Test Procedure for

DETERMINING FLAT AND ELONGATED PARTICLES

TxDOT Designation: Tex-280-F

Effective Date: November 2024

1. SCOPE

1.1 Use this test method to determine the percentage of flat and elongated particles in coarse aggregates. Flat and elongated aggregate particles interfere with compaction and can result in harsh, difficult to place materials. They also break under load and prevent development of an adequate aggregate skeleton.

1.2 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.

1.3 *This test procedure does not claim to address the safety concerns associated with its use. It is the responsibility of the user of this test procedure to establish the appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations before use.*

2. DEFINITIONS

2.1 *Flat and Elongated Particles*—aggregate particles having a ratio of length to thickness (L/T) greater than a specified value.

2.2 *Length (L)*—maximum dimension of the particle.

2.3 *Width (W)*—maximum dimension in the plane perpendicular to the length.

2.4 *Thickness (T)*—maximum dimension perpendicular to the length and width.

3. APPARATUS

3.1 Apparatus used in Tex-200-F.

3.2 *Proportional caliper device,* consisting of a base plate with two fixed vertical posts and a swinging arm mounted between them so that the openings between the arms and the posts maintain a constant ratio.

3.2.1 Adjustable axis position to provide the desired ratio of opening dimensions for the ratios of 2:1, 3:1, 4:1, and 5:1. Verify the ratio settings on the proportional caliper device using a machined block, micrometer, or other appropriate device.

4. SAMPLING

4.1 Sample a representative amount of coarse aggregate in accordance with Tex-221-F.

4.2 Reduce the sample to an amount suitable for testing in accordance with Tex-200-F.

5. PROCEDURE

5.1 Oven-dry the sample to constant weight, at a temperature of 230 ± 9°F (110 ± 5°C). Dry the limestone rock asphalt to constant weight at a temperature of 140 ± 5°F (60 ± 3°C).

5.2 Sieve the sample in accordance with Tex-200-F, Part I, using a 7/8 in., 5/8 in., 1/2 in., 3/8 in., and a No.4 sieve.

5.3 Calculate the individual percent retained for each sieve listed in Section 5.2.

5.4 Reduce each size fraction with 10% or more retained by quartering in accordance with Tex-200-F, until obtaining a minimum of 100 particles for each size.

5.5 Test each of the particles in each size fraction as follows:

5.5.1 Set the proportional caliper device to the 5:1 ratio.

5.5.2 Set the larger opening equal to the particle length. The particle is flat and elongated if the maximum dimension perpendicular to the length and width (thickness) can be placed through the smaller opening.

5.6 Place the tested particles into one of two groups:

- flat and elongated or
- not flat and elongated.

5.7 After classifying the particles into one of the groups described in Section 5.6, count and record the number of particles in each group.

5.7.1 Divide the total number of flat and elongated particles by the total number of particles tested.

5.7.2 Multiply by 100 and record to the nearest 0.1 percentage point.

6. CALCULATIONS

6.1 Using the sieve analysis determined in Section 5.2, add the percentages of the sieve sizes with 10% or more retained to determine an accumulative weighted total based on the sample tested. Divide the individual percentage of each sieve size by the accumulative weighted total. This is the adjusted sieve analysis of the sample tested for flat and elongated particles. See Table 1.

6.2 Calculate the percentage of flat and elongated particles for each sieve size as described in Section 5.7.

6.3 Multiply the adjusted sieve percentage by the corresponding percentage of flat and elongated particles for each sieve size. Divide this number by 100. See Table 1.

Table 1
Calculation Example

Sieve	%	%	%	%	adjusted %
7/8 in.	4.8➔	0.0	0.0	88.5=	0.0
5/8 in.	17.8 ➔	17.8	17.8 ÷	88.5 =	20.1

Sieve	%	%	%	%	adjusted %
1/2 in.	42.1 ➔	42.1	42.1 ÷	88.5 =	47.6
3/8 in.	28.6 ➔	28.6	28.6 ÷	88.5 =	32.3
No. 4	6.7 ➔	0.0	0.0 ÷	88.5 =	0.0
		88.5			100.0

6.4 Suppose the 5/8 in. sieve has a flat and elongated percentage of 5.2 for the ratio 5:1, then:

$$\frac{\text{Adjusted \%} \times \text{flat and elongated \%}}{100} = \text{weighted percentage}$$

$$\frac{20.1\% \times 5.2\%}{100} = 1.05\%$$

6.5 Add the percentages of flat and elongated particles measured on each sieve size and report to the nearest whole number.

7. REPORT

7.1 Identification of the coarse aggregate tested, producer, pit location, date, and person performing the test.

7.2 Grading of the aggregate sample, showing percentage retained on each sieve.

7.3 Weighted percentages for the sieve sizes that weigh 10% or more of the original sample weight.

7.4 Number of particles of each sieve size tested, in respective columns:

- flat and elongated particles, referred to as failing particles and
- total particles not considered as flat and elongated, referred to as passing particles.

7.5 Percentages calculated for failing particles for each sieve size and ratio.

8. ARCHIVED VERSIONS

8.1 Archived versions available.