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

1. SCOPE

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

2. RELEVANT DOCUMENTS

2.1 ASTM C 136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

2.2 ASTM E 11, Standard Specification for Wire-Cloth Sieves for Testing purposes.

2.3 LS-602, Method of Test for Sieve Analysis of Aggregates.

2.4 L'Haridon, R.; Essai Micro-Deval destiné a prévior à partir de petits échantillons, les qualitiés routières des roches carottées; Bulletin Liaison Laboratoire Routières Ponts et Chausées, Paris, France, No. 14, pp.1-17/1-21, 1965.

2.5 Chevassu, G.; Variation des résultats de l'essai Deval humide en fonction du nombre de pierres tendres; Bulletin Liaison Laboratoire Routières Ponts et Chausées, Paris, France, No. 41, pp.43-45, 1969.

2.6 Tourenq, C.; L'essai micro-Deval; Bulletin Liaison Laboratoire Routières Ponts et Chausées, Paris, France, No. 50, pp.69-76, 1971.

2.7 BNQ-2560-070; Détermination du coefficient d'usure par attrition à l'aide de l'appareil micro-Deval; Bureau de Normalisation due Québec (BNQ), Ministère de l'Industrie, du Commerce et du Tourisme, Québec G1R 4Z8.

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 = 194.0 mm ± 2.0 mm, external diameter = 200.0 mm ± 1.0 mm, internal height = 175.0 mm ± 2.0 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 5000 ± 5 g of balls.

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

19.0 mm,	16.0 mm,
13.2 mm,	9.5 mm,
6.7 mm,	4.75 mm,
1.18 mm	

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

3.6 BALANCE: A balance or scale accurate to 1.0 g.

3.7 LABORATORY CONTROL AGGREGATE: A supply of standard Brechin coarse aggregate available from the Soils and Aggregates Section, Ministry of Transportation, 1201 Wilson Avenue, Downsview, Ontario M3M 1J8, Fax (416) 235 4101.

4. PREPARATION OF TEST SAMPLE

4.1 Prepare the coarse aggregate in accordance with the Method for Preparation of Coarse Aggregate, MTO Method LS-600 to meet either A, B, or C Grading.

4.2 **A Grading**: Aggregate for the test shall normally consist of material passing the 19.0 mm sieve, retained on the 9.5 mm sieve. An oven dry sample of 1500 ± 5 g shall be prepared as follows:

Passing	Retained	Mass
19.0 mm	16.0 mm	375 g
16.0 mm	13.2 mm	375 g
13.2 mm	9.5 mm	750 g
	Total	1500 g

4.3 **B Grading**: In cases where the maximum nominal size of the coarse aggregate is less than 16.0 mm, a sample of 1500 ± 5 g shall be prepared as follows:

Passing	Retained	Mass
13.2 mm	9.5 mm	750 g
9.5 mm	6.7 mm	375 g
6.7 mm	4.75 mm	375 g
	Total	1500 g

4.4 **C Grading**: In cases where the maximum nominal size of the coarse aggregate is less than 13.2 mm, a sample of 1500 ± 5 g shall be prepared as follows:

Passing	Retained	Mass
9.5 mm	6.7 mm	750 g
6.7 mm	4.75 mm	750 g
	Total	1500 g

5. TEST PROCEDURE

5.1 Wash the sample.

5.2 Oven dry the sample to constant mass.

5.3 Prepare a representative 1500 ± 5 g sample. Record the Mass 'A' to the nearest 1.0 g.

5.4 Saturate the sample in 2.0 ± 0.05 L tap water (temperature 20 ± 5°C) for a minimum of 1 hour.

5.5 Place the sample in the micro-Deval abrasion container with 5000 ± 5 g of steel balls and the water. Place the micro-Deval container on the machine.

Note: It is permissible to saturate the sample in the water within the micro-Deval abrasion container rather than in a separate container.

5.6 Run the machine at 100 ± 5 rpm for the following times based on the preparation of the test sample (refer to Para. 4.2, 4.3, or 4.4):

Time	Test Sample
120 ± 1 minute	A Grading
105 ± 1 minute	B Grading
100 ± 1 minute	C Grading

5.7 Carefully pour the sample over two superimposed sieves: 4.75 mm and 1.18 mm. Take care to remove all of the sample from the stainless steel jar. Wash the retained material with water (a hand-held spray will be found useful) until the washings are clear. Remove the stainless steel balls using a magnet or other suitable means.

5.8 Combine the material retained on the 4.75 mm and 1.18 mm sieves, being careful not to lose any material.

5.9 Oven dry the sample to constant mass at 110 ± 5°C.

5.10 Weigh the sample to the nearest 1.0 g. Record the Mass 'B'.

6. CALCULATIONS

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

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

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 4.2.

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 (Figures 2 and 3).

7.3 The mean loss of the Brechin standard reference aggregate prepared to the grading shown in 4.2 is 16.9% (MTO MI Report 175, 1997). Individual test data should not normally be greater than 18.3%, or less than 15.6%.

8. REPORT

The Report shall include the following:

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

8.2 The maximum size of the aggregate tested and the grading used (A, B, or C).

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

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

9. PRECISION

In a limited study, it was found that the multi-laboratory coefficient of variation varies depending on the level as shown in Table 1. The differences between two samples of the same material tested in two experienced laboratories should only exceed the d2s value shown in column 3 one time in twenty.

Table 1

Material Property % Mean Loss	Coefficient of Variation	d2s % of Value
5	10.0%	28
12	6.4%	18
17	5.6%	16

Ministry of Transportation
Ontario

MICRO - DEVAL ABRASION TEST

LAB. NO.	DUE DATE	ORIGINAL MASS g	MASS AFTER TEST g	LOSS g	PERCENT LOSS	PASS 4.75 F.M.

DATE _____ OPERATOR _____ CONTROL NO. _____

REMARKS

PH-CC-446 90-08

Figure 2

Test Data Card

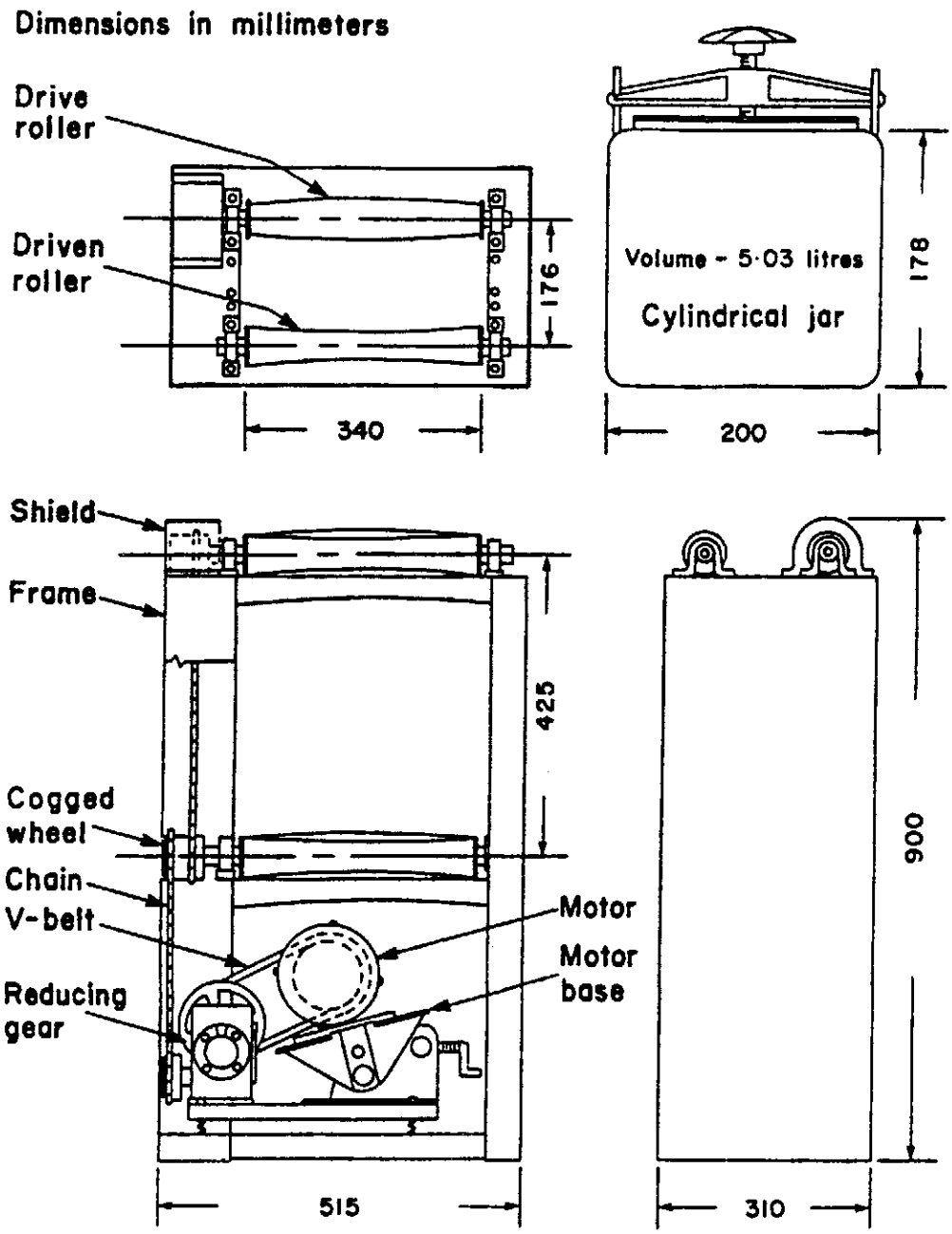

Figure 1

Micro-Deval Abrasion Machine and Container