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**Test Procedure for****SIEVE ANALYSIS OF FINE AND COARSE  
AGGREGATES****TxDOT Designation: Tex-200-F****Effective Date: January 2016**

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**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 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.
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**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  $200 \pm 9^{\circ}\text{F}$  ( $93 \pm 5^{\circ}\text{C}$ ).*
  - 2.6 *Various pans.*
  - 2.7 *Scoop.*
  - 2.8 *Brass wire brush.*
  - 2.9 *Bristle brush.*
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### 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  $200 \pm 9^\circ\text{F}$  ( $93 \pm 5^\circ\text{C}$ ).
- 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  $140 \pm 9^\circ\text{F}$  ( $60 \pm 5^\circ\text{C}$ ).  
**Note 2**—For control testing, particularly where rapid results are desired, it is generally 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 <sup>1</sup>	Minimum Weight of Field Sample, g (lb.)	Minimum Weight of Sample for Test, g (lb.)
<b>Fine Aggregate</b>		
No. 8 (2.36 mm)	4500 (10)	500 (1.1)
No. 4 (4.75 mm)	4500 (10)	500 (1.1)
<b>Coarse Aggregate</b>		
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.

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## PART I—DRY SIEVE ANALYSIS (BASED ON WEIGHT)

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### 4. SCOPE

- 4.1 Use this procedure to determine a weight-based dry-sieve analysis for an aggregate sample.

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### 5. PROCEDURE

- 5.1 Prepare the material sample in accordance with Section 3.
- 5.2 Accurately weigh the total sample to the nearest 0.1 g. Record this weight and designate as  $W_T$  in Section 8.
- 5.3 Place the set of sieves, with the largest opening on top, into a pan and pour the aggregate onto the top sieve.
- 5.4 Separate the material into a series of particle sizes using the sieves required by the material or project specifications.
- 5.5 The use a mechanical sieve shaker is the preferred method for separating the materials into the specified sizes. If a mechanical shaker is not available, proceed to Section 5.6.
- 5.5.1 Establish a shaking time for different types of aggregates that will assure proper sieving of the material without degradation.
- 5.5.2 When the required mechanical shaking time is complete, hand sieve by lateral and vertical motion of the sieves with a “jarring” action that keeps the material moving continuously over the surface of the sieves.

- 5.5.3 Continue hand sieving until no material passes through the sieve.
- 5.5.4 Proceed to Section 5.7.
- 5.6 If a mechanical shaker is not available, hand sieve the entire sample.
- 5.6.1 Hand sieve by lateral and vertical motion of the sieves with a “jarring” action that keeps the material moving continuously over the surface of the sieves.
- 5.6.2 Continue hand sieving until no material passes through the sieve.
- 5.7 Brush particles clinging to each sieve into the next lower sieve with a bristle brush. Ensure no material is lost.
- 5.8 Determine the individual weights to the nearest 0.1 g of aggregate retained on each sieve and record these weights.
- 5.8.1 Place an empty pan on the scale and tare or “zero out” its weight.
- 5.8.2 Pour the retained aggregate into the empty pan and record this weight as  $X_1$  in Section 8.
- 5.8.3 Re-tare the pan for the next size sieve or tare a new pan if required to keep the material separate.
- 5.8.4 Repeat this process until the weight of the material on each sieve and the retaining pan (typically the material passing the No. 200 sieve) has been recorded.
- 5.9 Report the percentages to the nearest 0.1% for each size of aggregate retained on each sieve as set forth by the specification requirements. Refer to Section 8 and Section 9.
- 5.10 Make the original sieve analysis a 'total retained' analysis by weighing the material cumulatively, placing the material retained on one sieve directly on top of the previously weighed material from the larger size sieve, already on the balance. Note the difference.
- 5.11 Take care to prevent loss of material during the sieving operation. However, if there is a small discrepancy (less than 0.2%) between the original dry weight of sample and the sum of the weights of the various sizes, assume the small amount as particles passing the smallest size sieve and use the original weight; if the discrepancy is large (greater than 0.2%), check the weights of the various sizes or rerun the analysis with a new sample to correct the error.

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

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### **6. SCOPE**

- 6.1 Use this procedure to determine a weight-based sieve analysis for an aggregate sample, requiring a washed sieve analysis.

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**7. PROCEDURE**

- 7.1 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.
- 7.2 Weigh the total dry sample to the nearest 0.1 g. Record the weight and designate as  $W_T$  in Section 8.
- 7.3 Place the sample in a wash pan and inundate with clean potable water.
- 7.4 Gently mix the water into the sample with the hands to break up clay lumps or “sand balls” and loosen the coating of fines on the coarse aggregate.
- 7.5 Rinse any sample particles clinging to the hands back into the wash pan.
- 7.6 Soak the sample a minimum of 10 minutes. A sample that contains very high clay content may require overnight soaking.
- 7.7 Remix the sample with the hands as noted in Section 7.4 and repeat Section 7.5.
- 7.8 Place a set of sieves, a No. 8 (2.36 mm) and a No. 200 (75  $\mu\text{m}$ ), in a pan or over an open sink.
- 7.9 Flush the wetted sample over the set in small batches to prevent overloading (clogging) and damage to the No. 200 (75  $\mu\text{m}$ ) sieve.
- 7.10 When the material retained on the No. 8 (2.36 mm) sieve is adequately washed, remove it and place in a clean drying pan.
- 7.11 Continue to wash the material retained on the No. 200 (75  $\mu\text{m}$ ) sieve until the wash water runs clean. Then place it in the drying pan with the previously cleaned No. 8 (2.36 mm) material.
- 7.12 Continue the process until entire sample is washed over the set of sieves. After the final wash, rinse the sieves over the drying pan.
- 7.13 After the fines have settled, decant excess water from the drying pan and dry the washed sample to a constant weight.
- 7.14 Weigh the dried washed sample and record the weight. Designate this weight as  $W_w$  in Section 8.
- 7.15 Determine the sieve analysis of the dried washed sample as described in Part I, Sections 5.3–5.8.
- 7.16 Report the percentages to the nearest 0.1% for each size of aggregate retained on each sieve as set forth by specification requirements. Refer to Sections 8 and 9.

- 7.17 Take care to prevent loss of material during the sieving operation. However, if there is a small discrepancy (less than 0.2%) between the original dry weight of sample and the sum of the weights of the various parts, assume the small amount as particles passing the smallest size sieve and use the original weight; if the discrepancy is large (greater than 0.2%), check the weights of the various sizes or rerun the analysis with a new sample to correct the error.

## 8. CALCULATIONS

- 8.1 *Dry Sieve Analysis*—calculate the percentages by weight retained between consecutive sieves:

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

Where:

W = Percentage by weight retained between consecutive sieves

X<sub>1</sub> = Weight of oven dry aggregate passing one sieve size and retained on the next smaller sieve size or pan

W<sub>T</sub> = Total weight of original dry sample which equals the sum (X<sub>1</sub> + X<sub>2</sub>, etc.) of all the weights of aggregate retained on sieve sizes and includes the portion which passes the smallest size sieve used.

- 8.2 *Washed Sieve Analysis*—the calculations are the same as for dry sieve analysis, except the percent finer than the No. 200 (75 μm) is:

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

Where:

W<sub>w</sub> = Total weight of the washed dry sample

W<sub>T</sub> = Total weight of the original dry sample.

**Note 4**—A small amount of additional passing No. 200 (75 μm) material is usually found during the sieve analysis performed after washing. Add this to the pass No. 200 (75 μm) percentage calculated above.

## 9. REPORT FORMS

- 9.1 Use [Sieve Analysis of Non-Surface Treatment Aggregates](#) in Excel to calculate both a dry or washed sieve analyses.
- 9.2 Use [Sieve Analysis of Surface Treatment Aggregate](#) in Excel to calculate the sieve analysis of aggregates for surface treatment applications.

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**PART III—VOLUMETRIC SIEVE ANALYSIS**

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**10. SCOPE**

- 10.1 Use this procedure 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.

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**11. APPARATUS**

- 11.1 Apparatus listed in Section 2, with the addition of the following items.
- 11.1.1 *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.
- 11.1.2 *Wide-mouth funnel*.
- 11.1.3 *Water or other appropriate liquids*.

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**12. PROCEDURE**

- 12.1 Prepare the material sample in accordance with Section 3.
- 12.2 Place the set of sieves, with the largest opening on top, into a pan and pour the aggregate onto the top sieve.
- 12.3 Perform a sieve analysis on the aggregate sample by separating the material into a series of particle sizes using sieves required by the material or project specifications.
- 12.4 The use of a mechanical sieve shaker is the preferred method for separating the materials into the specified sizes. If a mechanical shaker is not available, proceed to Section 12.5.
- 12.4.1 Establish a shaking time for different types of aggregates that will assure proper sieving of the material without degradation.
- 12.4.2 When the required mechanical shaking time is complete, hand sieve by lateral and vertical motion of the sieves with a “jarring” action that keeps the material moving continuously over the surface of the sieves.
- 12.4.3 Continue hand sieving until, by visual observation, no material passes through the sieve.
- 12.4.4 Proceed to Section 12.6.
- 12.5 If a mechanical shaker is not available, hand sieve the entire sample.
- 12.5.1 Hand-sieve by lateral and vertical motion of the sieves with a “jarring” action that keeps the material moving continuously over the surface of the sieves.

- 12.5.2 Continue hand-sieving until, by visual observation, no material passes through the sieve.
- 12.6 Fill the glass graduate with water or other appropriate liquid, enough to cover entire sample.
- 12.7 Make an initial reading of the liquid level and record on Form CST-M-2, "[Volumetric Sieve Analysis Worksheet](#)."
- 12.8 Place the aggregate retained on the largest sieve size into the graduate.  
**Note 5**—Begin with the finest size when preparing more absorptive materials.
- 12.9 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.
- 12.10 Read the liquid level within 20 seconds and record on the worksheet.
- 12.11 Prior to adding each aggregate size, re-check the liquid level reading. If 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.
- 12.12 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.
- 12.13 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.
- 12.14 Calculate the total percent retained and percent passing from the values calculated in Section 12.13.

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

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### **13. SCOPE**

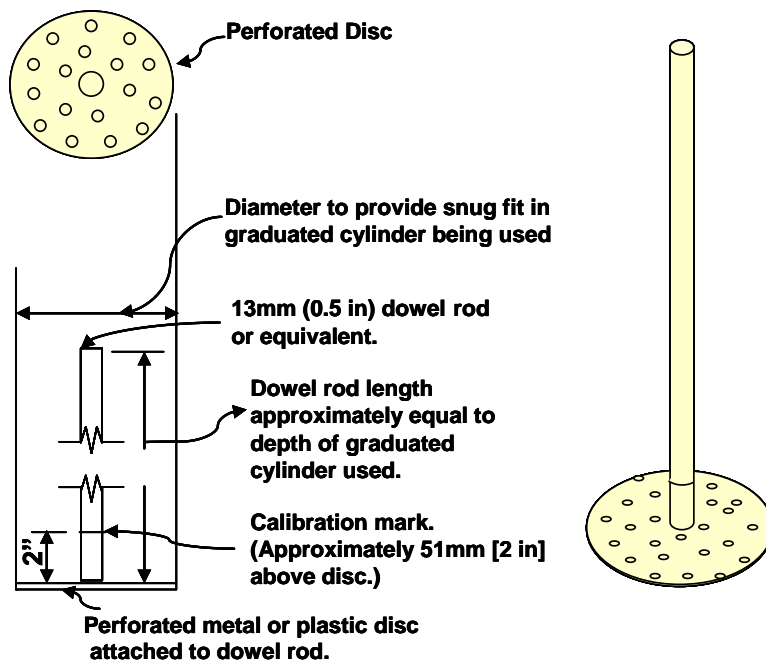
- 13.1 Use this procedure to determine precise data relating to aggregate compounds in which some percentage of the total volume includes material that is lighter than water or the usual suspension medium.

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### **14. APPARATUS**

- 14.1 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

## 15. PROCEDURE

- 15.1 Perform Part III, Sections 12.1–12.5.
- 15.2 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.
- 15.3 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.
- 15.4 Trap all material beneath the plunger disc, eliminating any air prior to making readings.
- 15.5 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.
- 15.6 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.
- 15.7 Slowly lower the plunger into the liquid until the level rises to the calibration mark on the plunger handle.

- 15.8 Read and record the liquid level from the calibrated scale on the graduated cylinder within 20 seconds of the aggregate being added.
- 15.9 Check the liquid level when ready to add the next aggregate size.
- 15.10 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.
- 15.11 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.
- 15.12 Make calculations in the same manner described previously under Part III, Sections 12.12–12.14.
- 15.13 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.
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## 16. ARCHIVED VERSIONS

- 16.1 Archived versions are available.