

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

MATERIALS PROCEDURE

STANDARD METHOD OF TEST
FOR PERCENT BY WEIGHT OF
SHALE IN CRUSHED AGGREGATE

1. PURPOSE

- 1.1 To provide a standard method for determining the percent by weight of shale and aggregate pieces exhibiting shale characteristics contained in crushed aggregate.
 - 1.2 In cases where more detailed examination is considered necessary, other methods described in ASTM C 295 should be followed.
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2. SCOPE

- 2.1 This method is applicable to that portion of crushed aggregate which is retained on the 4.75 mm (No. 4) sieve when that material is being used for applications where the standard specifications places a requirement on the percent of shale in crushed aggregate.
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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 *Oven*—An oven capable of maintaining a temperature of 230°F ± 9°F (110°C ± 5°C).
 - 3.3 *Sieve*—4.75 mm (No. 4), conforming to AASHTO M 92
 - 3.4 *Aggregate Sample Splitter*—compliant with AASHTO T 248.
 - 3.5 *Pans*—Large flat pans for spreading the aggregate in a single layer.
 - 3.6 *Beakers*—600 ml capacity suggested.
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4. DEFINITIONS

- 4.1 Although shale is defined by many noted authors in numerous ways, Walter T. Huang, PhD (Petrology, 1962) defines shale in a manner best suited for Division of Highways quality determinations. Therefore, Huang's definition will act as a guideline and is defined as follows: "Shale is a laminated and thinly bedded fine grained elastic rock containing mainly silt and clay and including many particles less than 1 or 2 microns in diameter." According to the same reference, most shale is made up of 1/3 quartz, 1/3 clay minerals, and 1/3 miscellaneous substances. "In addition, it may be said that shale usually has a relatively smooth or soapy texture, can be scratched with a copper penny and powder can be produced by scraping a piece of shale with a knife."
 - 4.1.1 In addition to the above characteristics, shale, when in contact with a moist environment, softens considerably due primarily to the clay constituent and bedding properties and often exhibits the property of slaking. This is one of the primary

characteristics which causes shale to be considered deleterious when contained in aggregate to be used in highway construction.

5. TEST PORTION PREPARATION

- 5.1 Obtain enough aggregate from the field sample to yield a test portion of the appropriate size by use of a sample splitter. (*see NOTE*)
- 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).

NOTE: Approximate mass of the test portion of crushed aggregate after sieving.

<u>NOMINAL MAXIMUM SIZE OF PARTICLES</u>	<u>MINIMUM MASS OF TEST PORTION</u>
19 mm (3/4 in.)	3000 grams
37.5 mm (1-1/2 in.)	5000 grams
75 mm (3 in.)	10000 grams

6. TEST PROCEDURE

- 6.1 Weigh the test portion and record the mass to the nearest 0.1 gram on the appropriate WVDOH Forms 702-Q or 703-Q, for Fine and Coarse Aggregate Respectively (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 See *NOTE* in Section 5. for the required test portion mass.
- 6.2 Spread the test portion in a thin layer on the bottom of a large flat pan.
- 6.3 Examine each particle for shale characteristics and separate the shale from the remainder of the crushed aggregate.
 - 6.3.1 In the case of pieces of aggregate resembling shale but not exhibiting all the properties of shale, weigh, and soak in water for 24 hours and re-examine.
 - 6.3.1.1 If after 24 hours the suspect pieces of aggregate remain sound, they should be considered satisfactory and not be included with other deleterious material.
 - 6.3.1.2 If after soaking in water for 24 hours the suspect pieces of aggregate show evidence of slaking or if slight hand pressure causes disintegration, these pieces should be recorded as being deleterious.

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

- 6.4 Weigh and record the mass of shale present in the test portion to the nearest 0.1 gram.

7. CALCULATIONS

- 7.1 Calculate the percentage of shale as follows:

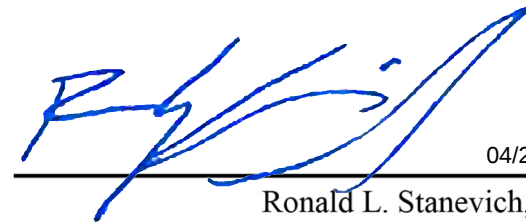
$$S = \left(\frac{M_1}{M_2} \right) \times 100$$

Where:

S = Total percent of shale or shale like pieces in the test portion.

M₁ = Total mass of shale or shale like pieces contained in the test portion.

M₂ = Total mass of coarse aggregate test portion retained on the 4.75 mm (No. 4) sieve



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Ronald L. Stanevich, P.E.

Director

Materials Control, Soils and Testing Division

RLS: Ms

Attachments

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) _____