
Test Procedure for**MICRO-DEVAL ABRASION OF AGGREGATE**

TxDOT Designation: Tex-461-A

Effective Date: November 2016

1. SCOPE

- 1.1 Use this test procedure to determine the Micro-Deval abrasion loss of coarse, intermediate, and fine aggregates. This loss is an indication of an aggregate's resistance to abrasion, weathering, and degradation using the Micro-Deval testing equipment with abrasive stainless steel balls and water.
- 1.2 Determining the Micro-Deval abrasion loss is useful for:
- detecting changes in the properties of aggregate produced from an aggregate source as part of a quality control process,
 - estimating the magnesium sulfate soundness loss of coarse aggregate sources used for hot-mix asphalt (HMA),
 - determining when blending is allowed for fine aggregate sources not meeting the acid insoluble requirements for hydraulic cement concrete, and
 - polishing coarse and fine aggregates for measuring texture and frictional loss properties.
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2. DEFINITION

- 2.1 *Constant Weight*—Aggregates are oven-dried such that they will not lose more than 0.1% moisture after 2 hr. of drying. Limestone Rock Asphalt (LRA) is oven-dried at a temperature of $140 \pm 5^\circ\text{F}$. All other aggregates are oven-dried at a temperature of $230 \pm 9^\circ\text{F}$. Verify constant weight by measuring the moisture content from weighing a sample before and after consecutive 2-hour drying periods.
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3. APPARATUS

- 3.1 *Micro-Deval apparatus*, an enclosed, multi-tiered unit equipped with an electronic controller and an optical sensing system to accurately track the test time and total revolutions, in accordance with AASHTO T 327.
- 3.2 *Micro-Deval container*, jar with a locking cover.
- 3.3 *Micro-Deval abrasive charge*, magnetic stainless steel balls, 9.5 mm diameter.
- 3.4 *Micro-Deval magnet*.
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- 3.5 Standard U.S. sieves, meeting the requirements of Tex-907-K.
- 3.6 Oven, capable of maintaining a temperature of either or both $140 \pm 5^\circ\text{F}$ and $230 \pm 9^\circ\text{F}$.
- 3.7 Balance, Class G2 in accordance with Tex-901-K.

4. PREPARING TEST SAMPLE

4.1 Obtain a representative sample in accordance with Tex-400-A.

4.2 Refer to Table 1 and select a gradation for the test sample.

Note 1—Use Gradations A and B for coarse aggregate stockpiles and Gradation C for coarse and intermediate aggregate stockpiles that best match the material sampled. Refer to the applicable specification for criteria defining aggregate stockpiles as coarse, intermediate, and fine.

Table 1—Sieve Sizes and Aggregate Weights for Preparing Test Samples

| Sieve Size | Gradation A | Gradation B | Gradation C | Fine Aggregate |
|-----------------------------|--------------------------------------|-------------|-------------|----------------|
| | Individual Retained Sieve Weights, g | | | |
| 3/4–1/2" | 660 ± 5 | – | – | – |
| 1/2–3/8" | 330 ± 5 | 750 ± 5 | – | – |
| 3/8–1/4" | 330 ± 5 | 375 ± 5 | 750 ± 5 | – |
| 1/4"–#4 | 180 ± 5 | 375 ± 5 | 750 ± 5 | – |
| #4–#8 | – | – | – | 50 ± 1 |
| #8–#16 | – | – | – | 125 ± 1 |
| #16–#30 | – | – | – | 125 ± 1 |
| #30–#50 | – | – | – | 100 ± 1 |
| #50–#100 | – | – | – | 75 ± 1 |
| #100–#200 | – | – | – | 25 ± 1 |
| Total Weight, g | 1,500 ± 5 | 1,500 ± 5 | 1,500 ± 5 | 500 ± 5 |
| Timer, minutes ¹ | 120 ± 1 | 105 ± 1 | 95 ± 1 | 15 ± 5 |

1. Test all samples at 100 ± 5 revolutions per minute throughout the duration of the test.

4.3 Coarse and Intermediate Aggregate:

4.3.1 Sieve the material into individual size fractions in accordance with Tex-401-A using the applicable sieves listed in Table 1 for the selected gradation.

4.3.2 Thoroughly wash each size fraction individually using a No. 12 sieve until the wash water is clear.

- 4.3.3 Dry the material in an oven to constant weight, as defined in Section 2.1.
- 4.3.4 Proceed to Section 4.5.
- 4.4 *Fine Aggregate:*
- 4.4.1 Thoroughly wash a sufficient amount of material to prepare a test sample using a No. 200 sieve until the wash water is clear.
- 4.4.2 Dry the material in an oven to constant weight, as defined in Section 2.1.
- 4.4.3 Sieve the material into individual size fractions in accordance with Tex-401-A using the applicable sieves listed in Table 1.
- 4.5 Prepare the test sample using the weights listed in Table 1.
- 4.6 Substitute a maximum of 10% from an adjacent sieve listed in Table 1 when there is not enough aggregate for any given sieve to prepare the test sample. Crush parent or coarser aggregate to obtain additional material when necessary.
- 4.7 Record the weight of the test sample, to the nearest 0.1 g, as *A* under Section 7.2.

5. PROCEDURE FOR COARSE AND INTERMEDIATE AGGREGATES

- 5.1 Obtain a clean Micro-Deval container.
- 5.2 Place 5000 ± 5 g of magnetic stainless steel balls into the Micro-Deval container.
- 5.3 Add the test sample prepared in Section 4 to the Micro-Deval container with the steel balls.
- Note 2**—Placing the aggregate test sample into the container after the steel balls will reduce potential abrasion and wear of the aggregate prior to testing.
- 5.4 Add 2000 ± 500 mL of tap water at a temperature of $68 \pm 9^\circ\text{F}$ to the Micro-Deval container with the steel balls and test sample, and let stand for a minimum of 1 hr.
- 5.5 Set the timer on the Micro-Deval machine to the number of minutes listed in Table 1 for the gradation selected, record this time as *T* under Section 7.1, and start the machine.
- 5.6 After the test is completed, record the number of revolutions registered by the tachometer as *N* under Section 7.1.
- 5.7 Calculate the RPM throughout the duration of the test in accordance with Section 7.1.
- 5.8 Stack a No. 4 sieve on top of a No. 16 sieve, and pour the test sample and steel balls from the Micro-Deval container into the No. 4 sieve.
- Note 3**—Pour the test sample and steel balls carefully to prevent any loss of material.

- 5.9 Wash the inside of the Micro-Deval container until it does not contain any material or residue from the test. Pour the wash water into the No. 4 sieve.
Note 4—Wash the inside of the container carefully to prevent any loss of material.
- 5.10 Wash the aggregate and the steel balls retained on the No. 4 sieve with water until the wash water is clear and all materials smaller than No. 16 pass the sieve.
- 5.11 Remove the stainless steel balls using a magnet.
Note 5—Use the magnet carefully to prevent any loss of material.
- 5.12 Combine the aggregate retained on the No. 4 and No. 16 sieves. Discard the material passing the No. 16 sieve.
- 5.13 Oven-dry the combined aggregate to constant weight, as defined in Section 2.1.
- 5.14 Allow the sample to cool to room temperature.
- 5.15 Weigh the sample to the nearest 0.1 g and record as *B* under Section 7.2.
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6. PROCEDURE FOR FINE AGGREGATES

- 6.1 Obtain a clean Micro-Deval container.
- 6.2 Place 1250 ± 5 g of magnetic stainless steel balls into the Micro-Deval container.
- 6.3 Add the test sample prepared in Section 4 to the Micro-Deval container with the steel balls.
Note 6—Placing the aggregate test sample into the container after the steel balls will reduce potential abrasion and wear of the aggregate prior to testing.
- 6.4 Add 750 ± 50 mL of tap water at a temperature of $68 \pm 9^\circ\text{F}$ to the Micro-Deval container with the steel balls and test sample and let stand for a minimum of 1 hr.
- 6.5 Set the timer on the Micro-Deval machine to 15 minutes, record this time as *T* under Section 7.1, and start the machine.
- 6.6 After the test is completed, record the number of revolutions registered by the tachometer as *N* under Section 7.1.
- 6.7 Calculate the RPM throughout the duration of the test in accordance with Section 7.1.
- 6.8 Stack a No. 4 sieve on top of a No. 200 sieve, and pour the test sample and steel balls from the Micro-Deval container into the No. 4 sieve.
Note 7—Pour the test sample and steel balls carefully to prevent any loss of material.
- 6.9 Wash the inside of the Micro-Deval container until it does not contain any material or residue from the test. Pour the wash water into the No. 4 sieve.
Note 8—Wash the inside of the container carefully to prevent any loss of material.
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- 6.10 Wash the aggregate and the steel balls retained on the No. 4 sieve with water until the wash water is clear and all materials smaller than No. 200 pass the sieve.
- 6.11 Remove the stainless steel balls using a magnet.
Note 9—Use the magnet carefully to prevent any loss of material.
- 6.12 Combine the aggregate retained on the No. 4 and 200 sieves. Discard the material passing the No. 200 sieve.
- 6.13 Oven-dry the combined aggregate to constant weight, as defined in Section 2.1.
- 6.14 Allow the sample to cool to room temperature.
- 6.15 Weigh the sample to the nearest 0.1 g and record as *B* under Section 7.2.
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7. CALCULATIONS

- 7.1 Calculate the RPM throughout the duration of the test:

$$RPM = \frac{N}{T}$$

Where:

N = number of revolutions registered by the tachometer of the Micro-Deval machine; and

T = time set on the timer of the Micro-Deval machine, minutes.

- 7.2 Calculate the Micro-Deval abrasion loss:

$$\text{Percent Loss} = \frac{(A - B)}{A} \times 100$$

Where:

A = initial dry weight of the test sample before testing, g

B = final dry weight of the test sample after testing, g.

- 7.3 Round and report the RPM and percent loss to the nearest whole percent.
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8. ARCHIVED VERSIONS

- 8.1 Archived versions are available.