RESISTANCE TO DEGRADATION OF COARSE AGGREGATE BY ABRASION AND IMPACT IN THE LOS ANGELES ABRASION MACHINE

LS-603 R33/C131/C131M – 14/C535 - 16

3. PROCEDURE

Procedures of ASTM C131 and C535 shall be followed, except as noted below, for the determination of degradation of coarse aggregate by abrasion and impact using the Los Angeles testing machine_____

4. EXCEPTIONS

4.1 SIEVES: Conforming to ASTM E11, except use 13.2 mm sieve size instead of 12.5 mm.....

4.2 Replace ASTM Standard C131 Clause 6.4.1, with Table 1 as follows: .....

Table 1

GRADING	# OF SPHERES	MASS, g
A	12	5000 ± 25
B	11	4580 ± 25
C	8	3330 ± 20
D	9	3740 ± 20

The abrasive charge, depending upon the grading of the test sample as described in Table 2, shall be as follows: .....

Table 2 - Gradation of Test Samples

SIEVE SIZE		MASS OF INDICATED SIZES, g			
PASSING	RETAINED	A	B	C	D
37.5 mm	26.5 mm	1250 ± 25	-	-	-
26.5 mm	19.0 mm	1250 ± 25	-	-	-
*19.0 mm	13.2 mm	1250 ± 10	2500 ± 10	-	2500 ± 10
13.2 mm	9.5 mm	1250 ± 10	2500 ± 10	-	1250 ± 10
* 9.5 mm	4.75 mm	-	-	-	1250 ± 10
9.5 mm	6.7 mm	-	-	2500 ± 10	-
6.7 mm	4.75 mm	-	-	2500 ± 10	-
	TOTAL	5000 ± 10	5000 ± 10	5000 ± 10	5000 ± 10

* Material previously separated into individual sizes shall be recombined in proportion to the original or laboratory crushed gradation.

5. USE OF LABORATORY CONTROL AGGREGATE

5.1 A supply of reference aggregates is available from the Soils and Aggregates Section of the Materials Engineering and Research Office at the Ministry of Transportation (soils-aggregates@ontarion.ca). The reference material may also be taken from a stock supply maintained by the laboratory.

Note: The reference material selected by the laboratory may be calibrated against a supply of Drain Brothers Stoney Lake Quarry stone maintained by the Ministry of Transportation. When prepared to an 11-B grading, the mean loss of the Drain Brothers standard reference aggregate is 26.0% (MERO-036, 2010). Individual test data should not normally be greater than 28.8%, or less than 23.2%.

5.2 At least every week in which a sample is tested, a sample of a reference aggregate shall also be tested.....

RESISTANCE TO DEGRADATION OF COARSE AGGREGATE BY ABRASION AND IMPACT IN THE LOS ANGELES ABRASION MACHINE LS-603 R33/C131/C131M – 14/C535 - 16

5.3 Control Chart Use: The percent loss of the last 20 samples of reference material shall be plotted on a control chart in order to monitor the performance of the laboratory.....

6. REPORT

The report shall also include the following:
6.1 The percent loss of the reference sample, tested closest to the time at which the aggregate sample was tested, to one decimal place.....
6.2 The percent loss of the last 2 samples of reference material on a control chart.....
Laboratories should report as a minimum what is shown in Figure 1 of the LS.....

For inquiries, please contact soils-aggregates@ontario.ca.

ASTM C131 LA Abrasion Small-Size Coarse Aggregates 5. Significance and Use

5.1 This test has been widely used as an indicator of the relative quality or competence of various sources of aggregate having similar mineral compositions. The results do not automatically permit valid comparisons to be made between sources distinctly different in origin, composition, or structure. Assign specification limits with extreme care in consideration of available aggregate types and their performance history in specific end uses. The percent loss determined by this test method has no known consistent relationship to the percent loss for the same material when tested by Test Method C535.

6. Apparatus

6.1 *Los Angeles Machine*—A Los Angles machine, conforming in all essential characteristics to the design shown in Fig. 1 of the ASTM, shall be used.....
The machine shall consist of a hollow steel cylinder, with a wall thickness of at least 12 mm [1⁄2 in.] (Note 3) closed at both ends, conforming to the dimensions shown in Fig. 1, having an inside diameter of 711 ± 5 mm [28 ± 0.2 in.] .....
And an inside length of 508 ± 5 mm [20 ± 0.2 in.] .....
The interior surface of the cylinder shall be free from protrusions disrupting the path of the sample and steel spheres except for the shelf described below.....
The cylinder shall be mounted on stub shafts attached to the ends of the cylinder but not entering it, and shall be mounted in such a manner that it rotates with the axis in a horizontal position within a tolerance in slope of 1 in 100.....
An opening in the cylinder shall be provided for the introduction of the test sample.....
A suitable, dust-tight cover shall be provided for the opening with means for bolting the cover in place.....
The cover shall be so designed as to maintain the cylindrical contour of the interior surface unless the shelf is so located that the steel spheres and sample shall not impact on or near the door opening and the opening cover during the test.....
A removable steel shelf extending the full length of the cylinder and projecting inward 89 ± 2 mm [3.5 ± 0.1 in.] shall be mounted on the interior cylindrical surface of the cylinder, in such a way that a plane centered between the large faces coincides with an axial plane.....

RESISTANCE TO DEGRADATION OF COARSE AGGREGATE BY ABRASION AND IMPACT IN THE LOS ANGELES ABRASION MACHINE LS-603 R33/C131/C131M – 14/C535 - 16

The shelf shall be of such thickness and so mounted, by bolts or other suitable means, as to be firm and rigid.....

The position of the shelf (Note 4) shall be such that the sample and the steel spheres shall not impact on or near the opening and its cover, and that the distance from the shelf to the opening, measured along the outside circumference of the cylinder in the direction of rotation, shall be not less than 1270 mm [50 in.] .....

Inspect the shelf periodically to determine that it is not bent either lengthwise or from its normal radial position with respect to the cylinder. If either condition is found, repair or replace the shelf before further tests are conducted.....

NOTE 3—Tolerances for wall thickness are given in Specification A6/A6M.

NOTE 4—The use of a shelf of wear-resistant steel, rectangular in cross section and mounted independently of the cover, is preferred. However, a shelf consisting of a section of rolled angle, properly mounted on the inside of the cover plate, may be used provided the direction of rotation is such that the charge will be caught on the outside face of the angle.

6.1.1 The machine shall be so driven and so counterbalanced as to maintain a rotation speed of 30 to 33 rpm (Note 5) .....

If an angle is used as the shelf, the direction of rotation shall be such that the charge is caught on the outside surface of the angle.....

NOTE 5—Back-lash or slip in the driving mechanism is very likely to furnish test results which are not duplicated by other Los Angeles machines producing constant peripheral speed.

6.2 *Sieves,* conforming to Specification E11.....

6.3 *Balance*—A balance or scale accurate within 0.1 % of test load over the range required for this test.....

6.4 *Charge*—The charge shall consist of steel spheres or ball bearings each having a diameter of between 46 mm [1 13⁄16 in.] and 48 mm [1 7⁄8 in.] and each having a mass of between 390 and 445 g .....

6.4.1 The charge (steel spheres or ball bearings), (Note 6) depending upon the grading of the test sample as described in Section 8, shall be as follows: .....

Grading	Number of Spheres	Mass of Charge, g
A	12	5000 ± 25
B	11	4580 ± 25
C	8	3330 ± 20
D	6	2500 ± 15

NOTE 6—The total mass specified requires an average mass of each steel sphere or ball bearing of 416 g. Steel spheres or ball bearings 46.0 mm [113⁄16 in.] and 47.6 mm [17⁄8 in.] in diameter, having a mass of approximately 400 and 440 g each, respectively, are readily available. Steel spheres or ball bearings 46.8 mm [127⁄32 in.] in diameter having a mass of approximately 420 g may also be obtainable. The charge may consist of a mixture of these sizes conforming to the mass tolerances of 6.4 and 6.4.1.

RESISTANCE TO DEGRADATION OF COARSE AGGREGATE BY ABRASION AND IMPACT IN THE LOS ANGELES ABRASION MACHINE

7. Sampling

7.1 Obtain the field sample in accordance with Practice D75, and reduce the field sample to adequate sample size in accordance with Practice C702.....

TABLE 1 Gradings of Test Samples

Sieve Size (Square Openings)		Mass of Indicated Sizes, g			
Passing	Retained on	Grading			
		A	B	C	D
37.5 mm (1 1/2 in.)	25.0 mm (1 in.)	1250 ± 25	-	-	-
25.0 mm (1 in.)	19.0 mm (3/4 in.)	1250 ± 25	-	-	-
19.0 mm (3/4 in.)	12.5 mm (1/2 in.)	1250 ± 10	2500 ± 10	-	-
12.5 mm (1/2 in.)	9.5 mm (3/8 in.)	1250 ± 10	2500 ± 10	-	-
9.5 mm (3/8 in.)	6.3 mm (1/4 in.)	-	-	2500 ± 10	-
6.3 mm (1/4 in.)	4.75-mm (No. 4)	-	-	2500 ± 10	-
4.75-mm (No. 4)	2.36-mm (No. 8)	-	-	-	5 000 ± 10
TOTAL		5000 ± 10	5000 ± 10	5000 ± 10	5000 ± 10

8. Test Sample Preparation

8.1 Wash the reduced sample (see 9.1.1) and oven dry at 110 ± 5°C [230 ± 9°F] to a constant mass.....
Separate into individual size fractions, and recombine to the grading of Table 1 most nearly corresponding to the range of sizes in the aggregate as furnished for the work.....
Record the mass of the sample prior to test to the nearest 1 g.....

9. Procedure

9.1 Place the test sample and the charge in the Los Angeles testing machine and rotate the machine at a speed of 30 to 33 r/min for 500 revolutions (Note 7) .....
After the prescribed number of revolutions, discharge the material from the machine and make a preliminary separation of the sample on a sieve coarser than the 1.70-mm (No. 12) sieve.....
Sieve the finer portion on a 1.70-mm (No. 12) sieve in a manner conforming to Test Method C136.....
Wash the material coarser than the 1.70-mm (No. 12) sieve and oven-dry at 110 ± 5°C [230 ± 9°F] to a constant mass, and determine the mass to the nearest 1 g (Note 8) .....

NOTE 7—Valuable information concerning the uniformity of the sample under test may be obtained by determining the loss after 100 revolutions. The loss should be determined by dry sieving the material on the 1.70-mm sieve without washing. The ratio of the loss after 100 revolutions to the loss after 500 revolutions should not greatly exceed 0.20 for material of uniform hardness. When this determination is made, take care to avoid losing any part of the sample; return the entire sample, including the dust of fracture, to the testing machine for the final 400 revolutions required to complete the test.

NOTE 8—Elimination of washing after test will seldom reduce the measured loss by more than about 0.2 % of the original sample mass.

RESISTANCE TO DEGRADATION OF COARSE AGGREGATE BY ABRASION AND IMPACT IN THE LOS ANGELES ABRASION MACHINE LS-603 R33/C131/C131M – 14/C535 - 16

9.1.1 If the aggregate is essentially free of adherent coatings and dust, the requirement for washing after the test is optional.....
However, in the case of referee testing, the washing procedure shall be performed.....

10. Calculation

10.1 Calculate the loss (difference between the original mass and the final mass of the test sample) as a percentage of the original mass of the test sample.....
Report this value as the percent loss (Note 9) .....
NOTE 9—The percent loss determined by this test method has no known consistent relationship to the percent loss for the same material when tested by Test Method C535.
And shall be calculated as follows: .....
Percent Loss = $[(C - Y) / C]$ X 100 (1)

where:
C = mass of original test sample, g, and
Y = final mass of the test sample, g.

11. Report

11.1 Report the following information:
11.1.1 Identification of the aggregate as to source, type, and nominal maximum size; .....
11.1.2 Grading designation from Table 1 used for the test; .....
11.1.3 Loss by abrasion and impact of the sample expressed to the nearest 1 % by mass.....

ASTM C535 LA Abrasion Large-Size Coarse Aggregates 5. Significance and Use

5.1 The test has been widely used as an indicator of the relative quality or competence of various sources of aggregate having similar mineral compositions. The results do not automatically permit valid comparisons to be made between sources distinctly different in origin, composition, or structure. Assign specification limits with extreme care in consideration of available aggregate types and their performance history in specific end uses.

6. Apparatus

6.1 *The Los Angeles Machine* shall conform to the requirements of Test Method C131/C131M.....
6.1.1 The operation and maintenance of the machine shall be as prescribed in Test Method C131/C131M.....
6.2 *Sieves,* conforming to Specification E11.....
6.3 *Balance*—A balance or scale accurate within 0.1 % of test load over the range required for this test.....
6.4 *Charge*—The charge (Note 2) shall consist of 12 steel spheres averaging approximately 47 mm (127⁄32 in.) in diameter, each having a mass between 390 and 445 g, and having a total mass of 5000 ± 25 g.....
NOTE 2—Steel ball bearings 46.0 mm (113⁄16 in.) and 47.6 mm (17⁄8 in.) in diameter, having a mass approximately 400 and 440 g each, respectively, are readily available. Steel spheres

46.8 mm (127⁄32 in.) in diameter having a mass approximately 420 g may also be obtainable. The charge may consist of a mixture of these sizes conforming to the total mass tolerance of 6.4.

TABLE 1 Gradings of Test Samples

Sieve Size (in.) (Square Openings)		Mass of Indicated Sizes, g		
Passing	Retained on	Grading		
		1	2	3
75 (3)	63 (2 1⁄2)	2 500 ± 50	-	-
63 (2 1⁄2)	50 (2)	2 500 ± 50	-	-
50 (2)	37.5 (1 1⁄2)	5 000 ± 50	5 000 ± 50	-
37.5 (1 1⁄2)	25.0 (1)	-	5 000 ± 25	5 000 ± 25
25.0 (1)	19.0 (3⁄4)	-	-	5 000 ± 25
	TOTAL	10 000 ± 100	10 000 ± 75	10 000 ± 50

7. Sampling

7.1 Obtain the field sample in accordance with Practice D75/D75M and reduce to an adequate sample size in accordance with Practice C702/C702M.....

8. Test Sample Preparation

8.1 Wash the reduced sample and oven dry at 110 ± 5°C (230 ± 9°F) to substantially constant mass
Separate into individual size fractions, and recombine to the grading of Table 1 most nearly corresponding to the range of sizes in the aggregate as furnished for the work. Record the mass of the sample prior to test to the nearest 1 g.....

9. Procedure

9.1 Place the test sample and charge in the Los Angeles testing machine and rotate the machine at 30 to 33 r/min for 1000 revolutions (Note 3) .....
After the prescribed number of revolutions, discharge the material from the machine and make a preliminary separation of the sample on a sieve coarser than the 1.70-mm (No. 12) sieve.....
Sieve the finer portion on a 1.70-mm sieve in a manner conforming to Test Method C136/C136M
Wash the material coarser than the 1.70-mm sieve and oven dry at 110 ± 5°C (230 ± 9°F) to substantially constant mass, and determine the mass to the nearest 1 g.....
9.1.1 If the aggregate is essentially free of adherent coatings and dust, the requirement for washing after the test is optional.....
However, in the case of referee testing, the washing procedure shall be performed.....
Elimination of washing after test will seldom reduce the measured loss by more than about 0.2 % of the original sample mass.....
NOTE 3—Valuable information concerning the uniformity of the sample under test may be obtained by determining the loss after 200 revolutions. This loss should be determined by dry sieving the material on the 1.70-mm (No. 12) sieve without washing. The ratio of the loss after 200 revolutions to the loss after

1000 revolutions should not greatly exceed 0.20 for material of uniform hardness. When this determination is made, take care to avoid losing any part of the sample; return the entire sample, including the dust of fracture, to the testing machine for the final 800 revolutions required to complete the test.

10. Calculation

10.1 Calculate the loss (the difference between the original mass and the final mass of the test sample) as a percentage of the original mass of the test sample (Note 4) ....._____

NOTE 4—The percent loss determined by this method has no known consistent relationship to the percent loss for the same material when tested by Test Method C131/C131M.

11. Report

11.1 Report the following information:

11.2 Identification of the aggregate as to source, type, and nominal size, ..._____

11.3 Grading designation from Table 1 used for the test, ..._____

11.4 Loss by abrasion and impact of the sample expressed to the nearest 1 % by mass....._____

COMMENTS