Test Procedure for

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES

TxDOT Designation: Tex-200-F

Effective Date: January 2020 – June 2021

1. SCOPE

1.1 Use this test method to determine the particle size distribution of aggregate samples, using standard U.S. sieves with square openings.

1.2 Use Part I to determine a weight-based, dry-sieve analysis for an aggregate sample.

1.3 Use Part II to determine a weight-based, sieve analysis for an aggregate sample requiring a washed sieve analysis.

1.4 Use Part III to determine a volume-based, sieve analysis for an aggregate sample. Perform a volumetric sieve analysis when aggregates with differences in bulk specific gravity greater than 0.3 are blended.

1.5 Use Part IV to determine the precise data relating to aggregate compounds in which some percentage of the total volume includes material that is lighter than water or the usual suspension medium.

1.6 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

2. APPARATUS

2.1 *Sample splitter, quartering machine, quartering cloth, or shovel and a smooth surface.*

2.2 *Set of standard U. S. sieves,* meeting the requirements of Tex-907-K.

2.3 *Mechanical sieve shaker.*

2.4 *Balance,* Class G2 in accordance with Tex-901-K, minimum capacity of 10,000 g.

2.5 *Drying oven,* capable of attaining a temperature of at least 225°F (107°C).

2.6 *Various pans.*

2.7 *Scoop.*

2.8 *Brass wire brush.*

2.9 *Bristle brush.*

3. PREPARING MATERIAL SAMPLE

3.1 Follow this method to prepare aggregate that has been sampled from a stockpile.

Note 1—This sample preparation method is not applicable when performing a sieve analysis on material obtained from an ignition oven or extraction sample.

3.2 Place a representative sample of processed aggregate in oven and dry to constant weight at a minimum temperature of 225°F (107°C).

3.2.1 For field testing of portland cement concrete aggregate, it is not necessary to completely dry, but merely to surface dry, the coarse aggregate.

3.2.2 Dry limestone rock asphalt (LRA) samples at 140 ± 9°F (60 ± 5°C).

Note 2—For control testing, where rapid results are desired, it is not necessary to dry LRA aggregate.

3.3 For coarse materials (major portion retained on the No. 8 [2.36 mm] sieve), quarter the sample to the required size as shown in Table 1 using one of the following methods:

- sample splitter,
- quartering cloth,
- quartering machine, or
- mix on a smooth clean surface with a large flat scoop or shovel until blended, and quarter with a straight edge.

3.4 For fine materials (major portion passing No. 8 [2.36 mm] sieve) thoroughly blend sample and take small portions from several places in the pan to make up a test sample with the required size as shown in Table 1.

3.5 For control testing, create the test sample for all size aggregates by blending small portions taken from several places in the pan.

3.6 For plant control testing, weigh aggregates in the same proportions as used in the bituminous mixture being produced, then combine and sieve to yield the combined aggregate gradation.

3.7 Reverse Sections 3.2–3.6 when this proves more practical.

Table 1—Minimum Size of Samples

Nominal Maximum Aggregate Size[1]	Minimum Weight of Field Sample, g (lb.)	Minimum Weight of Sample for Test, g (lb.)
Fine Aggregate		
No. 8 (2.36 mm)	4500 (10)	500 (1.1)
No. 4 (4.75 mm)	4500 (10)	500 (1.1)
Coarse Aggregate		
3/8 in. (9.75 mm)	4500 (10)	1000 (2)
1/2 in. (12.5 mm)	4500 (10)	1500 (3)
3/4 in. (19.0 mm)	4500 (10)	2000 (4)
1 in. (25.0 mm)	6800 (15)	3000 (6)
1-1/2 in. (37.5 mm)	9000 (20)	4000 (8)

1. Nominal maximum aggregate size is one sieve size large than the first sieve that retains more than 10% of the total aggregate.

PART I—DRY SIEVE ANALYSIS (BASED ON WEIGHT)

4. PROCEDURE

4.1 Prepare the material sample in accordance with Section 3.

4.2 Determine the mass of the total sample and record to the nearest 0.1 g as W_T in Section 6.

4.3 Using the sieve sizes required by the specification, arrange the set of sieves in descending order with the largest size on top.

4.4 When using a mechanical sieve shaker, place the set of sieves onto a pan and place into the shaker. When no mechanical shaker is available and hand sieving only, proceed to Section 5.5.

4.4.1 Pour the prepared aggregate into the top sieve. Establish a shaking time for different types of aggregates that will assure proper sieving of the material without degradation.

4.4.2 Cover the stack of sieves and pan, and shake the sample for at least 5 minutes.

4.4.3 It may be necessary to establish a shaking time for different types of aggregates to assure proper sieving of the material without degradation.

4.4.4 Begin with the largest sieve size and progress toward the smaller sieves. Obtain an initial weight of the aggregate on the individual sieve and hand sieve the material retained on the sieve to refusal as indicated in Section 4.4.5.

4.4.5 Hand sieve the material by lateral and vertical motion of the sieve with a "jarring" action that keeps the material moving continuously over the surface of the sieve until no more than 1% by mass of the aggregate on any individual sieve will pass that sieve during 1 minute of continuous hand sieving. Hand manipulation of the aggregate particles without forcing them through the sieve is permitted.

4.4.6 Brush any aggregate particles clinging to each sieve and the aggregate passing the sieve into the next smaller sieve. Ensure no material is lost.

4.4.7 Determine the mass of the aggregate retained on the sieve and record to the nearest 0.1 g.

4.4.8 Repeat Sections 4.4.4 through 4.4.7 for each individual sieve of the entire sample.

4.4.9 Proceed to Section 4.6.

4.5 When hand sieving, begin with the largest sieve size and progress toward the smaller sieve sizes following the method described in Section 4.4.4 through 4.4.9.

4.6 Calculate and report the percentages to the nearest 0.1% for each sieve size as shown in Section 6 and Section 7.

4.7 Take care to prevent loss of material during the sieving operation. When there is a discrepancy of equal to or less than 0.2% between the original dry weight of the sample and the sum of the weights of the various sizes, assume this amount is particles passing the smallest size sieve and use the original weight. When the discrepancy is greater than 0.2%, check the weights of the various sizes or rerun the analysis with a new sample to correct the error.

PART II—WASHED SIEVE ANALYSIS (WHEN SPECIFIED BASED ON WEIGHT)

5. PROCEDURE

5.1 Prepare the material sample in accordance with Section 3.

Note 3—Test a minimum of two samples from each stockpile when developing a mixture design in accordance with Tex-204-F.

5.2 Determine the mass of the total dry sample and record to the nearest 0.1 g as W_T in Section 6.

5.3 Place the sample in a wash pan and completely cover with clean potable water.

5.4 Gently mix the sample with the hands to break up clay lumps and friable particles and loosen the coating of fines on the coarse aggregate.

5.5 Rinse any sample particles clinging to the hands back into the wash pan.

5.6 Soak the sample a minimum of 10 minutes. A sample that contains very high clay content may require overnight soaking. After soaking, remix the sample with the hands as noted in Section 5.4 and repeat Section 5.5.

5.7 Stack a No. 8 (2.36 mm) on a No. 200 (75 µm) sieve and place in a pan or over an open sink.

5.8 Flush the wetted sample over the stacked sieves in small batches to prevent overloading and damage to the No. 200 (75 µm) sieve.

5.9 When the material retained on the No. 8 (2.36 mm) sieve is adequately washed, remove it and place in a clean drying pan.

5.10 Continue to wash the material retained on the No. 200 (75 µm) sieve until the wash water runs clear. Then place it in the drying pan with the previously cleaned No. 8 (2.36 mm) material.

5.11 Repeat Section 5.8 through 5.10 until the entire sample is washed over the set of sieves. After the final wash, rinse the sieves over the drying pan.

5.12 After the fines have settled, decant excess water from the drying pan and dry the washed sample to a constant weight.

5.13 Determine the mass of the dried washed sample and record as W_w in Section 6.

5.14 Determine the sieve analysis of the dried washed sample as described in Section 4.

5.15 Calculate and report the percentages to the nearest 0.1% for each sieve size as shown in Sections 6 and 7.

5.16 Take care to prevent loss of material during the sieving operation. When there is a discrepancy of equal to or less than 0.2% between the original dry weight of sample and the sum of the weights of the various sizes, assume this amount is particles passing the smallest size sieve and use the original weight. When the discrepancy is greater than 0.2%, check the weights of the various sizes or rerun the analysis with a new sample to correct the error.

6. CALCULATIONS

6.1 *Dry Sieve Analysis*—calculate the individual percent retained for each consecutive sieve using the following equation:

$$W = \left(\frac{X_1}{W_T} \right) \times 100$$

Where:

W = Individual percent retained

X_1 = Weight of oven dry aggregate retained on individual sieve or pan

W_T = Total weight of original dry sample.

6.2 *Washed Sieve Analysis*—the calculations are the same as for dry sieve analysis, except use the following equation to determine the percent finer than the No. 200 (75 µm) sieve:

$$Passing\ No.\ 200\ (75\mu m) = \frac{(W_T - W_W)}{W_T} \times 100$$

Where:

W_W = Total weight of the washed dry sample

W_T = Total weight of the original dry sample.

Note 4—When a small amount of additional material passing the No. 200 (75 µm) sieve is produced during the dry sieve analysis performed after washing, add this weight to the passing No. 200 (75 µm) sieve before calculating the percentage passing the No. 200 (75 µm) sieve.

7. REPORT FORMS

7.1 Use Sieve Analysis of Non-Surface Treatment Aggregates in Excel to calculate both a dry or washed sieve analyses.

7.2 Use Sieve Analysis of Surface Treatment Aggregate in Excel to calculate the sieve analysis of aggregates for surface treatment applications.

PART III—VOLUMETRIC SIEVE ANALYSIS

8. APPARATUS

8.1 Apparatus listed in Section 2, with the addition of the following items.

8.1.1 *Glass graduates*, 68 fl. oz. (2000 mL), with 0.68-fl. oz. (20-mL) graduations; and 8.45 fl. oz. (250 mL), with 0.07-fl. oz. (2-mL) graduations.

8.1.2 *Wide-mouth funnel*.

8.1.3 *Water or other appropriate liquids*.

9. PROCEDURE

9.1 Prepare the material sample in accordance with Section 3.

9.2 Perform the sieve analysis in accordance with Section 4.

9.3 Fill the glass graduate with water or other appropriate liquid, enough to cover entire sample.

9.4 Make an initial reading of the liquid level and record on Form CST-M-2, "Volumetric Sieve Analysis Worksheet."

9.5 Place the aggregate retained on the largest sieve size into the graduate.

Note 5—Begin with the finest size when preparing more absorptive materials.

9.6 Eliminate entrapped air from the graduate, particularly after adding the fine aggregate, by gently rolling the graduate or stirring the aggregate prior to taking a reading.

9.7 Read the liquid level within 20 seconds and record on the worksheet.

9.8 Prior to adding each aggregate size, re-check the liquid level reading. When it differs from the liquid level recorded for the previous aggregate size, use the new reading as the initial liquid level prior to adding the next aggregate size. The object of the procedure is to measure the volume change of the liquid for each size aggregate.

9.9 Determine the volume of each size of aggregate by subtracting the liquid reading prior to the addition of each size of aggregate from the liquid reading after the addition of each size of aggregate. Enter the result in Column 3 of the worksheet. The difference in initial and final readings will be the total volume of the aggregate.

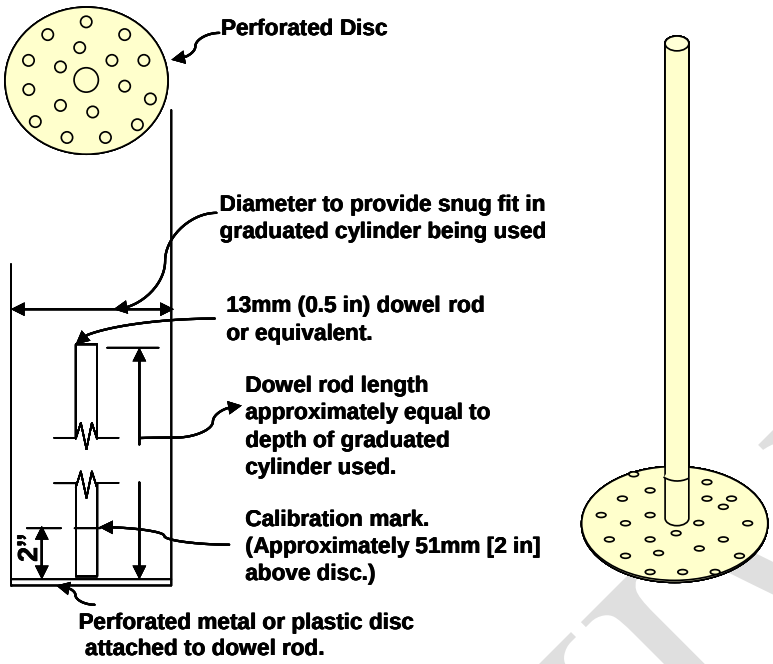
9.10 Divide the volume of each aggregate fraction by the total aggregate volume to determine the percent retained on each sieve and enter in Column 4. This percent will be an expression of each size as a portion of the total aggregate.

9.11 Calculate the total percent retained and percent passing from the values calculated in Section 9.10.

PART IV—VOLUMETRIC SIEVE ANALYSIS OF LIGHTWEIGHT AGGREGATE (WITH SPECIFIC GRAVITIES LIGHTER THAN WATER)

10. APPARATUS

10.1 Same apparatus as listed for Part III with the addition of a plunger. (See Figure 1.)



Note: The perforation in the disc should be small enough to permit the passage of any small floating particle.

Figure 1—Volumetric Sieve Analysis-Plunger—Diagram

11. PROCEDURE

11.1 Prepare the material sample in accordance with Section 3.

11.2 Perform the sieve analysis in accordance with Section 4.

11.3 Fill the graduate with enough water or other appropriate liquid to cover entire sample plus at least an additional 2 in. (51 mm).

Note 6—The additional 2 in. (51 mm) is required to ensure that the calibration mark on the plunger is submerged when taking a reading.

11.4 Slowly lower the plunger into the liquid, permitting air and liquid to percolate through the holes in the perforated disc, until the liquid level reaches the calibration mark on the plunger handle.

11.5 Trap all material beneath the plunger disc, eliminating any air prior to making readings.

11.6 With the liquid level on the calibration mark of the plunger handle, read and record the liquid level from the scale on the graduated cylinder. This is the "zero" or "initial" reading.

11.7 Remove the plunger and place the aggregate retained on the largest sieve into the graduate. Begin with the finest size when preparing more absorptive materials.

11.8 Slowly lower the plunger into the liquid until the level rises to the calibration mark on the plunger handle.

11.9 Read and record the liquid level from the calibrated scale on the graduated cylinder within 20 seconds of the aggregate being added.

11.10 Check the liquid level when ready to add the next aggregate size.

11.11 Record this as the initial reading and pour in the next sieve-size material. Make this reading within 20 seconds, in the same manner described above.

11.12 Continue this procedure for each sieve size material.

Note 7—Take care when lowering the plunger into the liquid so that floating particles do not slip by the edge of the plunger disc.

11.13 Make calculations in the same manner described previously under Part III, Sections 12.12–12.14.

11.14 Improve the precision of this procedure by using two graduates.

- 8.45-fl. oz. (250-mL) graduate with 0.07-fl. oz. (2-mL) graduations—The volumes of small amounts of aggregate of any given size can be measured with a greater precision in the 8.45-fl. oz. (250-mL) graduate.
- 68-fl. oz. (2000-mL) graduate with 0.68-fl. oz. (20-mL) graduations—The volumes of the larger amounts of aggregate of any given size can be measured in the 68-fl. oz. (2000-mL) graduate.

12. ARCHIVED VERSIONS

12.1 Archived versions are available.