aggregate: Sieved over same sieves used before test and in the same manner (i.e. if hand sieved originally, should be hand sieved at the end)? ..... _____
17. Coarse Aggregate: **Hand** sieved over:

    31.5 mm sieve for 63 to 37.5 mm? _____ (1 1/4 in. sieve for 2 ½ to 1 ½ in.)

    8.0 mm sieve for 19.0 to 9.5 mm? _____ (5/16 in. sieve for 3/4 to 3/8 in.)

    16.0 mm sieve for 37.5 to 19.0 mm? _____ (5/8 in. sieve for 1 ½ to 3/4 in.)

    4.00 mm sieve for 9.5 to 4.75 mm? _____ (No. 5 sieve for 3/8 in. to No. 4)
18. Mass of material retained on each sieve determined? ..... _____

COMMENTS (T104 / C88): (T104 / C88)

**CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATE** (T112) _____
**(C142) _____**

APPARATUS Date: _____

1. Sample containers, rust resistant, shape such that sample can be spread in thin layer on bottom? ..... _____
2. Sieves: 4.75 mm (No. 4), 1.18 mm (No. 16), and other sizes as needed? ..... _____
3. Balance, readable **[*ASTM: accurate*]** to 0.1% of sample mass, or better? ..... _____
4. Oven, maintains 110 ± 5°C (230 ± 9°F)? ..... _____

PROCEDURE

Sample Preparation

1. Samples taken from materials left over from (T11 / C117)? ..... _____
2. Material dried to substantially constant mass at 110 ± 5°C (230 ± 9°F)? ..... _____
3. Fine Aggregate, sample mass at least 25 g, consists of particles coarser than 1.18-mm (No. 16) sieve? ..... _____
4. Coarse Aggregate:
   (a) Consists of particles coarser than 4.75-mm (No. 4)? ..... _____
   (b) Sample mass at least:
   - No. 4 to 3/8 in. 1000 g? ..... _____
   - 3/8 to 3/4 in. 2000 g? ..... _____
   - 3/4 to 1 ½ in. 3000 g? ..... _____
   - Over 1 ½ in. 5000 g? ..... _____

5. Mixtures of Fine and Coarse Aggregate:
   (a) Material separated into two sizes on the 4.75-mm (No. 4) sieve? ..... _____
   (b) Samples prepared in accordance with either fine or coarse aggregate? ..... _____

Procedure:

1. Sample mass determined to 0.1% and spread in thin layer on bottom of container? ..... _____
2. Covered with distilled water and soaked for 20 to 28 hours? ..... _____
3. Particles rolled between thumb and forefinger to attempt to break them? ..... _____
4. Fingernails not used to break particles? ..... _____

5. Residue of friable particles removed by wet sieving as follows:
   (a) Fine aggregate on No. 20? ..... _____
   (b) No. 4 to 3/8 in. on No. 8? ..... _____
   (c) 3/8 to 3/4 in. on No. 4? ..... _____
   (d) 3/4 in. and larger on No. 4? ..... _____

6. Residue from each sieving dried to constant mass at 110 ± 5°C (230 ± 9°F)? ..... _____
7. Mass of residue determined to 0.1%? ..... _____

COMMENTS (T112 / C142): (T112 / C142)

**LIGHTWEIGHT PIECES IN AGGREGATE** (T113) _____
**(C123) _____**

APPARATUS Date: _____

1. Heavy liquid *AASHTO: One of the following.* ***ASTM: A heavy organic liquid with an appropriate specific gravity and that can readily removed from the aggregate such as one of the following:***

   (a) Solution of zinc chloride in water for materials with specific gravity less than 2.0?..... _____

   **or** (b) Solution of zinc bromide in water for material with specific gravity less than 2.6 **[*ASTM: 2.4*]**? ..... _____

   **or** (c) *AASHTO: Mixture of kerosene with 1,1,2,2 tetrabromoethane for materials with specific gravity between 2.4 and 2.95 (**must be used in a fume hood**)?* ..... _____
   ***ASTM: Mixture of heavy organic liquids proportioned to achieve the desired specific gravity (suggested: tetrabromoethane, dibromoethane, 26 tetrachloroethance, or dichloromethane)? ..... _____***

   **Note:** *The chemicals specified in option "c" above are highly toxic – a fume hood, eye protection, and skin protection are needed when working with these chemicals. Zinc chloride and zinc bromide do not have dangerous fumes.*

2. Containers:
   (a) Suitable drying containers?..... _____
   (b) Suitable containers for holding the heavy liquids? ..... _____

3. Specific gravity measurement:
   (a) Suitable device for measuring specific gravity of heavy liquid within ± 0.01:..... _____
   Hydrometer? _____ Pycnometer? _____ Other? _____

4. Skimmer:
   (a) Piece of 300-µm (No. 50) sieve cloth? ..... _____
   (b) Suitable size and shape? ..... _____

5. Hot plate or oven, capable of maintaining temperature of 110±5°C (230±10°F)?..... _____

6. Sieves: 300-µm (No. 50) and 4.75-mm (No. 4)?..... _____

7. Balance:
   *AASHTO: Readable to 0.1% of sample mass, or better?* ..... _____
   ***ASTM: For fine aggregate: Capacity at least 500 g and sensitive to 0.1 g? ..... _____***
   ***For coarse aggregate: Capacity at least 5000 g and sensitive to 1 g? ..... _____***

8. Miscellaneous:
   (a) Hood in good working condition (if kerosene mixture is used)?..... _____
   (b) Protective gloves and goggles?..... _____

COMMENTS (T113 / C123): (T113 / C123)

**LIGHTWEIGHT PIECES IN AGGREGATE** (T113) _____
**(C123) _____**

PROCEDURE Date: _____

Sample Preparation

1. Sample obtained by (T248 / C702)?? ..... _____
2. Minimum sample mass as follows? ..... _____
   *AASHTO: 4.75 mm (No. 4) - 200 g; 19.0 mm (3/4 in.) - 3 kg; 37.5 mm (1 ½ in.) - 5 kg; 75 mm (3 in.) - 10 kg.*
   ***ASTM: 4.75 mm (No. 4) or smaller - 200 g; 9.5 mm (3/8 in.) – 1.5 kg; 12.5 to 19.0 mm (1/2 to 3/4 in.) - 3 kg; 25 to 37.5 mm (1 to 1 1/2 in.) – 5 kg; 50 mm (2 in.) or larger – 10 kg.***
3. Aggregate dried to constant mass at 110±5°C (230±10°F) and cooled to room temperature? ..... _____

Fine Aggregate

1. Sieved on a 300-µm (No. 50) sieve? ..... _____
2. Sieving continued until less than 1% of material on sieve passes in 1 minute of continuous hand sieving? ..... _____
3. Mass of plus 300-µm material determined to nearest 0.1 g? ..... _____
4. Aggregate brought to saturated surface-dry condition by T84/C128*?* ..... _____

   *or* Amount of water that aggregate will absorb added, covered for 30 minutes, and tested? ..... _____

   **Note**, *AASHTO only: If material undergoes degradation in water, it does not have to be in SSD condition.*
5. Sample placed in container holding heavy liquid? ..... _____
6. Volume of heavy liquid at least 3 times the volume of aggregate tested? ..... _____
7. Liquid poured into second container through skimmer? ..... _____
8. Only floating particles decanted? ..... _____
9. Heavy liquid recovered and poured back into starting container? ..... _____
10. Aggregate agitated by stirring? ..... _____
11. Steps 7 through 10 repeated until all floaters are removed? ..... _____
12. Lightweight particles on skimmer washed free of heavy liquid using alcohol (for tetrabromoethane) or water (for zinc chloride or zinc bromide)? ..... _____
13. Lightweight particles allowed to air dry or dried to constant mass at no greater than 115°C (240°F)? ..... _____
14. Mass of lightweight particles determined to nearest 0.1 g? ..... _____
15. Lab says book formulas used in all calculations? ..... _____

Coarse Aggregate

1. Sieved on a 4.75-mm (No. 4) sieve? ..... _____
2. Mass determined to the nearest 1 g? ..... _____
3. Aggregate brought to saturated surface-dry condition by (T85 / C127)? ..... _____

   **Note,** *AASHTO only: If material undergoes degradation in water; it does not have to be in SSD condition.*
4. Sample placed in container holding heavy liquid? ..... _____
5. Volume of heavy liquid at least 3 times the volume of aggregate tested? ..... _____
6. Skimmer used to remove the floating particles and particles saved? ..... _____
7. Aggregate in container agitated? ..... _____
8. All floating particles removed by above process? ..... _____
9. Lightweight particles on skimmer washed free of heavy liquid using appropriate solvent? ..... _____
10. Lightweight particles allowed to air dry or dried to constant mass at no greater than 115°C (240°F)? ..... _____
11. Mass of lightweight particles determined to the nearest 1 g? ..... _____
12. Lab says book formulas used in all calculations? {% Lw = (dry mass of floating / sample mass) * 100} ..... _____

COMMENTS (T113 / C127): (T113 / C127)

**PLASTIC FINES IN GRADED AGGREGATES AND SOILS BY USE OF THE SAND EQUIVALENT TEST** (T176) _____ **(D2419) _____**

APPARATUS Date: _____

1. Graduated plastic cylinders (at least three recommended)? ..... _____
   (a) Outside diameter 38.1 mm (1.5 in.).
   (b) Inside diameter 31.0 – 32.0 mm (1.25 in.).
   (c) Inside height 430 mm (17 in.).
   (d) Graduations at 2.54 mm (0.1 in.), marked up to at least 15 in.
   (e) Rubber stopper that fits cylinder.

2. Satisfactory siphon assembly? ..... _____
   (a) Irrigator tube with an outside diameter 6.4 mm (1/4 in.) and length approximately 510 mm (20 in.).
   (b) Pinched end with No. 60 holes (1.0 mm diameter) drilled in two places on end.

3. Weighted foot assembly, weighs 1000 ± 5 g with a guide fixed to the shaft? ..... _____
   *Note: Older (1969) model of weighted foot assembly with guide cap that fits over upper end of graduated cylinder is acceptable.*

4. Tin measure, diameter approximately 57 mm (2 1/4 in.) and capacity of 85±5 mL? ..... _____

5. Wide-mouth funnel [*AASHTO only: Diameter approx. 100 mm (4 in.)* [*AMRL: 3 to 5 in.*] *at the mouth*]? ..... _____

6. Clock or watch, readable in minutes and seconds? ..... _____

7. Shaker (One of the following):
   ***Note**, AASHTO only: Mechanical shaker required for referee testing. Informational note if mechanical shaker NP.*
   (a) Mechanical
      (1) Operates at 175 ± 2 cycles per **minute** (127 to 135 cycles during testing period)?..... _____
      (2) Securely fastened to firm and level mount? ..... _____
   (b) Manually operated
      (1) Securely fastened to firm and level mount? ..... _____
   (c) Hand method
      (1) Effective method of determining 9 ± 1 in. throw length?..... _____

COMMENTS (T176 / D2419): (T176 / D2419)

**PLASTIC FINES IN GRADED AGGREGATES AND SOILS BY USE OF THE SAND EQUIVALENT TEST** (T176) _____ **(D2419) _____**

APPARATUS (Continued) Date: _____

8. Stock calcium chloride solution (One of the following):
   (a) 454 g (1 lb) technical grade anhydrous calcium chloride, 2050 g (4.515 lb ) USP glycerin, and 47 g (0.10 lb) formaldehyde (40% by volume solution); diluted to 3.78 L (1 gallon) with distilled or demineralized water? ..... _____
   **or** (b) 577 g (1.27 lb) A.C.S. grade calcium chloride dihydrate, 2050 g (4.515 lb) USP glycerin, and 59 g (0.13 lb) 1,5-pentanedial (glutaraldehyde) (50% solution in water); diluted to 3.78 (1 gallon) with distilled or demineralized water? ..... _____
   **or** (c) 577 g (1.27 lb) A.C.S. grade calcium chloride dihydrate, 2050 g (4.515 lb) USP glycerin, and 63 g (0.14 lb) kathon CG/ICP; diluted to 3.78 L (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.***

9. 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 4 L (1 gallon) bottle on shelf 915 ± 25 mm (36 ± 1 in.) **[*ASTM: 90 ± 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 45 in. (91 to 114 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?* ..... _____
   *AASHTO only: Solution discarded if more than 30 days old?* ..... _____
   ***ASTM only: Solution discarded if more than 2 weeks old, and fresh solution not added to old solution (Sections 6.6 to 6.8)***? ..... _____
10. Oven, maintains 110±5°C (230 ± 9°F)? ..... _____

11. Work surface free of vibration and not exposed to direct sunlight? ..... _____

12. 4.75-mm (No. 4) sieve? ..... _____

13. *AASHTO only: Straightedge or spatula?* ..... _____

14. *AASHTO only: Quartering or splitting cloth?* ..... _____

15. ***ASTM only: Flat pan, for mixing?*** ..... _____

COMMENTS (T176 / D2419): (T176 / D2419)

**PLASTIC FINES IN GRADED AGGREGATES AND SOILS BY USE OF THE SAND EQUIVALENT TEST** (T176) _____ **(D2419) _____**

PROCEDURE Date: _____

Sample Preparation

*AASHTO only:*

*1. Sample obtained by T2, pulverized and passed through 4.75-mm (No. 4) sieve?* _____
*2. All fines cleaned from +No. 4 particles and included with -No. 4 material?* _____
*3. Sample split or quartered to yield 500 to 750 g (1.1 to 1.6 lb) of -No. 4 material?* _____

***ASTM only:***

***1. Sampled by D75, 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 +No. 4 lumps pulverized to pass No. 4 sieve?*** _____
***4. All fines cleaned from +No. 4 particles and included with -No. 4 material?*** _____
***5. Sample is at least 1500 g of -No. 4 material?*** _____

Method 1 - Air Dry

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

*AASHTO only:*

1. *Enough -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?* _____

***ASTM only (Procedure A):***

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

Method 2 - Pre-Wet (*AASHTO* and ***ASTM** Procedure **B)***

1. ***ASTM only: Material dampened sufficiently to prevent segregation or loss of fines?*** _____
2. ***ASTM only: 1000 to 1500 g of material split or quartered out?*** _____
3. ***ASTM only: Material mixed thoroughly with hand trowel in circular pan by scooping toward middle of pan while rotating it horizontally?*** _____
4. ***ASTM only: Mixing continued for at least one 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? _____

COMMENTS (T176 / D2419): (T176 / D2419)

**PLASTIC FINES IN GRADED AGGREGATES AND SOILS BY USE OF THE SAND EQUIVALENT TEST** (T176) _____ **(D2419) _____**

PROCEDURE (Continued) Date: _____

Method 2 - Pre-Wet (AASHTO and ***ASTM Procedure B)*** (Continued)

1. *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?*** ..... _____
2. *AASHTO only: When material appears to be homogeneous, mixing finished with sample in a pile near center of cloth?* ..... _____
3. Tin measure pushed through base of pile with free hand against pile opposite the measure? ..... _____
4. Material fills tin to overflowing? ..... _____
5. Material compacted into tin with palm of hand? ..... _____
6. Tin struck off level full with spatula or straightedge **[*ASTM: or with trowel using a sawing motion*]**? ..... _____

*Method 3 – AASHTO only Reference / Referee Method*

1. *AASHTO only: If using referee method (mechanical shaker), sample obtained by either Method 1 or 2, then dried to constant mass at 110±5°C (230 ± 9°F), and cooled to room temperature before testing?* ..... _____

Procedure

1. 101.6±2.5 mm (4±0.1 in.) of working calcium chloride solution siphoned into plastic cylinder? ..... _____
2. 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 (127 to 135 cycles during testing period)? ..... _____

   Manual Shaker Method
   (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 horizontally and shaken vigorously in horizontal linear motion from end to end? ..... _____
   (b) Cylinder shaken 90 cycles (one cycle is a complete back and forth motion) in approx. 30 seconds [AMRL: ± 3 s.], using throw of 229±25 mm (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. (381 mm) 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? ..... _____

COMMENTS (T176 / D2419): (T176 / D2419)

**PLASTIC FINES IN GRADED AGGREGATES AND SOILS BY USE OF THE SAND EQUIVALENT TEST** (T176) _____ **(D2419) _____**

PROCEDURE (Continued) Date: _____

Procedure (Continued)

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? ..... _____
18. Weighted foot assembly gently lowered into cylinder, without hitting mouth of cylinder? ..... _____
19. When foot rests 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 (T176 / D2419): (T176 / D2419)

## AGGREGATE DURABILITY INDEX

(T210) _____
**(D3744) _____**

APPARATUS Date: _____

1. Mechanical washing vessel (pot):
   (a) Flat-bottomed, straight-sided, flared-edge, and cylindrical, approximately 4 liter (2 gallon) capacity?. _____
   (b) Pot is 0.9 mm (20-gage) stainless steel with a gasket that is 3.2-mm (1/8-in.) neoprene rubber? ..... _____
   (c) Three trunk clamps, placed at 1/3 intervals and clamps attached to pot by rivets or welds? ..... _____
   (d) Lid forms watertight seal with flared edge of pot with gasket and lid clamped in place? ..... _____

2. Collection pan:
   (a) Round, with vertical or nearly vertical sides? ..... _____
   (b) *AASHTO: At least 250 mm (10 in.) in diameter and at least 100 mm (4 in.) deep?* ..... _____
   ***ASTM: At least 9 in. (230 mm) in diameter and approximately 4 in. (100 mm) deep?*** ..... _____
   (c) Holds wire mesh of 203.2-mm (8-in.) diameter sieve at least 76 mm (3 in.) above bottom? ..... _____
   **Note:** A sieve frame resting on the bottom of the pan may be used.

3. Agitator, mechanical device capable of lateral reciprocating motion of 285 ± 10 complete cycles/minute with a length of stroke 44.5 ± 0.6 mm (1.75 ± 0.025 in.) **[*ASTM: 45 ± 6 mm*]**? ..... _____
4. All (T176 / D2419) equipment (covered in T176 / D2419 worksheets)? ..... _____
   (a) Method C only: at least two sand equivalent cylinders? ..... _____
5. Sieves: 19.0 mm (3/4 in.), 12.5 mm (½ in.), 9.5 mm (3/8 in.), 4.75 mm (No. 4), 2.36 mm (No. 8), and 1.18 mm (No. 16), and 75 µm (No. 200)? ..... _____
6. Balance, class G2, readable to 0.1g **[*ASTM: GP5, readable to 1 g, min. capacity of 500 g*]**? ..... _____
7. Calcium chloride solutions, stock and working solutions as specified in (T176 / D2419), and for referee testing the temperature of working solution is 22±3°C (72±5°F)? ..... _____
8. Distilled or demineralized water, for referee testing the temperature of water is 22±3°C (72±5°F)? ..... _____
***9. ASTM only: Graduated cylinder, 1000 mL capacity?*** ..... _____

**Note to Assessors:** *It is preferable to observe Procedure A or Procedure C during the on-site assessment.*

SAMPLE PREPARATION

Initial Sample Preparation (all methods)

1. Sample obtained in accordance with (T2 / D75) (Sampling Aggregates)? ..... _____
2. Aggregate dried at temperature not exceeding 60°C (140°F), sufficiently to permit complete separation on 4.75-mm (No. 4) sieve and to develop free-flowing condition in the portion passing the sieve? ..... _____
3. If sample contains appreciable clay, aggregate turned frequently during drying process? ..... _____
4. Hard clods broken up, fine coatings removed from coarse aggregate particles? ..... _____
5. Grading determined by sieving in accordance with (T27 / C136) on 19.0, 12.5, 9.5, 4.75, 2.36 and 1.18-mm (3/4 in., ½ in., 3/8-in., No. 4, No. 8, and No. 16) sieves? ..... _____
6. Material retained on 19.0-mm (3/4-in.) sieve discarded? ..... _____
7. Test Procedure (A, B or C) determined based on grading of aggregate? ..... _____
   (a) If less than 10% aggregate passes 4.75 mm (No. 4), tested by Procedure A only? ..... _____
   (b) If less than 10% aggregate is coarser than 4.75 mm (No. 4), tested by Procedure B only? ..... _____
   (c) If both coarse and fine aggregate fractions are each present in quantities ≥ 10%:
      (1) If percent passing 1.18 mm (No. 16) is greater than 10%, both Procedures A and B used on appropriate aggregate sizes? ..... _____
      (2) If percent passing 1.18 mm (No. 16) is less than or equal to 10%, Procedure A or C used on appropriate aggregate sizes? ..... _____
   (d) If most aggregate (75 - 80%) is between 9.5 and 1.18 mm (3/8 in. and No. 16), tested by Procedure C only? ..... _____

COMMENTS (T210 / D3744): (T210 / D3744)

**AGGREGATE DURABILITY INDEX** (T210) _____
**(D3744) _____**

PROCEDURE A – COARSE AGG Date: _____

Sample Preparation – Coarse Aggregate

1. Preliminary test sample having mass of 2550 ± 25 g (air-dry) prepared using following table? ..... _____

| Aggregate Size | Air-Dry Mass, g |
|---|---|
| 19.0 to 12.5 mm (3/4 to 1/2 in) | 1070 ± 10 |
| 12.5 to 9.5 mm (1/2 to 3/8 in) | 570 ± 10 |
| 9.5 to 4.75 mm (3/8 toNo.4) | 910 ± 5 |

***Note:*** *If material has less than 10% of any size fraction, above masses adjusted to the actual percentage of the original grading, and sizes proportioned accordingly.*

2. *AASHTO only: Sample dried to constant mass at 110±5°C (230±9°F), allowed to cool, and mass recorded?*.... _____
***Note**, AASHTO only: If an adjustment of the test specimen mass or volume of wash and test water, or both, is not required, it is not necessary to oven-dry the test sample prior to the initial wash.*
3. Sample placed in mechanical washing vessel, and 1000 ± 5 mL distilled or demineralized water added? ..... _____
4. Vessel lid clamped in place and vessel secured in sieve agitator?..... _____
5. When all aggregate is not completely inundated by water:
   (a) Material not inundated is washed and added to test sample?..... _____
   (b) Adjusted sample masses and water volumes used in testing when washed material is used? ..... _____
   (c) Bulk, oven-dry specific gravity, and percentage of absorption of aggregate determined in accordance with (T85 / C127)?..... _____
6. Agitation started 60±10 seconds after introduction of wash water? ..... _____
7. Vessel in agitator agitated for 120 seconds (2 minutes) ± 5 seconds?..... _____
8. Vessel removed from agitator, lid unclamped, and contents poured onto 4.75 mm (No. 4) sieve?..... _____
9. Remaining fines from vessel rinsed onto sieve and water (from a flexible hose attached to a faucet) directed onto the aggregate until water passing through the sieve is clear? ..... _____
10. Material retained on 4.75 mm sieve dried to constant mass at 110±5°C (230±9°F) and mass determined?..... _____
11. If loss in mass due to washing is equal to or less than 75 g, skip to Procedure for Coarse Aggregate?..... _____
12. If loss in mass exceeds 75 g:
   (a) Preliminary test sample retained and combined with a second washed sample (by above washing procedure) according to the specified masses to provide the desired test sample?..... _____
   (b) Grading for preliminary test sample determined using the following table – if each of the aggregate sizes listed in following table represents 10% or more of the 19.0 to 4.75-mm (3/4-in. to No. 4) portion, as determined from masses recorded in Step 6 of Initial Sample Preparation (previous page), are following oven-dry masses used in preparing the preliminary test sample? ..... _____

| Aggregate Size | Oven-Dry Mass, g |
|---|---|
| 19.0 to 12.5 mm (3/4 to 1/2 in) | 1050 ± 10 |
| 12.5 to 9.5 mm (1/2 to 3/8 in) | 550 ± 10 |
| 9.5 to 4.75 mm (3/8 to No. 4) | 900 ± 5 |
| Total | 2500 ± 25 |

   (c) 2500 ± 25 g preliminary test sample prepared using the prescribed grading? ..... _____
   (d) Test sample dried to constant mass at 110±5°C (230±9°F)?..... _____
   (e) Preliminary sample mechanically washed as in the same manner as the first specimen?..... _____
   (f) Steps repeated, if necessary, to obtain sufficient material to yield a washed test sample of 2500±25 g and contain each size fraction in quantity specified in table above?..... _____
   (g) After oven-dried material is allowed to cool, washed coarse aggregate separated on 12.5, 9.5 and 4.75-mm (½ in., 3/8-in., and No. 4) sieves?..... _____
   (h) Material passing 4.75-mm (No. 4) sieve discarded?..... _____
   (i) Washed test sample prepared using masses specified in Step (b) above from representative portions of each size of washed material? ..... _____

COMMENTS (T210 / D3744): (T210 / D3744)

**AGGREGATE DURABILITY INDEX** (T210) _____
**(D3744)** _____

PROCEDURE A – COARSE AGG Date: _____

Procedure for Coarse Aggregate

1. Sand equivalent test cylinder placed on work surface free of vibration? ..... _____
2. 7 mL (0.24 oz) of **stock** solution poured into cylinder? ..... _____
3. 4.75 and 75-µm (No. 4 and No. 200) sieves placed in collection pan, with 4.75 mm on top? ..... _____
4. Washed test sample placed in mechanical washing vessel? ..... _____
5. Distilled or demineralized water added, lid clamped in place, and vessel secured in agitator? ..... _____
6. Agitation started 60 seconds after introduction of wash water? ..... _____
7. Vessel agitated for 600 seconds (10 minutes) ±15 seconds, immediately taken from agitator and lid removed? . _____
8. Contents of vessel agitated by moving upright vessel vigorously in horizontal circular motion 5 or 6 times to bring fines into suspension? ..... _____
9. Contents immediately poured over nested 4.75 and 75-µm (No. 4 and No. 200) sieves in collection pan? ..... _____
10. Material retained on 4.75 mm (No. 4) sieve discarded? ..... _____
11. All wash water and material passing 75-µm (No. 200) sieve collected in collection pan? ..... _____
12. To ensure all minus 75-µm material is washed through the sieve:
    (a) Jarring action applied to sieve by lightly bumping side of sieve frame with heel of hand as wash water drains through 75-µm sieve? ..... _____
    (b) When concentration of material is retained on 75-µm sieve, fine material re-rinsed by pouring wash water through sieve again as follows:
        (1) Wash water allowed to stand undisturbed in collection pan for short time to permit heavier particles to settle to bottom? ..... _____
        (2) Upper portion of wash water poured into another container? ..... _____
        (3) Wash water poured back through 75-µm sieve, and all wash water and minus 75-µm material collected in collection pan again? ..... _____
        (4) Washing process repeated until all minus 75-µm material has been washed through the sieve? _____
13. ***ASTM only: Wash water transferred to 1000-mL graduated cylinder?*** ..... _____
14. Distilled or demineralized water added to bring volume of dirty wash water to 1000±5 mL? ..... _____
15. Wash water transferred to container suitable for stirring and pouring? ..... _____
16. Funnel placed in sand equivalent cylinder? ..... _____
17. Wash water stirred by hand to bring fines into suspension? ..... _____
18. While water is still turbulent, enough wash water poured into cylinder to bring level of liquid to 381-mm (15-in.) mark? ..... _____
19. Funnel removed, stopper placed in end of cylinder, and contents mixed immediately? ..... _____
20. Contents mixed by alternately turning cylinder upside down and right side up, allowing bubble to completely traverse the length of the cylinder 20 times in approximately 35 [AMRL: ± 5 s.] seconds? ..... _____
21. Cylinder placed on work table, stopper removed? ..... _____
22. Cylinder allowed to stand undisturbed for 1200 seconds (20 minutes) ±15 seconds? ..... _____
23. Height of sediment column immediately read and recorded to nearest 2.5 mm (0.1 in.)? ..... _____

Calculations for Procedure A – Coarse Aggregate

1. Durability index calculated to nearest whole number using the following equation, or from Table 1 ..... _____

$$D_c = 30.3 + 20.8 \cot (0.29 + 0.15\ H) \text{ for H in inches.}$$

OR

$$D_c = 30.3 + 20.8 \cot (0.29 + 0.0059\ H) \text{ for H in mm.}$$

COMMENTS (T210 / D3744): (T210 / D3744)

**AGGREGATE DURABILITY INDEX** (T210) _____
**(D3744)** _____

PROCEDURE B – FINE AGG Date: _____

Sample Preparation – Fine Aggregate

1. Representative portion of 500±25 g obtained from minus 4.75 mm (No. 4) sieve oven-dry material? ..... _____
2. Preliminary test sample dried to constant mass at 110±5°C (230±9°F) and cooled to room temp.?..... _____
3. Sample placed in mechanical washing vessel and 1000±5 mL distilled or demineralized water added? ..... _____
4. Vessel lid clamped in place and vessel secured in agitator?..... _____
5. Agitation started 600 seconds (10 minutes) ±30 seconds after introduction of wash water?..... _____
6. Vessel agitated for 120 seconds (2 minutes) ±5 seconds, vessel removed from agitator, and lid unclamped? ..... _____
7. Contents poured over 4.75 and 75-µm (No. 4 and No. 200) sieve nest?..... _____
8. Any remaining fines rinsed from vessel onto sieve using water (from flexible hose attached to faucet) directed onto the aggregate until water passing through sieve is clear?..... _____
9. If clayey or silty samples need to be flooded prior to pouring them over the sieve (to prevent clogging of the 75-µm (No. 200) sieve), flooded by adding water to vessel following agitation period? ..... _____
10. After rinsing, material transferred from sieve to drying pan? ..... _____
11. Pan left in slanted position until clear water can be decanted? ..... _____
12. Large shallow pans used and sample spread as thin as possible to speed drying? ..... _____
13. Sample dried to constant mass at 110±5°C (230±9°F)?..... _____
14. After oven-dried material allowed to cool, sufficient amount of washed material split or quartered to fill 85-mL (3-oz.) measuring tin to overflowing? ..... _____
15. Bottom of tin tapped on hard surface while filling?..... _____
16. Tin struck off level full using straightedge?..... _____
17. ***ASTM only: Mass of the material determined?*** ..... _____

Procedure for Fine Aggregate (Procedure B)

1. Procedure followed for Sand Equivalent Test (T176 / D2419), except agitator used to continuously shake cylinder and contents for 600 seconds (10 minutes) ±15 seconds? ..... _____

Calculation for Procedure B – Fine Aggregate

1. Durability index calculated to nearest 0.1 using the following equation: ..... _____

$$D_f = \frac{\text{sand reading}}{\text{clay reading}} \times 100$$

2. If $D_f$ is not a whole number, is it reported as next higher whole number? ..... _____
3. If average series of values are desired, are whole number values averaged?..... _____
4. If average of whole number values is not a whole number, rounded to next higher whole number? ..... _____

COMMENTS (T210 / D3744): (T210 / D3744)

**AGGREGATE DURABILITY INDEX** (T210) _____
**(D3744) _____**

PROCEDURE C – Not Fine Not Coarse AGG Date: _____

Sample Preparation – Not Fine Not Coarse Aggregate

1. Sample contained between the 9.5 and 1.18-mm (3/8-in. and No 16) sieves? ..... _____
2. Sample preparation followed as in Procedure B (Fine Aggregate)? ..... _____

Procedure for Not Fine Not Coarse Aggregate

1. Sand equivalent cylinder filled to 102.0±2.5 mm (4±0.1 in.) level with distilled or demineralized water? ..... _____
2. Prepared test sample poured into cylinder using funnel, avoiding spillage? ..... _____
3. Bottom of cylinder tapped sharply with heel of hand? ..... _____
4. Cylinder allowed to stand undisturbed for 10±1 minutes? ..... _____
5. Stopper placed on cylinder, material loosened from bottom, and cylinder placed in mechanical sand equivalent shaker? ..... _____
6. Contents agitated for 30±1 minutes? ..... _____
7. Water and passing 75-µm (No. 200) material transferred to another cylinder as follows:
   (a) 7 mL **stock** calcium chloride solution added to an empty second cylinder? ..... _____
   (b) Nos. 8 and 200 sieves nested into a funnel that empties into the second cylinder? ..... _____
   (c) Cylinder containing specimen and water held inverted over the nested sieves (with stopper in place)? _____
   (d) Stopper removed and contents poured over sieves? ..... _____
   (e) Remaining fines rinsed from first cylinder onto sieves with small amount of fresh distilled water? ..... _____
   (f) Material retained on the sieves rinsed with additional fresh distilled water until all minus 75-µm material passes through the sieve? ..... _____
   (g) Care taken not to fill the second cylinder above the 380-mm (15-in.) mark? ..... _____
   (h) Fresh distilled water added to bring level of liquid to 380-mm (15-in.) mark? ..... _____
8. Stopper placed on second cylinder and contents mixed by inverting 20 times in 35 seconds? ..... _____
9. Cylinder allowed to stand undisturbed for 1200 seconds (20 minutes) ±15 seconds? ..... _____
10. Top of clay suspension read to nearest 2.5 mm (0.1 in.)? ..... _____

Calculation for Procedure C – Not Fine Not Coarse Aggregate

1. Durability index calculated to nearest whole number using the following equation, or from Table 1? ..... _____

$$D_c = 30.3 + 20.8 \cot (0.29 + 0.15\ H) \text{ for H in inches.}$$

OR

$$D_c = 30.3 + 20.8 \cot (0.29 + 0.0059\ H) \text{ for H in mm.}$$

COMMENTS (T210 / D3744): (T210 / D3744)

**REDUCING SAMPLES OF AGGREGATE TO TESTING SIZE** (T248) _____
**(C702) _____**

PROCEDURE Date: _____

Selection of Method

1. Fine aggregate, drier than saturated surface-dry – use Method A (Splitter)? ..... _____
2. Fine aggregate, with free moisture present – use Method B (Quartering) or Method C (Miniature Stockpile)? .. _____
3. Coarse Aggregate or Mixture of coarse and fine – use Method A (Splitter) or Method B (Quartering)? ..... _____

**Note:** If Method B or C is desired but sample does not have free moisture present, sample may be moistened and thoroughly mixed before sample reduction.
**Note:** If moist sample is very large, preliminary split may be made using wide chute openings 38 mm (1 ½ in.) or larger to reduce sample to at least 5 kg. That portion should then be dried before sample reduction by Method A.

Observe one of the following methods:

Method A – Splitting

1. Material spread uniformly on feeder? ..... _____
2. For fine aggregate (< 3/8 in.), maximum chute width is ¾ in. (19 mm)? ..... _____
3. For coarse aggregate, minimum chute width is at least 50% bigger than maximum particle size? ..... _____
4. Rate of feed slow enough so that sample flows freely through chutes? ..... _____
5. Material in one pan re-split until desired weight is obtained? ..... _____

Method B - Quartering

1. Sample placed on clean, hard, and level surface? ..... _____
   **Note:** *The sample may be placed upon a canvas quartering cloth or tear resistant tarp and a stick or pipe may be placed under the cloth to divide the pile into quarters.*
2. Mixed by turning over at least 3 times with shovel or by raising canvas or tarp and pulling over pile? ..... _____
3. Thoroughly mixed conical pile formed? ..... _____
4. Pile flattened to uniform thickness and diameter? ..... _____
5. Diameter about 4 to 8 times thickness? ..... _____
6. Divided into 4 equal portions with shovel or trowel? ..... _____
   **Note to assessors:** *The two unused quarters can be used for other testing.*
7. Two diagonally opposite quarters, including all fine material, removed? ..... _____
8. Cleared space between quarters brushed clean? ..... _____
9. Process continued until desired sample size is obtained? ..... _____

Method C - Miniature Stockpile Sampling (Fine Aggregate Only)

1. Sample placed on clean, hard, and level surface? ..... _____
2. Material thoroughly mixed by turning over three times? ..... _____
3. Small stockpile formed? ..... _____
4. At least 5 grab samples taken at random with sampling thief, small scoop, or spoon? ..... _____

COMMENTS (T248 / C702): (T248 / C702)

**TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING** (T255) _____
**(C566) _____**

APPARATUS Date: _____

1. Heat source:
   (a) Ventilated oven, maintains 110±5°C (230±9°F)? ..... _____
   **or** (b) If close temp control is not required: hot plate, heat lamp, or ventilated microwave oven? ..... _____

2. Sample containers, not affected by heat source, of sufficient volume to hold samples, and has a shape so that the depth of the sample does not exceed 1/5 of least lateral dimension? ..... _____

3. Stirrer, metal spoon or spatula of convenient size? ..... _____

4. Balance, readable to 0.1% of sample mass **[*ASTM: test load*]**, or better? ..... _____

PROCEDURE

1. Representative test sample obtained with mass conforming to the following table? ..... _____

| No. 4 | 3/8 in. | ½ in. | 3/4 in. | 1 in. | 1 ½ in. | 2 in | 2 ½ in. |
|---|---|---|---|---|---|---|---|
| 0.5 kg | 1.5 kg | 2 kg | 3 kg | 4 kg | 6 kg | 8 kg | 10 kg |

2. Mass determined to the nearest 0.1%? ..... _____
3. Loss of moisture avoided prior to determining the mass? ..... _____
4. Sample dried by a suitable heat source? ..... _____
5. If heated by means other than a controlled temperature oven, is sample stirred to avoid localized overheating? (Stirring optional for microwave use) ..... _____
6. Sample dried to constant mass and mass determined to nearest 0.1%? ..... _____
7. Moisture content calculated by following equation?: ..... _____

$$\% \text{ moisture} = \frac{\text{original sample mass - dried sample mass}}{\text{dried sample mass}} \times 100$$

**Note**: If hot plate is used, denatured alcohol may be used to burn off moisture.

COMMENTS (T255 / C566): (T255 / C566)

**UNCOMPACTED VOID CONTENT OF FINE AGGREGATE** (T304) _____
**(C1252) _____**

APPARATUS Date: _____

1. Cylindrical measure, approximately 100-mL capacity:
   (a) Volume calculated to nearest 0.1 mL [AMRL: calibrated capacity is 99.0 mL to 101.0 mL]? ..... _____
   (b) Inside diameter approximately 39 mm, inside height approximately 86 mm? ..... _____
   (c) Made of drawn copper water tube, bottom at least 6 mm thick and firmly sealed to tubing? ..... _____
   (d) Bottom provided with means for aligning axis of cylinder with axis of funnel? ..... _____
   (e) Calibrated according to Section 8 with freshly boiled, deionized water at 18 to 24°C? ..... _____

2. Funnel, lateral surface of right frustum of a cone sloped 60±4° from the horizontal:
   (a) Made of metal, smooth on inside and at least 38 mm high? ..... _____
   (b) Opening diameter 12.7±0.6 mm? ..... _____
   (c) At least 200 mL capacity or provided with supplemental glass or metal container to increase volume? _____
   **Note:** *Pycnometer top C9455 is satisfactory for funnel section, except size of opening has to be enlarged and any apparent burrs or lips should be removed by filing or sanding. Pycnometer top must be used with suitable glass jar with bottom removed.*

3. Funnel stand, 3 or 4 legged and holds funnel firmly in position:
   (a) Aligns funnel with axis of cylindrical measure (within a 4° angle and a displacement of 2 mm)? ..... _____
   (b) Funnel opening 115±2 mm above top of cylinder? ..... _____

4. Glass plate for calibration of measure, at least 4 mm thick, approximately 60 by 60 mm? ..... _____

5. Flat metal or plastic pan, of sufficient size to contain the funnel stand and to prevent loss of material when filling the measure, and sufficiently flat to remain steady during testing? ..... _____

6. Metal spatuala, straight edged:
   (a) Straight edge of blade approximately 100 mm long [AMRL: 3 to 6 in. long] and at least 20 mm wide? _____
   (b) End cut at right angle to edges? ..... _____

7. Scale or balance, accurate and readable to ±0.1 g ..... _____

COMMENTS (T304 / C1252): (T304 / C1252)

**UNCOMPACTED VOID CONTENT OF FINE AGGREGATE** (T304) _____
**(C1252) _____**

PROCEDURE Date: _____

Sampling

1. Sample obtained by splitting and quartering (C702), sieve analysis (C136), or from an extraction sample?..... _____

2. Methods A and B:
   (a) Sample washed over 150-μm (No. 100) or 75-μm (No. 200) sieve in accordance with C117?..... _____
   (b) Sample dried and sieved into separate size fractions in accordance with C136?..... _____
   (c) Size fractions maintained in a dry condition in separate containers for each size? ..... _____

3. Method C: A split of the as-received sample dried in accordance with the drying procedure of C136?..... _____

Sample Preparation

1. Method A - Standard Graded Sample: Aggregate combined according to the following table?..... _____

| Method A - Individual Size Fractions | Mass, g | OK? |
|---|---|---|
| 2.36 to 1.18 mm (No. 8 to No.16) | 44 ± 0.2 | |
| 1.18 mm to 600 μm (No. 16 to No. 30) | 57± 0.2 | |
| 600 to 300 μm (No. 30 to No. 50) | 72 ± 0.2 | |
| 300 to 150 μm (No. 50 to No. 100) | 17 ± 0.2 | |
| Total | 190 ± 0.8 | |

2. Method B - Individual Size Fractions: 3 separate 190-g samples of aggregate tested (see table)?..... _____

| Method B - Individual Size Fractions | Mass, g | OK? |
|---|---|---|
| 2.36 to 1.18 mm (No. 8 to No. 16) | 190 ± 1 | |
| 1.18 mm to 600 μm (No. 16 to No. 30) | 190 ± 1 | |
| 600 to 300 μm (No. 30 to No. 50) | 190 ± 1 | |

**Note:** *These size fractions are tested separately. They should not be mixed during testing.*

3. Method C – As Received Grading
   (a) Sample (dried in accordance with C136) passed through 4.75-mm (No. 4) sieve? ..... _____
   (b) A 190±1-g sample of material passing the 4.75-mm sieve obtained?..... _____

COMMENTS (T304 / C1252): (T304 / C1252)

**UNCOMPACTED VOID CONTENT OF FINE AGGREGATE** (T304) _____
**(C1252)_____**

PROCEDURE (Continued) Date: _____

Specific Gravity of Fine Aggregate

1. If bulk dry specific gravity of aggregate from the source is unknown, specific gravity determined on material passing 4.75-mm (No. 4) sieve in accordance with C128? ..... _____
2. This value used in subsequent calculations unless some size fractions differ by more than 0.05 from the specific gravity typical of the completed sample (in which case the specific gravity of the fraction(s) being tested must be determined)? ..... _____
3. If specific gravity differences exceed 0.05:
   (a) Specific gravity of the individual 2.36-mm (No. 8) to 150-µm (No. 100) sizes determined for use with Method A or the individual size fractions for use with Method B? ..... _____
   (b) Specific gravity determined by direct measurement or by calculation using specific gravity data on gradings with and without the size fraction of interest? ..... _____

Procedure

1. Each test sample mixed with spatula until it appears to be homogeneous? ..... _____
2. Jar and funnel section positioned in stand and cylindrical measure centered? ..... _____
3. Finger used to block opening of funnel while test sample is poured into funnel? ..... _____
4. Material in funnel leveled with spatula? ..... _____
5. Finger removed and sample allowed to fall freely into cylindrical measure? ..... _____
6. Excess heaped aggregate rapidly struck off from cylindrical measure by a single pass of spatula? ..... _____
7. Spatula used with the blade width vertical and using the straight part of its edge in light contact with **[*ASTM: both sides of*]** the top of the measure? ..... _____
8. Care used to avoid any disturbance that could cause compaction of aggregate into cylindrical measure? ..... _____
   **Note:** *After strike-off, measure may be tapped lightly to make it easier to transfer without spilling any of the sample.*
9. Adhering grains brushed from outside of container? ..... _____
10. Mass of cylindrical measure and contents determined to nearest 0.1 g? ..... _____
11. All aggregate particles retained and recombined for second test run? ..... _____
12. Sample from retaining pan and cylindrical measure recombined and procedure repeated? ..... _____
13. Mass of empty measure recorded? ..... _____

Calculations

1. Uncompacted voids for each determination calculated as follows: ..... _____

$$U = \frac{V - (F/G)}{V} \times 100$$

where:
V = volume of cylindrical measure, mL
F = mass of aggregate in measure
G = bulk dry specific gravity of aggregate
U = uncompacted voids in material, %

2. For Methods A and C, average uncompacted voids determined? ..... _____
3. For Method B, average uncompacted voids for each size fraction determined and mean determined? ..... _____

COMMENTS (T304 / C1252): (T304 / C1252)

**RESISTANCE OF COARSE AGGREGATE TO DEGRADATION BY ABRASION (T327) _____**
**IN THE MICRO-DEVAL APPARATUS (COARSE AGGREGATE) (D6928) _____**

APPARATUS Date: _____

1. Micro-Deval Abrasion Machine, a jar rolling mill similar to Fig 1, capable of running at 100 ± 5 rpm? ..... _____

2. Micro-Deval abrasion jars:
   (a) Stainless steel, 5 L capacity, with a rubber ring in the rotary locking cover? ..... _____
   (b) External diameter of 194 to 202 mm and internal height of 170 to 177 mm? ..... _____
   (c) Inside and outside surfaces smooth and have no observable ridges or indentations? ..... _____

3. Abrasive Charge,
   (a) A total charge of 5000 ± 5 g presented for use in an abrasion jar? ..... _____
   (b) Magnetic steel balls, 9.5 ± 0.5 mm in diameter? (Measure at least 10 balls)..... _____

| 9.5 ± 0.5 mm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Diameter ok? | | | | | | | | | | |

4. Sieves, 19.0 mm (3/4 in.), 16.0 mm (5/8 in.), 12.5 mm (1/2 in.), 9.5 mm (3/8 in.), 6.3 mm (1/4 in.), 4.75 mm (No. 4), and 1.18 mm (No. 16)?..... _____
5. Oven, maintains 110 ± 5°C? ..... _____
6. Balance, accurate to 1.0 g?..... _____

*AASHTO USE OF REFERENCE AGGREGATE*

*Supplies*
*1. Reference aggregate, mean loss between 15 to 25 %?* ..... _____

*Reference Aggregate Procedure*
*1. 10 initial samples of reference aggregate taken at random and tested?*..... _____
*2. Mean loss and sample standard deviation determined from the 10 initial samples?*..... _____
*3. One reference aggregate sample tested for every 10 normal samples tested, but at least one reference sample tested in every week in which a regular sample is tested?*..... _____
*4. For continued acceptance, individual test results of reference aggregate falls within ±2 standard deviations of the established mean percent loss 95% of the time?* ..... _____
*5. If the results fall outside of this range, is an investigation into the cause conducted?* ..... _____
*6. Percent loss of last 20 samples of calibration aggregate plotted on trend chart?*..... _____

**Note:** *After 10 weekly samples of reference aggregate are plotted, the interval may be increased to one reference sample per month.*

***ASTM CALIBRATION***

***Calibration Supplies***
***1. Brechin Quarry No. 2 aggregate, test data falls between 17.5 to 20.7 % loss for 95 % of the time?***..... _____
***Note:*** *Brechin Quarry No. 2 aggregate is not currently available for purchase. The AASHTO Accreditation Program (AAP) has approved the use of Drain Brothers aggregate as a substitute for Brechin Quarry No. 2 aggregate until the test method is revised to specify an available reference aggregate.*
***2. Calibration Aggregate, mean loss between 15 to 25 %?*** ..... _____

***Calibration Procedure***
***1. 10 samples of calibration aggregate taken at random and tested?*** ..... _____
***2. 10 samples of Brechin Quarry No. 2 aggregate tested?*** ..... _____
***3. If Brechin Quarry No. 2 aggregate mean loss and variation are within allowed tolerance, the mean value obtained with the supply of in-house calibration aggregate used thereafter?*** ..... _____
***4. Calibration procedure conducted for new supplies of calibration aggregate, batched according to Section 8?*** _____
***5. Control sample tested every 10 samples, but at least every week in which a sample is tested?*** ..... _____
***6. Percent loss of last 20 samples of calibration aggregate plotted on trend chart?*** ..... _____

COMMENTS (T327 / D6928): (T327 / D6928)

**RESISTANCE OF COARSE AGGREGATE TO DEGRADATION BY ABRASION (T327) _____**
**IN THE MICRO-DEVAL APPARATUS (COARSE AGGREGATE) (D6928) _____**

SAMPLE PREPARATION Date: _____

Sample Preparation

1. Test Sample washed and oven-dried to constant mass at 110±5°C?..... _____
2. Sample separated into individual size fractions in accordance with Test Method (T27 / C136)?..... _____
3. For material passing the 19.0 mm (3/4 in.) sieve:

Table A

| Passing | Retained | Mass | OK? |
|---|---|---|---|
| 19.0-mm (3/4 in.) | 16.0-mm (5/8 in.) | 375g | |
| 16.0-mm (5/8 in.) | 12.5-mm (1/2 in.) | 375g | |
| 12.5-mm (1/2 in.) | 9.5-mm (3/8 in.) | 750g | |
| Total | | 1500 ± 5g | |

4. In a case where the nominal maximum size of the coarse aggregate is: less than 12.5 mm (1/2 in.):

Table B

| Passing | Retained | Mass | OK? |
|---|---|---|---|
| 12.5-mm (1/2 in.) | 9.5-mm (3/8 in.) | 750g | |
| 9.5-mm (3/8 in.) | 6.3-mm (1/4 in.) | 375g | |
| 6.3-mm (1/4 in.) | 4.75-mm (No. 4) | 375g | |
| Total | | 1500 ± 5g | |

5. In a case where the nominal maximum size of the coarse aggregate is less than 9.5 mm (3/8 in.):

Table C

| Passing | Retained | Mass | OK? |
|---|---|---|---|
| 9.5-mm (3/8 in.) | 6.3-mm (1/4 in.) | 750g | |
| 6.3-mm (1/4 in.) | 4.75-mm (No. 4) | 750g | |
| Total | | 1500 ± 5g | |

**Note to assessors – The 6.3-mm sieve may be replaced with a 6.7-mm sieve if desired.**

COMMENTS (T327 / D6928): (T327 / D6928)

**RESISTANCE OF COARSE AGGREGATE TO DEGRADATION BY ABRASION (T327) _____**
**IN THE MICRO-DEVAL APPARATUS (COARSE AGGREGATE) (D6928) _____**

PROCEDURE Date: _____

Procedure

1. Prepared sample weighed to nearest 1 g? ..... _____
2. Sample immersed in 2.0 ± 0.05 L of tap water either in Micro-Deval container or other suitable device? ..... _____
3. Temperature of tap water 20 ± 5°C and immersed for a minimum of 1 hour? ..... _____
4. Sampled placed in Micro-Deval abrasion container with 5000 ± 5 g of steel balls and the same water used to saturate the sample? ..... _____
5. Cover installed and Micro-Deval container placed on the machine? ..... _____
6. If machine is capable of recording total number of revolutions, machine run at 100 ± 5 rpm:
   (a) For 12,000 ± 100 revolutions for grading in Table A above? ..... _____
   (b) For 10,500 ± 100 revolutions for grading in Table B above? ..... _____
   (c) For 9,000 ± 100 revolutions for grading in Table C above? ..... _____
7. If machine is not capable of recording total number or revolutions, machine run at 100 ± 5 rpm:
   (a) For 2 h ± 1 min for grading in Table A above? ..... _____
   (b) For 105 min ± 1 min for grading in Table B above? ..... _____
   (c) For 95 min ± 1 min for grading in Table C above? ..... _____
8. Sample and steel balls carefully poured over a 4.75-mm (No. 4) nested on a 1.18-mm (No. 16) sieve? ..... _____
9. Care taken to remove entire sample from the stainless steel jar? ..... _____
10. Retained material washed and manipulated using a held hand water hose and hand? ..... _____
11. Washed until all washing are clear and all material smaller than 1.18-mm (No. 16) passes that sieve? ..... _____
12. Stainless steel balls removed using a magnet or other suitable means? ..... _____

or ***ASTM only: Preferred method – sample and charge dried to constant mass before removal of charge? ..... _____***

13. Material retained on the nest of sieves combined, with care taken not to lose any material? ..... _____
14. Sample dried to constant mass at 110 ± 5°C and weighed to nearest 1 g? ..... _____
15. Micro-Deval abrasion loss calculated as follows? ..... _____

$$\text{Percent Loss} = (A - B) / A * 100$$

where:
A = Initial sample mass
B = Final sample mass

COMMENTS (T327 / D6928): (T327 / D6928)

**DETERMINING THE PERCENTAGE OF FRACTURED PARTICLES IN COARSE AGGREGATE** (T335) _____ **(D5821) _____**

APPARATUS Date: _____

1. Balance, accurate and readable to within 0.1% of sample mass? _____
2. Sieves, conforming to M92 / E11? _____
3. Sample splitter, as specified in T248 / C702? _____

PROCEDURE

Sample Preparation (AASHTO Method 1 and ASTM)

1. Aggregate sampled in accordance with T2 / D75 and reduced in accordance with T248 / C702? _____
2. Sample dried sufficiently to obtain clean separation of fine and coarse material in sieving operation? _____
3. Sample sieved over the 4.75-mm (No. 4) sieve, or other specified sieve, in accordance with T27 / C136? _____
4. Portion retained on sieve reduced to appropriate size for test using splitter (T248 / C702)? _____
5. *AASHTO Method 1: Minimum mass of sample is as indicated in the table below (or slightly more than listed to account for additional mass that will be lost in washing procedure)?* _____
   ***ASTM: Minimum mass of sample is as indicated in the table below OR at least large enough so that the largest particle is not more than 1% of the sample mass (whichever amount is smaller)?*** _____

***6. (Optional) ASTM only optional additional procedure***
***For aggregate with nominal maximum size of 19.0 mm (3/4 in.) or larger, where the fracture particle content is to be determined for material retained on the 4.75-mm (No. 4) or smaller sieve:***

- ***(a) Sample separated on the 9.5-mm (3/8-in.) sieve?*** _____
- ***(b) Portion passing 9.5-mm (3/8-in.) sieve further reduced by C702, to a minimum of 200 g (0.5 lb)?*** _____
  ***Note:*** *This will reduce the number of particles to be separated during the procedure.*
- ***(c) Percent fractured particles determined on each portion?*** _____
- ***(d) Weighted average percentage of fractured particles calculated based on mass of each of the portions to reflect total percentage of fractured particles in the entire sample?*** _____

*Sample Preparation (AASHTO Method 2 – Individual size fractions)*

*1. Aggregate sampled in accordance with T2 and reduced in accordance with T248?* _____
*2. Sample dried sufficiently to obtain clean separation of fine and coarse material in sieving operation?* _____
*3. Sample meets on of the following:*
   *(a) A previously washed sample from the gradation determination (T11 and T27)?* _____
   *(b) Aggregate is sieved according T27 over the sieves listed in the specification for the material?* _____
*4. Representative portion from each sieve selected by splitting or quartering to size specified in table below?* _____

| *AASHTO* | *Method 1* | *AASHTO* | *Method 2* | ***ASTM*** | |
|---|---|---|---|---|---|
| Nominal maximum particle size | Minimum mass g (lb) | Nominal maximum particle size mm (in.) | Minimum mass g (lb) | Nominal maximum particle size mm (in.) | Minimum mass g (lb) |
| 37.5 (1 ½) | 2500 (6) | 31.5 (1 ¼) | 1500 (3.5) | 9.5 (3/8) | 200 (0.5) |
| 25.0 (1) | 1500 (3.5) | 25.0 (1) | 1000 (2.2) | 12.5 (½) | 500 (1) |
| 19.0 (3/4) | 1000 (2.2) | 19.0 (3/4) | 700 (1.5) | 19.0 (3/4) | 1500 (3) |
| 12.5 (1/2) | 700 (1.5) | 16.0 (5/8) | 500 (1.0) | 25.0 (1) | 3000 (6.5) |
| 9.5 (3/8) | 400 (0.9) | 12.5 (1/2) | 300 (0.7) | 37.5 (1 ½) | 7500 (16.5) |
| 4.75 (No. 4) | 200 (0.5) | 9.5 (3/8) | 200 (0.5) | 50.0 (2) | 15,000 (33) |
| | | 6.3 (1/4) | 100 (0.2) | 63.0 (2 ½) | 30,000 (66) |
| | | 4.75 (No. 4) | 100 (0.2) | 75.0 (3) | 60,000 (132) |
| | | 2.36 (No. 8) | 25 (0.1) | 90.0 (3 ½) | 90,000 (198) |
| | | 2.00 (No. 10) | 25 (0.1) | | |

COMMENTS (T335 / D5821): (T335 / D5821)

**DETERMINING THE PERCENTAGE OF FRACTURED PARTICLES IN COARSE AGGREGATE** (T335) _____ **(D5821)** _____

APPARATUS Date: _____

*AASHTO Procedure*

1. *Fractured face defined as follows?* ..... _____
   - (a) *An angular, rough, or broken surface of an aggregate particle.*
   - (b) *Face considered fractured if one-half or more of the projected area is fractured.*
   - (c) *Fractured face has sharp and well-defined edges (excluding small nicks).*
2. *Fractured particle defined as a particle having at least the minimum number of fractured faces specified (typically 1 or two fractured faces are required, depending on specification)?* ..... _____
3. *Sample dried and cooled on a clean flat surface large enough to permit careful inspection of each particle?* .... _____
4. *Particle held so that the face is viewed directly (normal to the surface of the face)?* ..... _____
5. *Sample separated into three categories to aid in making the fracture determination?* ..... _____
   - (a) *Group 1 - fractured particles meeting the above criteria.*
   - (b) *Group 2 - particles not meeting specification criteria.*
   - (c) *Group 3 - questionable or borderline particles.*
6. *Mass of particles in each of the three categories determined?* ..... _____
7. *If on any of the determinations more than 15 percent of the total mass of the sample is placed in the questionable category, is the determination repeated until no more than 15 percent is present in that category?* _____
8. *Mass percentage of the fracture faces calculated to the nearest 1 percent according to the following equation?* _____

$$P = [ (F + Q/2) / (F+Q+N) ] \times 100$$

***ASTM Procedure***

1. ***Fractured face defined as follows?*** ..... _____
   - (a) ***An angular, rough, or broken surface of an aggregate particle.***
   - (b) ***Face considered fractured if one-fourth or more of the maximum projected area is fractured.***
   - (c) ***Fractured face has sharp or slightly blunt edges (excluding small nicks).***
2. ***Fractured particle defined as a particle having at least the minimum number of fractured faces specified (typically 1 or two fractured faces are required, depending on specification)?*** ..... _____
3. ***Sample washed over sieve designated for determination of fractured particles and dried to constant mass?*** .. _____
4. ***Mass of test sample, and any subsequent masses, determined to nearest 0.1% of original dry sample mass?*** . _____
5. ***Dried sample spread on clean flat surface large enough to permit careful inspection of each particle?*** ..... _____
6. ***Particle held so that face is viewed directly?*** ..... _____
7. ***Particles separated into two categories, (1) particles meeting the criteria for the required number of fractured faces, (2) particles that do not meet the requirements?*** ..... _____
8. ***If required number of fractured faces is not specified, minimum of one fracture face used?*** ..... _____
9. ***Mass or count of particles in each of the two categories determined (use mass if not specified)?*** ..... _____
10. ***If more than one number of fractured faces is specified (for example, 70% with one or more fractured faces and 40% with two or more fractured faces), procedure repeated on the same sample for each requirement?*** _____
11. ***Mass percentage or count percentage of particles with specified number(s) of fractured faces reported to nearest 1% in accordance with the following equation?*** ..... _____

$$P = [ F / (F + N) ] \times 100$$

COMMENTS (T335 / D5821): (T335 / D5821)

**RESISTANCE TO DEGRADATION OF LARGE-SIZE COARSE AGGREGATE BY ABRASION AND IMPACT IN THE LOS ANGELES MACHINE (C535)**

APPARATUS Date: _____

1. Los Angeles machine (Serial No. _____ )
   - (a) Horizontal cylindrical drum, inside diameter 711±5 mm (28±0.2 in.), inside length 508±5 mm (20±0.2 in.), and wall thickness 12.7 mm (1/2 in.)? ..... _____
   - (b) Opening in drum side about 508 x 152 mm (20 in. x 6 in.)? ..... _____
   - (c) Cover for opening has dust-tight gasket and is securely fastened to drum? ..... _____

   Interior Shelf requirements:
   - (d) Shelf projects inward 89±2 mm (3.5±0.1 in.) or 152 x 102 x 12.7 mm (6 x 4 x ½in.)? ..... _____
   - (e) Interior surface of the cylinder free of protrusions disrupting the path of sample and steel spheres (except for the shelf)? ..... _____
   - (f) Shelf firm, rigid, and in good physical condition? ..... _____
   - (g) Shelf extends [*AASHTO only: to within 5 mm (0.2 in.) of*] full length of the cylinder? ..... _____
   - (h) Shelf located such that the charge does not impact near the opening and its cover? ..... _____
   - (i) Distance from shelf to the opening is 1270 mm (50 in.) or more in the direction of rotation? ..... _____

   Rotation requirements:
   - (j) Uniform peripheral speed ( ± 1.5 RPM from the average suggested)? ..... _____
   - (k) Cylinder rotates at 30 to 33 revolutions per minute over 5 minutes period? ..... _____

   Counter reading (Start): _____ Counter reading (End): _____
   Elapsed time (minutes and seconds): _____ Elapsed time (seconds): _____
   Average speed = 60 * (# of revolutions) / time in seconds: _____ RPM

2. Charge:
   - (a) Number of spheres tested: _____ Number of spheres having a mass of 390-445 g: _____
   - (b) Mass of charge: 12 balls = 4975 to 5025 g? ..... _____

3. Sieves, 1.70 mm (No. 12) and other sizes as needed? ..... _____

4. Balance, accurate to 0.1% of test load? ..... _____

5. Oven, maintains 110 ± 5°C (230 ± 9°F)? ..... _____

COMMENTS (C535): (C535)

**RESISTANCE TO DEGRADATION OF LARGE-SIZE COARSE AGGREGATE BY ABRASION AND IMPACT IN THE LOS ANGELES MACHINE (C535)**

PROCEDURE Date: _____

1. Sample obtained by C702?..... _____
2. Sample washed and oven-dried to constant mass at 110±5°C (230±9°F)? ..... _____
3. Mass determined to nearest 1.0 g? ..... _____
4. Specimen masses conform to the table below? ..... _____

| SIEVE SIZE | GRADING 1 | GRADING 2 | GRADING 3 |
|---|---|---|---|
| 3 to 2 ½ in | 2500 ± 50 g | | |
| 2 ½ to 2 in | 2500 ± 50 g | | |
| 2 to 1 ½ in | 5000 ± 50 g | 5000 ± 50 g | |
| 1 ½ to 1 in | | 5000 ± 25 g | 5000 ± 25 g |
| 1 to 3/4 in | | | 5000 ± 25 g |
| | | | |
| Total Mass | 10,000 ± 100 g | 10,000 ± 75 g | 10,000 ± 50 g |

5. Sample and spheres put in machine and tumbled 1000 times? ..... _____
   **Note:** *Loss after 200 revolutions may be determined, and then <u>entire</u> sample returned to drum for final 800 revolutions.*
6. Contents of drum separated on a sieve coarser than a 1.70 mm (No. 12)? ..... _____
7. Finer material separated on a No. 12 sieve?..... _____
8. Material coarser than No. 12 washed and dried to constant mass at 110±5°C (230±9°F)? (**See Note**) ..... _____
   **Note:** *If material is essentially free of adherent coatings and dust, the requirement for washing is optional. For referee testing, the washing procedure must be performed.*
9. Mass of material coarser than No. 12 determined to nearest 1 g? ..... _____
10. Percentage of wear calculated as: % wear = (original - final mass) / original mass?..... _____

COMMENTS (C535): (C535)

## FLAT PARTICLES, ELONGATED PARTICLES, OR FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATE (D4791)

### APPARATUS

Date: _____

1. Proportional caliper device,
   (a) Similar to Figures 2 or 3 of the test method? ..... _____
   **Note:** *Other devices may also be acceptable if they can be verified using a machined block, micrometer, etc*
   (b) Ratio settings verified on the proportional caliper using a machined block, micrometer, etc? ..... _____

2. Balance, accurate to 0.5% of sample mass? ..... _____
   **Note to assessors:** *accurate to 5 g for smallest sample size, a G20 / GP10.*

3. Oven, maintains 110 ± 5°C (230 ± 9°F) [if determination by mass is required]? ..... _____

### PROCEDURE

Sample Preparation

1. Sample mixed and reduced in accordance with C702 to approximately the amount required for testing? ..... _____
2. Test sample mass when dry conforms to following table? ..... _____

**Table of minimum sample masses for D4791**

| 9.5 mm (3/8 in.) | 12.5 mm (1/2 in.) | 19.0 (3/4 in.) | 25.0 mm (1 in.) | 37.5 mm (1.5 in.) | 50 mm (2 in.) |
|---|---|---|---|---|---|
| 1 kg (2 lb) | 2 kg (4 lb) | 5 kg (11 lb) | 10 kg (22 lb) | 15 kg (33 lb) | 20 kg (44 lb) |
| | | | | | |
| 63 mm (2.5 in.) | 75 mm (3 in.) | 90 mm (3.5 in.) | 100 mm (4 in.) | 125 mm (5 in.) | 150 mm (6 in.) |
| 35 kg (77 lb) | 60 kg (130 lb) | 100 kg (220 lb) | 150 kg (330 lb) | 300 kg (660 lb) | 500 kg (1100 lb) |

3. Reduction to exact predetermined mass not permitted? ..... _____

COMMENTS (D4791): (D4791)

**FLAT PARTICLES, ELONGATED PARTICLES, OR FLAT AND ELONGATED PARTICLES IN COARSE AGGREGATE (D4791)**

PROCEDURE (Continued) Date: _____

Procedure

1. If determination by mass, sample oven-dried to constant mass at 110±5° C (230±9° F)? _____
   **Note:** *If determination is by particle count, drying is not necessary.*
2. Sample sieved according to C136? _____
3. Using material retained on 9.5 mm (3/8 in.) or 4.75 mm (No. 4), as required, each size fraction present in amount of 10% or more of original sample reduced according to C702 until approximately 100 particles obtained for each size fraction required? _____
4. Size fractions containing less than 10% by mass of the original total sample not tested (can be discarded)? _____

***Terminology Note:*** *Length is defined as the biggest dimension of the particle. Thickness is the small dimension of the particle. Length > Width > Thickness or L > W > T*

**Method A**

1. Each particle in each size fraction tested and placed in one of four groups: (1) Flat, (2) Elongated, (3) meeting the requirements of groups 1 and 2, and (4) neither Flat nor Elongated? _____
2. Proportional caliper device positioned at proper ratio? _____
3. **Flat particles** determined by setting larger opening equal to particle width? _____
4. Particle is flat if thickness can be placed in the smaller opening? _____
   ***Example:*** *At a ratio of 2:1 an AASHTO test method book is flat.* $W >> T$
5. **Elongated particles** determined by setting larger opening equal to particle length? _____
6. Particle is elongated if width can be placed within the smaller opening? _____
   ***Example:*** *At a ratio of 2:1 a pencil or ballpoint pen is elongated.* $L >> W$
7. Proportion of sample in each group determined by count or by mass, as required? _____

**Method B – for Superpave**

1. Each particle in each size fraction tested and placed into one of two groups: (1) Flat & Elongated or (2) not Flat & Elongated? _____
2. Proportional caliper device positioned at proper ratio? _____
3. Larger opening set equal to particle length? _____
4. Particle is flat and elongated if the thickness can be placed in the smaller opening? _____
   ***Example:*** *At a ratio of 2:1 a ruler is flat & elongated.* $L >> T$
5. Proportion of sample in each group determined by count or by mass, as required? _____

Calculation

1. Percent particles in each category calculated to nearest 1% for each sieve size tested? _____
2. Report shows original gradation of aggregate sample, number/mass of particles tested for each sieve size, percent particles in each category, and dimension ratio used? _____

COMMENTS (D4791): (D4791)

**SPECIFIC GRAVITY AND ABSORBTION OF FINE AGGREGATE USING INFRARED** **(D7172)**

APPARATUS Date: _____

1. Large neck volumetric flask, capacity 500-mL? ..... _____
2. Automatic Volumetric Mixer:
   (a) Orbital mixer capable of holding a 500 mL volumetric flask? ..... _____
   (b) Clamp and clamping rod capable of securely holding the neck of the flask? ..... _____
   (c) Vacuum pump capable of removing entrapped air? ..... _____
   (d) Hose and stopper capable of joining the vacuum pump and mouth of the flask? ..... _____
3. Infrared Unit:
   (a) Capable of detecting saturated surface-dry (SSD) condition using an infrared sourced and detector?... _____
   (b) Calibrated monthly? (Record S/N:_____ and check records) ..... _____
   (c) Consists of an orbital mixer, water pump, infrared source, infrared detector, and mixing bowl?..... _____
   (d) Lid for mixing bowl, consists of two sapphire lenses and an injection nozzle? ..... _____
4. Distilled Water? ..... _____
5. Thermometer:
   (a) Range of 0 to 50°C (0° to 122°F)? ..... _____
   (b) Readable to 0.5°C (1°F)? ..... _____
6. Balance, readable to within 0.1% of the test sample mass at any point within the range of use? ..... _____
7. Timer, capable of measuring at least 5 minutes? ..... _____

CALIBRATION

Calibration of Water Pump:

1. Calibration performed monthly? ..... _____
2. Infrared device filled with distilled water? ..... _____
3. Mass of empty water-collection container determined? ..... _____
4. Water-collection container positioned to minimize splashing? ..... _____
   **Note**: *Placing the container under the nozzle in the lid is a good way to minimize splashing.*
5. Manufacturers' instructions followed to determine the number of injections into the test flask (usually 3000 total injections)? ..... _____
6. Mass of water-collection container determined? ..... _____
7. Mass of water injected determined by subtracting mass of empty container from mass of full container? ..... _____

Calibration of Infrared Unit:

1. Calibration performed monthly? ..... _____
2. Infrared water unit full? ..... _____
3. Unit turned on and allowed to warm up per manufacturers' instructions? ..... _____
4. Initiate calibration routine per manufacturers' instructions? ..... _____
5. 500.0 g (no tolerance) of Ottawa Silica sand inserted into mixing bowl? ..... _____
6. After calibration, unit displays results? ..... _____
7. Silica sand dried to constant mass at 110 ± 5°C (230 ± 9°F) and stored for future calibrations? ..... _____

COMMENTS (D7172): (D7172)

**SPECIFIC GRAVITY AND ABSORBTION OF FINE AGGREGATE USING INFRARED** **(D7172)**

PROCEDURE Date: _____

Sampling Procedure:

1. Sample obtained by C702? ..... _____
2. Approximately 1.5 kg ± 10 g of fine aggregate obtained? ..... _____
3. Dried to constant mass at 110 ± 5°C (230 ± 9°F)? ..... _____
4. Allowed to cool to 23 ± 2.0°C (73 ± 3°F)? ..... _____
5. Sample split into two 500 ± 5 g samples? ..... _____
6. Excess sample discarded? ..... _____

Film Coefficient Determination:

1. Approximately 250-mL of water at 23 ± 2.0°C (73 ± 3°F) placed in calibrated pycnometer? ..... _____
2. Pycnometer placed on balance and zeroed? ..... _____
3. Approximately 500.0 ± 0.1 g sample transferred to pycnometer with water and mass determined? ..... _____
4. Water in pycnometer completely covers the sample but does not overflow or exceed calibration line? ..... _____
5. Sample allowed to stand for 5 minutes? ..... _____
   **Note**: *Paper towel or isopropyl alcohol may be used to remove air bubbles if necessary.*
6. Pycnometer filled with 23 ± 2.0°C (73 ± 3°F) water to the calibration mark? ..... _____
7. Mass determined to the nearest 0.1 g? ..... _____
8. Pycnometer with rubber stopper inserted in AVM unit? ..... _____
9. Mixer agitates pycnometer for three minutes, then the vacuum pump engages at a level of 56 cm (22 in.) Hg for another 3 minutes, and last 5 minutes engages at a level of 69 cm (27 in.) Hg (automatic setting)? ..... _____
10. AVM unit stops automatically when testing is complete (approximately 11 minutes)? ..... _____
11. Isopropyl alcohol or paper towel used to remove air bubbles? ..... _____
12. Pycnometer filled to calibration mark with water and mass determined? ..... _____
13. Proper book formulas used to calculate film coefficient? ..... _____

Specific Gravity and Percent Absorption Determination:

1. Infrared unit allowed to warm up for 30 minutes? ..... _____
2. Sample weighing 500 ± 0.1 g placed into the bowl and the mass determined? ..... _____
3. Bowl with aggregate placed in infrared unit with the notch in front aligned with metal mounting plate? ..... _____
4. Ring on the bowl fastened by pressing down and turning the ring one quarter turn until tight? ..... _____
5. Lid closed and latched with notch lined up in front of the bowl? ..... _____
6. Reservoir unit full of distilled water? ..... _____
7. Film coefficient entered? ..... _____
8. After the test, film coefficient on display compared with the measured film coefficient for the material? ..... _____
9. Mass of the bowl immediately determined after removing the lid? ..... _____
10. Percent absorption determined? ..... _____
11. Lab says proper book formulas used in calculations? ..... _____

COMMENTS (D7172): (D7172)

**RELATIVE DENSITY AND ABSORPTION OF AGGREGATE USING VACUUM SATURATION AND RAPID SUBMERSION** **(D7370) _____**

APPARATUS Date: _____

Balance, readable and accurate to 0.1 g, equipped with a suitable apparatus for suspending the sample in water? ..... _____

Water Bath:

1. Equipped with an overflow outlet? ..... _____
2. Sample completely submerged when suspended? ..... _____
3. Maintains temperature of 25 ± 1°C (77 ± 2°F)? ..... _____
4. Square: Length of 610 mm by Width of 460 mm (18 in.) by Depth of 460 mm (24 x 18 x 18 in square)? ..... _____

**or** Cylindrical: Minimum diameter and minimum depth of 460 mm (18 in.)? ..... _____

Sample holder:

1. Having no sharp edges, for displacement of the sample? ..... _____

Vacuum Chamber:

1. Equipped with a pump capable of evacuating chamber to 6 mm Hg (at sea level)? ..... _____
2. Automatically seals bag? ..... _____
3. Exhausts air back into chamber in a controlled manner to ensure plastic conforms to specimen? ..... _____
4. Air exhaust and vacuum operation time set at factory prior to initial use? ..... _____

Vacuum Measurement Gauge:

1. Independent of the vacuum sealing device? ..... _____
2. Capable of being placed directly inside chamber to verify vacuum performance and sealing of unit? ..... _____
3. Capable of reading pressure down to 3 mm Hg? ..... _____
4. Readable to ± 1 mm Hg? ..... _____

Plastic Bags:

1. Made of puncture-resistance plastic, impermeable to water, minimum thickness of 0.127 mm (0.005 in.)? ..... _____
2. Apparent specific gravity of bags provided by the manufacturer? ..... _____
3. One of the following sizes used:
   (a) Smaller bags: Opening in bag 235 – 260 mm (9.25 – 10.25 in.)? ..... _____
   (b) Larger bags: Opening in bag 375 – 394 mm (14.75 – 15.5 in.)? ..... _____

Small Metal Pycnometer (for testing fine aggregate):

1. Inner diameter of 137 ± 0.2 mm (5.375 ± 0.008 in.)? ..... _____
2. Height of 89 ± 0.40 mm (3.5 ± 0.016 in.)? ..... _____
3. Machined smooth on all surfaces? ..... _____
4. Inside of lid machined at 5° angle to create an inverted conical surface? ..... _____
5. Equipped with a graduated temperature strip to monitor temperature during testing? ..... _____
6. Lid has a 3 mm (1/8 in.) hole on its surface? ..... _____
7. Equipped with a fixture for holding and securing lid in place and equipped with a leveling indicator? ..... _____

Large Metal Pycnometer (for testing coarse and blended aggregate):

1. Inner diameter of 198 ± 0.2 mm (7.776 ± 0.008 in.)? ..... _____
2. Height of 114 ± 0.8 mm (4.5 ± 0.03 in.)? ..... _____
3. Machined smooth on all surfaces? ..... _____
4. Inside of lid machined at 5° angle to create an inverted conical surface? ..... _____
5. Equipped with a graduated temperature strip to monitor temperature during testing? ..... _____
6. Lid as a 3 mm (1/8 in.) hole on its surface? ..... _____

COMMENTS (D7370): (D7370)

**RELATIVE DENSITY AND ABSORPTION OF AGGREGATE USING VACUUM SATURATION AND RAPID SUBMERSION** **(D7370) _____**

APPARATUS (Continued) Date: _____

Accessories:

1. Knife or scissors for cutting plastic bags? _____
2. Spray bottle filled with isopropyl alcohol? _____
3. A bucket large enough to allow the pycnometer to be fully submerged in water? _____
4. Water containers to dispense water during testing? _____
5. Syringe with a needle no larger than 3 mm (0.125 in.)? _____
6. Small paint brush? _____
7. Metal spatula 25 ± 5 mm (1 ± 0.2 in.) wide? _____

Rubber Sheets:

1. For protecting plastic bags against sharp edges of the aggregate sample? _____
2. Apparent specific gravity provided by the manufacturer? _____
3. Thermometric device, for monitoring temperature to within ± 1°C (± 1.8°F)? _____

VERIFICATION

System Standardization:

1. Vacuum settings of chamber verified every 12 months, after major repairs, and after shipment / relocation? _____
2. Vacuum measurement gauge placed inside vacuum chamber? _____
3. Setting recorded while vacuum is operating? _____
4. Gauge indicates a pressure of 6 mm Hg (6 TORR) or less? _____
5. Unit not used if gauge reads above 6 mm? _____
6. Vacuum Measurement Gauge, standardized for accuracy once a year? _____

**Note:** *In-line vacuum gauges are not suitable for use in enclosed chambers and shall not be used.*

Calibration of Small and Large Pycnometer:

1. Pycnometer re-calibrated before each day of use? _____
2. Pycnometer conditioned to 25 ± 1°C (77 ± 2°F) by placing inside a bucket of water maintained at that temp.? _____
3. *Small Pycnometer:* Lid-holding fixture leveled during conditioning (using attached or separate level ok)? _____
4. Pycnometer removed from water bucket and dried with a towel? _____
5. *Small Pycnometer:* Pycnometer placed in the fixture and pushed back until contact is made with the stops? _____
6. *Large Pycnometer:* Pycnometer set on a level surface? _____
7. Pycnometer filled with water at 25 ± 1°C (77 ± 2°F) to approximately 10 mm (0.375 in.) from the top? _____
8. Surface of the water sprayed with isopropyl alcohol spray bottle to remove bubbles? _____
9. Lid gently placed on pycnometer (*Small Pycnometer:* and fixture clamps closed)? _____
10. Syringe filled with water at 25 ± 1°C (77 ± 2°F)? _____
11. Pycnometer filled through the large fill hole on the lid post with the syringe? _____
12. Syringe tip kept below the water level while filling? _____
13. Formation of air bubbles avoided? _____
14. Pycnometer filled until water comes out of the 3 mm hole on the lid? _____
15. Any remaining water on the top of the lid wiped with a towel? _____
16. Pycnometer (*Small Pycnometer:* Entire Fixture) placed on the scale and the mass recorded to nearest 0.1 g? _____
17. Pycnometer cleaned and calibration repeated two more times? _____
18. Average of three calibration masses obtained? _____
19. *Small Pycnometer:* Range of three calibration masses is within 0.5 g? _____
20. *Large Pycnometer:* Range of three calibration masses is within 1 g? _____
21. If the range of calibration masses is not within 0.5 g (*small pycnometer*) or 1 g (*large pycnometer*), steps taken to ensure that the calibration is done correctly? _____
22. Calibration repeated until 0.5 g (*small pycnometer*) or 1 g (*large pycnometer*) requirement is met? _____

COMMENTS (D7370): (D7370)

**RELATIVE DENSITY AND ABSORPTION OF AGGREGATE USING VACUUM SATURATION AND RAPID SUBMERSION** **(D7370) _____**

SAMPLE PREPARATION Date: _____

Fine Aggregate Samples (Method A):

1. Sample thoroughly mixed before reducing? ..... _____
2. Reduced to one 1000 ± 5 g (for apparent density) and two 500 ± 3 g samples (for bulk density)? ..... _____
3. Reduction done in accordance with ASTM C702? ..... _____

Coarse Aggregate Samples (Method B):

1. Aggregate dried to constant mass at 110 ± 5°C (230 ± 9°F)? ..... _____
2. Thoroughly mixed before reducing? ..... _____
3. Reduced to one 2000 ± 10 g (for apparent density) and two 1000 ± 10 g samples (for bulk density)? ..... _____
4. Reduction done in accordance with ASTM C702? ..... _____
5. If the sample is tested in two or more size fractions, sample is graded in accordance with ASTM C136? ..... _____
6. Grading must include the sieves used for separating the size fractions? ..... _____

**Method A** (Fine Aggregate) - PROCEDURE

**Method A, Fine Aggregate** - Bulk Density Determination:

1. Water temperature maintained at 25 ± 1°C (77 ± 2°F) throughout bulk and apparent density determination? ..... _____
2. Pycnometer conditioned to 25 ± 1°C (77 ± 2°F) by placing inside a bucket of water maintained at that temp.? . _____
3. Samples dried to constant mass and allowed to cool to room temperature? ..... _____
4. Pycnometer removed from water bucket and dried with a towel? ..... _____
5. Pycnometer placed in the fixture and pushed back until contact is made with the stops? ..... _____
6. A 500 ± 3 g sample at 25 ± 1°C (77 ± 2°F) weighted and mass recorded? ..... _____
7. Approximately 500 mL of water (halfway full) placed in pycnometer? ..... _____
8. Sample slowly and evenly poured into the pycnometer? ..... _____
9. Care taken to ensure that aggregate is not lost in the filling process? ..... _____
10. Brush used to sweep away any remaining fines into the pycnometer, if necessary? ..... _____
11. If any aggregate is lost during the filling process, is the test started over? ..... _____
12. Metal spatula pushed to the bottom of the pycnometer against the circumference? ..... _____
13. Spatula slowly and gently dragged to the center of the pycnometer and removed after reaching center? ..... _____
14. Steps 10 & 11 repeated 7 more times (8 times total) around the sample in 45° increments until the start point is reached? ..... _____
15. Squeeze water bottle used to rinse sample residue off of the spatula and into the sample, if necessary? ..... _____
16. Pycnometer filled with water to approximately 10 mm (0.375 in.) from the rim of the container? ..... _____
17. Surface of the water sprayed with isopropyl alcohol spray bottle to remove bubbles? ..... _____
18. Lid gently placed on pycnometer and fixture clamps closed? ..... _____
19. Syringe filled with water at 25 ± 1°C (77 ± 2°F)? ..... _____
20. Pycnometer filled through the large fill hole on the lid post with the syringe? ..... _____
21. Syringe tip kept below the water level while filling? ..... _____
22. Formation of air bubbles avoided? ..... _____
23. Pycnometer filled until water comes out of the 3 mm hole on the lid? ..... _____
24. Any remaining water on the top of the lid wiped with a towel? ..... _____
25. Entire fixture, including pycnometer, placed on the scale and the mass recorded to nearest 0.1 g? ..... _____
26. Procedure repeated with a second 500 ± 3 g sample? ..... _____
27. Average masses calculated for all determinations made for the duplicate samples? ..... _____

COMMENTS (D7370): (D7370)

**RELATIVE DENSITY AND ABSORPTION OF AGGREGATE USING VACUUM SATURATION AND RAPID SUBMERSION** **(D7370) _____**

**Method A** (Fine Aggregate) – PROCEDURE (continued) Date: _____

**Method A, Fine Aggregate** - Apparent Density Determination:

1. Pressure level set on vacuum device according to manufacturer's instructions? ..... _____
2. Small plastic bag inspected for holes, stress points, or side seal discontinuities (discarded if bag is damaged)? . _____
3. Plastic bag mass recorded?..... _____
4. The 1000 ± 5 g sample of oven dried aggregate mass recorded and sample placed in bag?..... _____
5. Bottom of the bag supported by a smooth tabletop while pouring to prevent puncture and impact?..... _____
6. The bag containing sample placed in vacuum chamber? ..... _____
7. Sample spread flat by grabbing the bag from two sides and shaking gently? ..... _____
8. Pressing down on the sample from outside of the bag avoided?..... _____
9. If the aggregate sample contains a large amount of minus 75-µm (No. 200) material, sample lightly misted to keep dust down during sealing? ..... _____
10. Open end of the bag placed over the seal bar in the chamber? ..... _____
11. Chamber door closed and vacuuming and sealing process begins? ..... _____
12. After sealing, chamber door opened and sample removed? ..... _____
13. Sample immediately submerged into the water tank? ..... _____

    **Note:** *It is extremely important the sample be submerged immediately after vacuum sealing to prevent air from slowly entering the bag. This can result in low apparent density results.*
14. One corner of the plastic bag, approximately 25 to 50 mm (1 to 2 in.), cut from one side? ..... _____
15. Bag is completely submerged at least 2 in. below water surface while cutting the bag? ..... _____
16. Cut portion of bag held open for 45 seconds to allow water to freely enter? ..... _____
17. Any small residual air bubbles allowed to escape? ..... _____
18. Shaking and squeezing the sample avoided (may cause fines to escape)?..... _____
19. Second corner of the bag cut and any residual air bubbles removed by running fingers across the top the bag? . _____
20. Bag placed in weighing basket in the water? ..... _____
21. If bag is folded to place it in the basket, is the bag unfolded to allow water to freely flow into the sample once it is in the basket?..... _____
22. Sample and bag kept underwater at all times? ..... _____
23. Care is taken to ensure that the bag and sample are not touching the bottom or sides of the tank, or floating out of the water tank?..... _____
24. Sample allowed to stay in the water bath for a minimum of 15 minutes?..... _____
25. Underwater mass of sample and bag recorded to nearest 0.1 g?..... _____
26. Data entered into PC using manufacturer's software or equations given in method? ..... _____

COMMENTS (D7370): (D7370)

**RELATIVE DENSITY AND ABSORPTION OF AGGREGATE USING VACUUM SATURATION AND RAPID SUBMERSION** **(D7370) _____**

**Method B** (Coarse or Combined Aggregate) - PROCEDURE Date: _____

**Method B, Coarse and Combined Aggregate Samples** - Bulk Density Determination

1. Water temperature maintained at 25 ± 1°C (77 ± 2°F) throughout bulk and apparent density determination? _____
2. Pycnometer conditioned to 25 ± 1°C (77 ± 2°F) by placing inside a bucket of water maintained at that temp.? _____
3. Samples dried to constant mass and allowed to cool to room temperature? _____
4. Pycnometer removed from water bucket and dried with a towel? _____
5. A 1000 ± 10 g sample at 25 ± 1°C (77 ± 2°F) weighted and mass recorded? _____
6. Approximately 1000 mL of water (halfway full) placed in pycnometer? _____
7. Sample slowly and evenly poured into the pycnometer? _____
8. Care taken to ensure that aggregate is not lost in the filling process? _____
9. Brush used to sweep away any remaining fines into the pycnometer, if necessary? _____
10. If any aggregate is lost during the filling process, is the test started over? _____
11. Metal spatula pushed to the bottom of the pycnometer against the circumference? _____
12. Spatula slowly and gently dragged to the center of the pycnometer and removed after reaching center? _____
13. Steps 10 to 11 repeated 7 more times (8 times total) around the sample in 45° increments until the start point is reached? _____
14. Squeeze water bottle used to rinse sample residue off of the spatula and into the sample, if necessary? _____
15. Pycnometer filled with water to approximately 10 mm (0.375 in.) from the rim of the container? _____
16. Surface of the water sprayed with isopropyl alcohol spray bottle to remove bubbles? _____
17. Lid gently placed on pycnometer? _____
18. Syringe filled with water at 25 ± 1°C (77 ± 2°F)? _____
19. Pycnometer filled through the large fill hole on the lid post with the syringe? _____
20. Syringe tip kept below the water level while filling? _____
21. Formation of air bubbles avoided? _____
22. Pycnometer filled until water comes out of the 3 mm hole on the lid? _____
23. Any remaining water on the top of the lid wiped with a towel? _____
24. Pycnometer placed on the scale and the mass recorded to nearest 0.1 g? _____
25. Procedure repeated with a second 1000 ± 10 g sample? _____
26. Average masses calculated for all determinations made for the duplicate samples? _____

**Method B, Coarse and Combined Aggregate Samples** - Apparent Density Determination

1. Pressure level set on vacuum device according to manufacturer's instructions? _____
2. One small plastic bag and one large plastic bag selected, inspected for holes, stress points, or side seal discontinuities, and any defective bags discarded? _____
3. Both plastic bags weighed and the mass recorded? _____
4. Two rubber sheets weighed and the mass recorded? _____
5. Mass of the 2000 ± 10 g sample of oven dried aggregate recorded and sample placed in small bag? _____
6. Bottom of the bag supported by a smooth tabletop while pouring to prevent puncture and impact? _____
7. Large bag placed in the vacuum chamber? _____
8. Rubber sheet placed inside large plastic bag? _____
9. Rubber sheet is flat, centered, and pushed all the way to the back of the bag? _____
10. Small plastic bag containing sample placed into large plastic bag on top of rubber sheet? _____
11. Sample manually spread inside small plastic bag? _____

COMMENTS (D7370): (D7370)

**RELATIVE DENSITY AND ABSORPTION OF AGGREGATE USING VACUUM SATURATION AND RAPID SUBMERSION** **(D7370) _____**

PROCEDURE (Continued) Date: _____

**Method B, Coarse and Combined Aggregate Samples** - Apparent Density Determination (Continued)

12. If the aggregate sample contains a large amount of minus 75-µm (No. 200) material, sample lightly misted to keep dust down during sealing? ..... _____
13. Another rubber sheet placed on top of small bag, inside large bag? ..... _____
14. Is the small bag completely contained within the area between the two rubber sheets? ..... _____
15. Open end of the large bag placed over the seal bar in the chamber? ..... _____
16. Rubber sheets are not over the seal bar? ..... _____
17. Chamber door closed and vacuuming and sealing process begins? ..... _____
18. Chamber door opened and sample removed? ..... _____
19. Sample immediately submerged into the water tank? ..... _____
    **Note:** *It is extremely important the sample be submerged immediately after vacuum sealing to prevent air from slowly entering the bag. This can result in low apparent density results.*
20. One corner of the large plastic bag, approximately 70 to 100 mm (3 to 4 in.), cut from one side? ..... _____
21. Bags are completely submerged below water surface while cutting the bag? ..... _____
22. Cut portion of large bag held open for 25 seconds to allow water to freely enter? ..... _____
23. Any small residual air bubbles allowed to escape? ..... _____
24. Second corner of the large bag cut? ..... _____
25. Any residual air bubbles removed by running fingers across the top the large bag? ..... _____
26. Bags placed in weighing basket in the water? ..... _____
27. If bag is folded to place it in the basket, is the bag unfolded to allow water to freely flow into the sample once it is in the basket? ..... _____
28. Sample and bag kept underwater at all times? ..... _____
29. Care is taken to ensure that the bag and sample are not touching the bottom or sides of the tank, or floating out of the water tank? ..... _____
30. Sample allowed to stay in the water bath for a minimum of 20 minutes? ..... _____
31. Underwater mass of sample and bags recorded to nearest 0.1 g? ..... _____
32. Data entered into PC using manufacturer's software or equations given in method? ..... _____

COMMENTS (D7370): (D7370)

**RESISTANCE OF COARSE AGGREGATE TO DEGRADATION BY ABRASION (D7428) _____**
**IN THE MICRO-DEVAL APPARATUS (FINE AGGREGATE)**

APPARATUS Date: _____

1. Micro-Deval Abrasion Machine, a jar rolling mill similar to Fig 1, capable of running at 100 ± 5 rpm? ..... _____

2. Micro-Deval abrasion jars:
   (a) Stainless steel, 5 L capacity, with a rubber ring in the rotary locking cover? ..... _____
   (b) External diameter of 194 to 202 mm and internal height of 170 to 177 mm? ..... _____
   (c) Inside and outside surfaces smooth and have no observable ridges or indentations? ..... _____

3. Abrasive Charge,
   (a) A total charge of at least 1250 ±5 g presented for use in an abrasion jar? ..... _____
   (b) Magnetic steel balls, 9.5 ± 0.5 mm in diameter? (Measure at least 10 balls)..... _____

| 9.5 ± 0.5 mm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Diameter ok? | | | | | | | | | | |

**Note:** *It is recommended that separate containers be used to test fine aggregate than those used to test coarse aggregate.*

4. Sieves, 6.3-mm (1/4 in.), 4.75-mm (No. 4), 2.36-mm (No. 8), 1.18-mm (No. 16), 600-µm (No. 30), 300-µm (No. 50), 150-µm (No. 100), 75-µm (No. 200)?..... _____
   **Note:** *A 6.7-mm sieve may be used in place of a 6.3-mm sieve.*
5. Oven, maintains 110 ± 5°C? ..... _____
6. Balance, accurate to 0.1 g?_____

CALIBRATION

Calibration Supplies

1. Standard Sutherland Micro-Deval Fine Aggregate (material prepared according to table)? ..... _____

| Passing | Retained | Mass | OK? |
|---|---|---|---|
| 4.75-mm (No. 4) | 2.36-mm (No. 8) | 40g | |
| 2.36-mm (No. 8) | 1.18-mm (No. 16) | 115g | |
| 1.18-mm (No. 16) | 600-µm (No. 30) | 180g | |
| 600-µm (No. 30) | 300-µm (No. 50) | 120g | |
| 300-µm (No. 50) | 150-µm (No. 100) | 38g | |
| 150-µm (No. 100) | 75-µm (No. 200) | 7g | |

2. Calibration Aggregate, mean loss between 15 to 25 %? ..... _____

Calibration Procedure

1. 10 samples of calibration aggregate taken at random and tested?..... _____
2. 10 samples of Standard Sutherland Micro-Deval Fine aggregate tested? ..... _____
3. If Standard Sutherland Micro-Deval Fine aggregate mean loss and variation within the range of 15.2 to 18.4% loss 95% of the time, the mean value obtained with the supply of in-house calibration agg. used thereafter?.....
4. Calibration procedure conducted for new supplies of calibration aggregate, batched according to Section 8?.... _____
5. Control sample tested every 10 samples, but at least every week in which a sample is tested? ..... _____
6. Percent loss of last 20 samples of calibration aggregate plotted on trend chart? ..... _____

COMMENTS (D7428): (D7428)

**RESISTANCE OF COARSE AGGREGATE TO DEGRADATION BY ABRASION (D7428) _____**
**IN THE MICRO-DEVAL APPARATUS (FINE AGGREGATE)**

PROCEDURE Date: _____

Sample Preparation

1. Test Sample washed over 75-µm sieve and oven-dried to constant mass at 110±5°C? ..... _____
2. Sample separated into individual size fractions in accordance with ASTM: C136? ..... _____
3. Sample prepared as follows:

| Passing | Retained | Mass | OK? |
|---|---|---|---|
| 4.75-mm (No. 4) | 2.36-mm (No. 8) | 50g | |
| 2.36-mm (No. 8) | 1.18-mm (No. 16) | 125g | |
| 1.18-mm (No. 16) | 600-µm (No. 30) | 125g | |
| 600-µm (No. 30) | 300-µm (No. 50) | 100g | |
| 300-µm (No. 50) | 150-µm (No. 100) | 75g | |
| 150-µm (No. 100) | 75-µm (No. 200) | 25g | |
| Total | | 500 ± 5 g | |

**Note:** *It may be practical to test material without preparing for the above grading for routine quality control purposes.*

Procedure

1. Prepared sample weighed to nearest 0.1 g? ..... _____
2. Sample immersed in 0.75 ± 0.05 L of tap water either in Micro-Deval container or other suitable device? ..... _____
   (a) Temperature of tap water 20 ± 5°C? ..... _____
   (b) Immersed for a minimum of 1 h? ..... _____
3. Sample placed in Micro-Deval abrasion container? ..... _____
   (a) With 1250 ± 5 g of steel balls? ..... _____
   (b) Also with the same water used to saturate the sample? ..... _____
4. Cover installed and Micro-Deval container placed on the machine? ..... _____
5. If machine is capable of recording total number of revolutions:
   (a) Machine run at 100 ± 5 rpm for 1500 ±10 revolutions? ..... _____

***or*** If machine is not capable of recording total number or revolutions:

   (a) Machine run at 100 ± 5 rpm for 15 min ± 5 seconds? ..... _____
6. Sample and steel balls carefully poured over a 6.3-mm (1/4 in.) sieve into a suitable container? ..... _____
   *Note: A 6.7-mm sieve may be used instead of a 6.3-mm sieve.*
   (a) Care taken to remove entire sample from the stainless steel jar? ..... _____
   (b) No aggregate is lost in the process? ..... _____
   (c) Steel balls retained on the sieve washed to remove adhering aggregate? ..... _____
7. Material recovered in the container below the 6.3-mm (1/4 in.) sieve washed in accordance with ASTM C117? _____
   (a) Washing continued until water runs clear and all material smaller than 75 µm passes through sieve? . _____
8. Sample dried to constant mass at 110 ± 5°C? ..... _____
9. Sample weighed to the nearest 0.1 g? ..... _____
10. Micro-Deval abrasion loss calculated to the nearest 0.1% as follows: ..... _____

$$\text{Percent Loss} = (A - B) / A * 100$$

where:
A = Initial sample mass
B = Final sample mass

COMMENTS (D7428): (D7428)