METHOD OF TEST FOR THE
RESISTANCE OF FINE AGGREGATE TO DEGRADATION
BY ABRASION IN THE MICRO-DEVAL APPARATUS

1. SCOPE
1.1 This method covers the testing of fine aggregates to determine their abrasion loss in the presence of water and an abrasive charge. It furnishes information helpful in judging the suitability of fine aggregate subject to weathering action when adequate information is not available from service records.

2. RELEVANT DOCUMENTS
2.4 LS-601, Method of Test for Materials Finer than 75 μm Sieve in Mineral Aggregates by washing.
2.5 LS-602, Method of Test for Sieve Analysis of Aggregates.

3. APPARATUS
3.1 MICRO-DEVAL ABRASION MACHINE: A jar rolling mill capable of running at 100 ± 5 rpm (Figure 1).
3.2 CONTAINERS: Stainless steel, micro-Deval abrasion jars having a 5 litre capacity with a rubber ring in the rotary locking cover. Internal diameter = 194 mm, internal height = 170 mm. The inside and outside surfaces of the jars shall be smooth and have no observable ridges or indentations.
3.3 ABRASION CHARGE: Stainless steel balls are required. These shall have a diameter of 9.5 ± 0.5 mm. Each jar requires a charge of 1250 ± 5 g of balls.

Note 1: Prior to use, new containers and new steel balls should be conditioned. Conditioning is accomplished by running the equipment with a charge of 500 g silica sand with 750 ml of water for a period of four hours. At the end of four hours this procedure must be repeated with a new sand
sample. From time to time it may be necessary to recondition the containers and steel balls, the need for this will be indicated by significant change in loss with the control material. It has been found that reconditioning is usually needed when the equipment has been used for testing carbonate coarse aggregate in MTO LS-618 which leads to polishing of the container and ball surfaces.

3.4 SIEVES: Sieves with square openings, and of the following sizes conforming to ASTM E 11 specifications:

- 2.36 mm
- 1.18 mm
- 600 μm
- 300 μm
- 150 μm
- 75 μm

A minimum 200 mm diameter 75 μm sieve is to be used for washing the aggregate. A 6.7 mm sieve will be found useful for separating the steel balls from the aggregate.

3.5 OVEN: An oven capable of maintaining a temperature of 110 ± 5°C.

3.6 BALANCE: A balance or scale accurate to 0.1 g.

3.7 LABORATORY CONTROL AGGREGATE: A supply of standard screenings (J. Dick) available from the Soils and Aggregates Section, Ministry of Transportation, 1201 Wilson Avenue, Downsview, Ontario, M3M 1J8.

4. SAMPLE PREPARATION

4.1 Aggregate for the test shall consist of material passing the 4.75 mm sieve (fine aggregate). Split a representative 725 ± 25 g sample for the micro-Deval test and place in a sealed container.

5. PROCEDURE

5.1 Wash the sample over a 75 μm sieve until the wash water is clear, as described in MTO Method LS-601, Method of Test for Materials Finer Than 75 μm Sieve in Mineral Aggregates by Washing.

5.2 Oven the sample to a constant mass at a temperature of 110 ± 5°C.

5.3 The sample shall be sieved into separate sizes. The sample shall be made up to an F.M. of 2.8 using the following gradation and then tested:
Record the Mass 'A' to the nearest 0.1 g.

Note 2: Where prior testing has shown the loss on a material from a source to be less than 17 %, a representative 500 ± 5 g sample from the original 700 g sample may be tested without sieving into individual fractions. Testing of low Micro-Deval loss material without sieving into separate fractions has a small effect on the measured loss and may considerably reduce the complexity of the testing. If testing shows this loss to be greater than 17 %, then a further sample shall be tested which has been prepared to a F.M. of 2.8 using the gradation specified in 5.3. This loss shall be reported as the final test result.

5.4 Saturate the sample in tap water for 24 ± 4 hours.
5.5 Pour off the excess water and place the sample in the micro-Deval abrasion container with 1250 ± 5 g of steel balls and 750 ± 25 mL of tap water. Place the micro-Deval container on the machine.
5.6 Run the machine at 100 ± 5 rpm for 15 min ± 10 sec.
5.7 Remove the balls from the sample by passing the sample and water through a 6.7 mm sieve over a pan. Wash the aggregate over a 75 µm sieve, according to the procedure described in LS-601, being careful not to lose any retained 75 µm material.
5.8 Oven dry the sample to a constant mass at 110 ± 5°C.
5.9 Weigh the sample to the nearest 0.1 g. Record the Mass 'B'.

6. CALCULATION

6.1 Calculate the micro-Deval abrasion loss, as follows, to the nearest 0.1 %:

\[ \text{Percent Loss} = \left( \frac{A - B}{A} \right) \times 100 \]
7. USE OF LABORATORY CONTROL AGGREGATE

7.1 Every 10 samples, but at least every week in which a sample is tested, a sample of the standard reference aggregate shall also be tested. The material shall be taken from a stock supply and prepared according to the following procedure: The material shall be sieved into separate sizes, and each size fraction thoroughly washed, and dried to a constant mass. The reference sample shall be made up using the following gradation:

<table>
<thead>
<tr>
<th>Passing</th>
<th>Retained</th>
<th>Mass</th>
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<tbody>
<tr>
<td>4.75 mm</td>
<td>2.36 mm</td>
<td>170 g</td>
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<tr>
<td>2.36 mm</td>
<td>1.18 mm</td>
<td>115 g</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>600 µm</td>
<td>75 g</td>
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<td>600 µm</td>
<td>300 µm</td>
<td>55 g</td>
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<td>150 µm</td>
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<td>35 g</td>
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<td>TOTAL</td>
<td></td>
<td>500 g</td>
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7.2 Control Chart Use: The percent loss of the last twenty samples of reference material shall be plotted on a control chart in order to monitor the variation in results. The average loss of the control material should be 19.9%. Individual test data should not normally be greater than 21.9% or less than 17.9%.

8. REPORT

The Report shall include the following:

8.1 The percent loss of the test sample to one decimal place.

8.2 The percent loss of the reference sample, tested closest to the time at which the aggregate sample was tested, to one decimal place.

8.3 The percent loss of the last twenty samples of reference material on a control chart.

9. PRECISION

9.1 Data indicates that for materials with a micro-Deval loss of between 7 and 38 %, the average multi-laboratory coefficient of variation is about 5%. Therefore, results of two properly conducted tests, in different laboratories, on samples of the same aggregate should not differ from each other by more than 14 % of their average, 19 times in 20.
Dimensions in millimeters

Drive roller

Driven roller

Volume - 5.03 litres
Cylindrical jar

Motor
Motor base

Cogged wheel
Chain
V-belt
Reducing gear
Frame
Shield

Figure 1

Micro-Deval Abrasion Machine and Container
### MICRO - DEVAL ABRASION TEST

<table>
<thead>
<tr>
<th>LAB. NO.</th>
<th>DUE DATE</th>
<th>ORIGINAL MASS g</th>
<th>MASS AFTER TEST g</th>
<th>LOSS g</th>
<th>PERCENT LOSS</th>
<th>PASS 4.75 F.M.</th>
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</table>

**DATE** ___________________  **OPERATOR** ___________________  **CONTROL NO.** ___________________

**REMARKS**

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Figure 2.

Test Data Card