

MECHANICAL ANALYSIS OF EXTRACTED AGGREGATE FOP FOR AASHTO T 30

Scope

This procedure covers mechanical analysis of aggregate recovered from asphalt mix samples in accordance with AASHTO T 30-15. This FOP utilizes the aggregate recovered from the ignition oven used in AASHTO T 308. AASHTO T 30 was developed for analysis of extracted aggregate and thus includes references to extracted bitumen and filter element, which do not apply in this FOP.

Sieve analyses determine the gradation or distribution of aggregate particles within a given sample in order to determine compliance with design and production standards.

Apparatus

- Balance or scale: Capacity sufficient for the sample mass, accurate to 0.1 percent of the sample mass or readable to 0.1 g
- Sieves, meeting the requirements of FOP for AASHTO T 27/T 11.
- Mechanical sieve shaker, meeting the requirements of FOP for AASHTO T 27/T 11.
- Mechanical Washing Apparatus (optional)
- Suitable drying equipment, meeting the requirements of the FOP for AASHTO T 255.
- Containers and utensils: A pan or vessel of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water

Sample Sieving

- In this procedure, it is required to shake the sample over nested sieves. Sieves are selected to furnish information required by specification. Intermediate sieves are added for additional information or to avoid overloading sieves, or both.
- The sieves are nested in order of increasing size from the bottom to the top, and the test sample, or a portion of the test sample, is placed on the top sieve.
- The loaded sieves are shaken in a mechanical shaker for approximately 10 minutes, refer to Annex A; *Time Evaluation*.

Mass Verification

Using the aggregate sample obtained from the FOP for AASHTO T 308, determine and record the mass of the sample, $M_{(T30)}$, to 0.1 g. This mass shall agree with the mass of the aggregate remaining after ignition, M_f from T 308, within 0.10 percent. If the variation exceeds 0.10 percent the results cannot be used for acceptance.

Calculation

$$Mass\ verification = \frac{M_{f(T308)} - M_{(T30)}}{M_{f(T308)}} \times 100$$

Where:

$M_{f(T308)}$ = Mass of aggregate remaining after ignition from the FOP for AASHTO T 308

$M_{(T30)}$ = Mass of aggregate sample obtained from the FOP for AASHTO T 308

Example:

$$Mass\ verification = \frac{2422.5\ g - 2422.3\ g}{2422.5\ g} \times 100 = 0.01\%$$

Where:

$M_{f(T308)} = 2422.5\ g$

$M_{(T30)} = 2422.3\ g$

Procedure

1. Nest a sieve, such as a 2.0 mm (No. 10) or 1.18 mm (No. 16), above the 75µm (No. 200) sieve.
2. Place the test sample in a container and cover with water. Add a detergent, dispersing agent, or other wetting solution to the water to assure a thorough separation of the material finer than the 75µm (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

3. Agitate vigorously to ensure complete separation of the material finer than 75 μ m (No. 200) from coarser particles and bring the fine material into suspension above the coarser material. Avoid degradation of the sample when using a mechanical washing device. Maximum agitation is 10 min.
Note 1: When mechanical washing equipment is used, the introduction of water, agitating, and decanting may be a continuous operation. Use care not to overflow or overload the 75 μ m (No. 200) sieve.
4. Immediately pour the wash water containing the suspended material over the nested sieves; be careful not to pour out the coarser particles or over fill the 75 μ m (No. 200) sieve.
5. Add water to cover material remaining in the container, agitate, and repeat Step 4. Continue until the wash water is reasonably clear.
6. Remove the upper sieve, return material retained to the washed sample.
7. Rinse the material retained on the 75 μ m (No. 200) sieve until water passing through the sieve is reasonably clear and detergent or dispersing agent is removed.
8. Return all material retained on the 75 μ m (No. 200) sieve to the washed sample by rinsing into the washed sample.
9. Dry the washed test sample to constant mass according to the FOP for AASHTO T 255. Cool to room temperature. Determine and record the “dry mass after washing.”
10. Select sieves required by the specification and those necessary to avoid overloading. With a pan on bottom, nest the sieves increasing in size starting with the 75 μ m (No. 200).
11. Place the test sample, or a portion of the test sample, on the top sieve. Place sieves in mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used (approximately 10 minutes, the time determined by Annex A).
Note 2: Excessive shaking (more than 10 minutes) may result in degradation of the sample.
12. Determine and record the individual or cumulative mass retained for each sieve including the pan. Ensure that all material trapped in full openings of the sieves are removed and included in the mass retained.
Note 3: For sieves 4.75 mm (No. 4) and larger, check material trapped in less than a full opening by sieving over a full opening. Use coarse wire brushes to clean the 600 μ m (No. 30) and larger sieves, and soft bristle brushes for smaller sieves.
13. Perform the *Check Sum* calculation – Verify the *total mass after sieving* of material agrees with the *dry mass after washing* within 0.2 percent. Do not use test results for acceptance if the *Check Sum* result is greater than 0.2 percent.

- 14. Calculate the total percentages passing, and the individual or cumulative percentages retained, to the nearest 0.1 percent by dividing the individual sieve masses or cumulative sieve masses by the total mass of the initial dry sample.
- 15. Apply the Aggregate Correction Factor (ACF) to the calculated percent passing, as required in the FOP for AASHTO T 308 “Correction Factor,” to obtain the reported percent passing.
- 16. Report total percent passing to 1 percent except report the 75 μm (No. 200) sieve to 0.1 percent.

Calculations

Check Sum

$$check\ sum = \frac{dry\ mass\ after\ washing - total\ mass\ after\ sieving}{dry\ mass\ after\ washing} \times 100$$

Percent Retained

Individual

$$IPR = \frac{IMR}{M_{T30}} \times 100$$

Cumulative

$$CPR = \frac{CMR}{M_{T30}} \times 100$$

Where:

- IPR = Individual Percent Retained
- CPR = Cumulative Percent Retained
- M_{T30} = Total dry sample mass before washing
- IMR = Individual Mass Retained
- CMR = Cumulative Mass Retained

Percent Passing**Individual**

$$PP = PCP - IPR$$

Cumulative

$$PP = 100 - CPR$$

Where:

PP = Calculated Percent Passing

PCP = Previous Calculated Percent Passing

Reported Percent Passing

$$RPP = PP + ACF$$

Where:

RPP = Reported Percent Passing

ACF = Aggregate Correction Factor (if applicable)

ExampleDry mass of total sample, before washing (M_{T30}): 2422.3 gDry mass of sample, after washing out the 75 μm (No. 200) minus: 2296.2 gAmount of 75 μm (No. 200) minus washed out ($2422.3 \text{ g} - 2296.2 \text{ g}$): 126.1 g

Check sum

$$check\ sum = \frac{2296.2\ g - 2295.3\ g}{2296.2\ g} \times 100 = 0.04\%$$

This is less than 0.2 percent therefore the results can be used for acceptance purposes.

Percent Retained for the 75 μm (No. 200) sieve

$$IPR = \frac{63.5\ g}{2422.3\ g} \times 100 = 2.6\%$$

or

$$CPR = \frac{2289.6\ g}{2422.3\ g} \times 100 = 94.5\%$$

Percent Passing using IPR and PCP for the 75 μm (No. 200) sieve

$$PP = 8.1\% - 2.6\% = 5.5\%$$

Percent Passing using CPR for the 75 μm (No. 200) sieve

$$PP = 100.0\% - 94.5\% = 5.5\%$$

Reported Percent Passing

$$RPP = 5.5\% = (-0.6\%) = 4.9\%$$

Gradation on All Screens

| Sieve Size mm (in.) | Mass Retained (g) (MR) | Percent Retained (PR) | Cumulative Mass Retained (g) (CMR) | Cumulative Percent Retained (CPR) | Percent Passing (PP) | Agg. Corr. Factor from T 308 (ACF) | Reported Percent Passing (RPP) |
|------------------------|---------------------------------|-----------------------------|--|--|----------------------------|---|---|
| 19.0 (3/4) | 0.0 | | 0.0 | 0 | 100.0 | | 100 |
| 12.5 (1/2) | 346.9 | 14.3 | 346.9 | 14.3 | 85.7 | | 86 |
| 9.5 (3/8) | 207.8 | 8.6 | 554.7 | 22.9 | 77.1 | | 77 |
| 4.75 (No. 4) | 625.4 | 25.8 | 1180.1 | 48.7 | 51.3 | | 51 |
| 2.36 (No. 8) | 416.2 | 17.2 | 1596.3 | 65.9 | 34.1 | | 34 |
| 01.18 (No. 16) | 274.2 | 11.3 | 1870.5 | 77.2 | 22.8 | | 23 |
| 0.600- (No. 30) | 152.1 | 6.3 | 2022.6 | 83.5 | 16.5 | | 16 |
| 0.300 (No. 50) | 107.1 | 4.4 | 2129.7 | 87.9 | 12.1 | | 12 |
| 0.150 (No. 100) | 96.4 | 4.0 | 2226.1 | 91.9 | 8.1 | | 8 |
| 75 µm (No. 200) | 63.5 | 2.6 | 2289.6 | 94.5 | 5.5 | -0.6 | 4.9 |
| Pan | 5.7 | | 2295.3 | | | | |

* Report total percent passing to 1 percent except report the 75 µm (No. 200) sieve to 0.1 percent.

Report

- Results on forms approved by the agency
- Sample ID
- Depending on the agency, this may include:
 - Individual mass retained on each sieve
 - Individual percent retained on each sieve
 - Cumulative mass retained on each sieve
 - Cumulative percent retained on each sieve
 - Aggregate Correction Factor for each sieve from AASHTO T 308
 - Calculated percent passing each sieve to 0.1 percent
- Percent passing to the nearest 1 percent, except 75 µm (No. 200) sieve to the nearest 0.1 percent.

ANNEX A TIME EVALUATION

The minimum time requirement should be evaluated for each shaker at least annually by the following method:

1. Shake the sample over nested sieves for approximately 10 minutes.
2. Provide a snug-fitting pan and cover for each sieve, and hold in a slightly inclined position in one hand.
3. Hand-shake each sieve by striking the side of the sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turning the sieve about one sixth of a revolution at intervals of about 25 strokes.

If more than 0.5 percent by mass of the total sample before sieving passes any sieve after one minute of continuous hand sieving adjust shaker time and re-check.

In determining sieving time for sieve sizes larger than 4.75 mm (No. 4), limit the material on the sieve to a single layer of particles.

ANNEX B OVERLOAD DETERMINATION

- For sieves with openings smaller than 4.75 mm (No. 4), the mass retained on any sieve shall not exceed 7 kg/m² (4 g/in²) of sieving surface.
- For sieves with openings 4.75 mm (No. 4) and larger, the mass (in kg) shall not exceed the product of 2.5 x (sieve opening in mm) x (effective sieving area). See Table B1.

Additional sieves may be necessary to keep from overloading the specified sieves. The sample may also be sieved in increments or sieves with a larger surface area.

TABLE B1
Maximum Allowable Mass of Material Retained on a Sieve, g
Nominal Sieve Size, mm (in.)
Exact size is smaller (see AASHTO T 27)

| Sieve Size mm (in.) | | 203 dia (8) | 305 dia (12) | 305 by 305 (12 × 12) | 350 by 350 (14 × 14) | 372 by 580 (16 × 24) |
|------------------------|----------|-----------------------------|-----------------|-------------------------|-------------------------|-------------------------|
| | | Sieving Area m ² | | | | |
| | | 0.0285 | 0.0670 | 0.0929 | 0.1225 | 0.2158 |
| 90 | (3 1/2) | * | 15,100 | 20,900 | 27,600 | 48,500 |
| 75 | (3) | * | 12,600 | 17,400 | 23,000 | 40,500 |
| 63 | (2 1/2) | * | 10,600 | 14,600 | 19,300 | 34,000 |
| 50 | (2) | 3600 | 8400 | 11,600 | 15,300 | 27,000 |
| 37.5 | (1 1/2) | 2700 | 6300 | 8700 | 11,500 | 20,200 |
| 25.0 | (1) | 1800 | 4200 | 5800 | 7700 | 13,500 |
| 19.0 | (3/4) | 1400 | 3200 | 4400 | 5800 | 10,200 |
| 16.0 | (5/8) | 1100 | 2700 | 3700 | 4900 | 8600 |
| 12.5 | (1/2) | 890 | 2100 | 2900 | 3800 | 6700 |
| 9.5 | (3/8) | 670 | 1600 | 2200 | 2900 | 5100 |
| 6.3 | (1/4) | 440 | 1100 | 1500 | 1900 | 3400 |
| 4.75 | (No. 4) | 330 | 800 | 1100 | 1500 | 2600 |
| -4.75 | (-No. 4) | 200 | 470 | 650 | 860 | 1510 |

