

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

METHOD OF DETERMINATION OF PERCENT OF
THIN OR ELONGATED PIECES IN COARSE AGGREGATE

1. PURPOSE

- 1.1 To provide a standard method for determining the percent of thin and elongated pieces in a coarse aggregate sample.
 - 1.2 Excessive amounts of thin or elongated pieces of aggregate can create structural and workability problems in base course, portland cement concrete and bituminous concrete mixtures resulting in a loss in strength, skid resistance and wearing ability. Their presence may cause internal and/or external damages when utilized in the previously mentioned applications and consequently the quality of the finished product may be related to the presence of thin or elongated pieces.
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2. SCOPE

- 2.1 This method of determination is applicable to all coarse aggregates (both natural and crushed) and is applied when a test for thin or elongated pieces is required.
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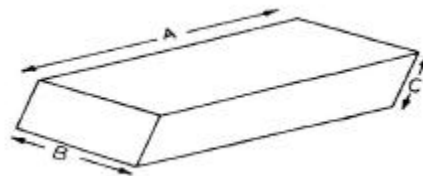
3. EQUIPMENT

- 3.1 *Balance*—The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of AASHTO M 231.
- 3.2 *Pans*—Large flat pans for spreading the aggregate in a single layer.
- 3.3 *Calipers*—Precision built calipers that will maintain a constant 4:1 ratio.
- 3.4 *Oven* – An oven capable of maintaining a temperature of 230°F +/- 9°F (110°C +/- 5°C)
- 3.5 *Sieve* – 4.75 mm (No. 4), conforming to AASHTO M 92
- 3.6 *Aggregate Sample Splitter* – Compliant with AASHTO M 92

4. DEFINITIONS

- 4.1 Thin Aggregate - One in which the ratio of the width to the thickness is greater than 4:1.
- 4.2 Elongated Aggregate - One in which the length to the width is greater than 4:1.
- 4.3 For consistency in evaluating aggregate for possible thin or elongated pieces, the following diagram is provided so as not to confuse one measured dimension with another.

Where:



A = length
B = width
C = thickness

5. TEST PORTION PREPARATION

- 5.1 Obtain enough aggregate from the field sample to yield a 5000 g minimum test portion by use of a sample splitter.
- 5.2 Sieve the aggregate over a 4.75 mm (No. 4) sieve and discard the minus 4.75 mm (No. 4) material.
- 5.3 Gently wash the aggregate retained on the 4.75 mm (No. 4) sieve to remove any dust or coatings.
- 5.4 Dry the clean, sieved aggregate to a constant mass in an oven maintained at 230°F ± 9°F (110°C ± 5°C).

6. TEST PROCEDURE

- 6.1 Weigh the test portion and record the mass to the nearest whole gram on the WVDOH Forms 702-Q and 703-Q (see attached sample forms). The live forms are available on the WVDOH MCS&T [Webpage Toolbox](https://transportation.wv.gov/highways/mcst/Pages/tbox.aspx).¹
- 6.2 Spread the test portion in a thin layer in the bottom of a large flat pan.
- 6.3 Make a preliminary separation of all material which is obviously neither thin nor elongated.

¹ <https://transportation.wv.gov/highways/mcst/Pages/tbox.aspx>

- 6.4 Determine the maximum thickness (C) of the possible THIN pieces of aggregate by using the small opening of the calipers.
- 6.4.1 Remove the aggregate particle from the caliper without disturbing the setting of the opening and place the greatest width (B) of the particle in the large opening.
- 6.4.2 If the greatest width of the aggregate particle is larger than the large opening of the calipers, it shall be considered a THIN piece of aggregate and shall be placed aside for weighing.
- 6.5 Determine the maximum width (B) of the possible ELONGATED pieces of aggregate by using the small opening of the calipers.
- 6.5.1 Remove the aggregate particle from the caliper without disturbing the setting of the opening and place the greatest length (A) of the particle in the large opening.
- 6.5.2 If the greatest length (A) of the aggregate particle is larger than the large opening of the calipers, it shall be considered an ELONGATED piece of aggregate and shall be placed aside for future reference.
- 6.6 Combine all pieces of aggregate classified as either THIN or ELONGATED. Weigh each of these classifications separately, then record the mass to the nearest gram.

7. CALCULATION

- 7.1 The percent of thin and/or elongated pieces is determine in the following manner:

$$T\&E = \frac{M_1 + M_2}{M_3} \times 100$$

Where:

T&E = percent of thin and/or elongated pieces

M₁ = oven dry mass of THIN pieces

M₂ = oven dry mass of ELONGATED pieces

M₃ = oven dry mass of test portion

Deleterious Substances for Coarse Aggregates - Section 703.1.2

Lab Ref No.: _____

Source: _____

Date Logged: _____

Technician: _____

Thin or Elongated pieces: 5% by weight max.

 W_i (0.1g): _____ g $W_{t/e}$ (0.1g): _____ g W_p (0.1%) = $(W_{t/e} / W_i) \times 100 =$ _____ %

Shale / Shale-like Material: 1% by weight max.

 W_i (0.1g): _____ g W_s (0.1g): _____ g W_p (0.1%) = $(W_s / W_i) \times 100 =$ _____ %

Friable Particles: 0.25% by weight max.

 W_i (0.1g): _____ g W_{fri} (0.1g): _____ g W_p (0.01%) = $(W_{fri} / W_i) \times 100 =$ _____ %

Coal & Lightweight Materials: 1.5% by weight max.

 W_i (0.1g): _____ g $W_{c/L}$ (0.1g): _____ g W_p (0.1%) = $(W_{c/L} / W_i) \times 100 =$ _____ %

Form 702-Q

Deleterious Substances for Fine Aggregate: Section 702.1.2

Lab Ref No.:	_____	Source:	_____
Date Logged :	_____	Technician :	_____

Coal & Lightweight: 2% by weight max.	
W_i (0.1g):	_____ g
$W_{c/L}$ (0.1g):	_____ g
W_p (0.1%) = $(W_{c/L} / W_i) \times 100 =$ _____ %	

Friables: 1% by weight max.	
W_i (0.1g):	_____ g
W_{fri} (0.1g):	_____ g
W_p (0.1%) = $(W_{fri} / W_i) \times 100$ _____ %	

Organic Impurities - result of 4 or 5, send to lab for mortar strength	
Color reading after 24 hours _____	Time start/end: _____
Send Sample for Mortar Strength Test?	Jar #: _____
no _____ yes _____	Date Sent (if yes) _____