



# Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine<sup>1</sup>

This standard is issued under the fixed designation C131/C131M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This test method covers a procedure for testing of coarse aggregates with a maximum size smaller than 37.5 mm [ $1\frac{1}{2}$  in.] for resistance to degradation using the Los Angeles testing machine (**Note 1**).

**NOTE 1**—A procedure for testing coarse aggregate larger than 19.0 mm [ $\frac{3}{4}$  in.] is covered in Test Method **C535**. Thus coarse aggregates with a maximum size between 19 mm [ $\frac{3}{4}$  in.] and 37.5 mm [ $1\frac{1}{2}$  in.] may be tested by Test Method **C535** or Test Method C131/C131M.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

**NOTE 2**—Sieve size is identified by its standard designation in Specification **E11**. The Alternative designation given in parentheses is for information only and does not represent a different standard sieve size.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

**A6/A6M** Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling  
**C125** Terminology Relating to Concrete and Concrete Aggregates

**C136** Test Method for Sieve Analysis of Fine and Coarse Aggregates

**C535** Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

**C670** Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

**C702** Practice for Reducing Samples of Aggregate to Testing Size

**D75** Practice for Sampling Aggregates

**E11** Specification for Woven Wire Test Sieve Cloth and Test Sieves

## 3. Terminology

3.1 **Definitions**—For definitions of terms used in this test method, refer to Terminology **C125**.

## 4. Summary of Test Method

4.1 This test is a measure of degradation of mineral aggregates of standard gradings resulting from a combination of actions including abrasion or attrition, impact, and grinding in a rotating steel drum containing a specified number of steel spheres, the number depending upon the grading of the test sample. As the drum rotates, a shelf plate picks up the sample and the steel spheres, carrying them around until they are dropped to the opposite side of the drum, creating an impact-crushing effect. The contents then roll within the drum with an abrading and grinding action until the shelf plate picks up the sample and the steel spheres, and the cycle is repeated. After the prescribed number of revolutions, the contents are removed from the drum and the aggregate portion is sieved to measure the degradation as percent loss.

## 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

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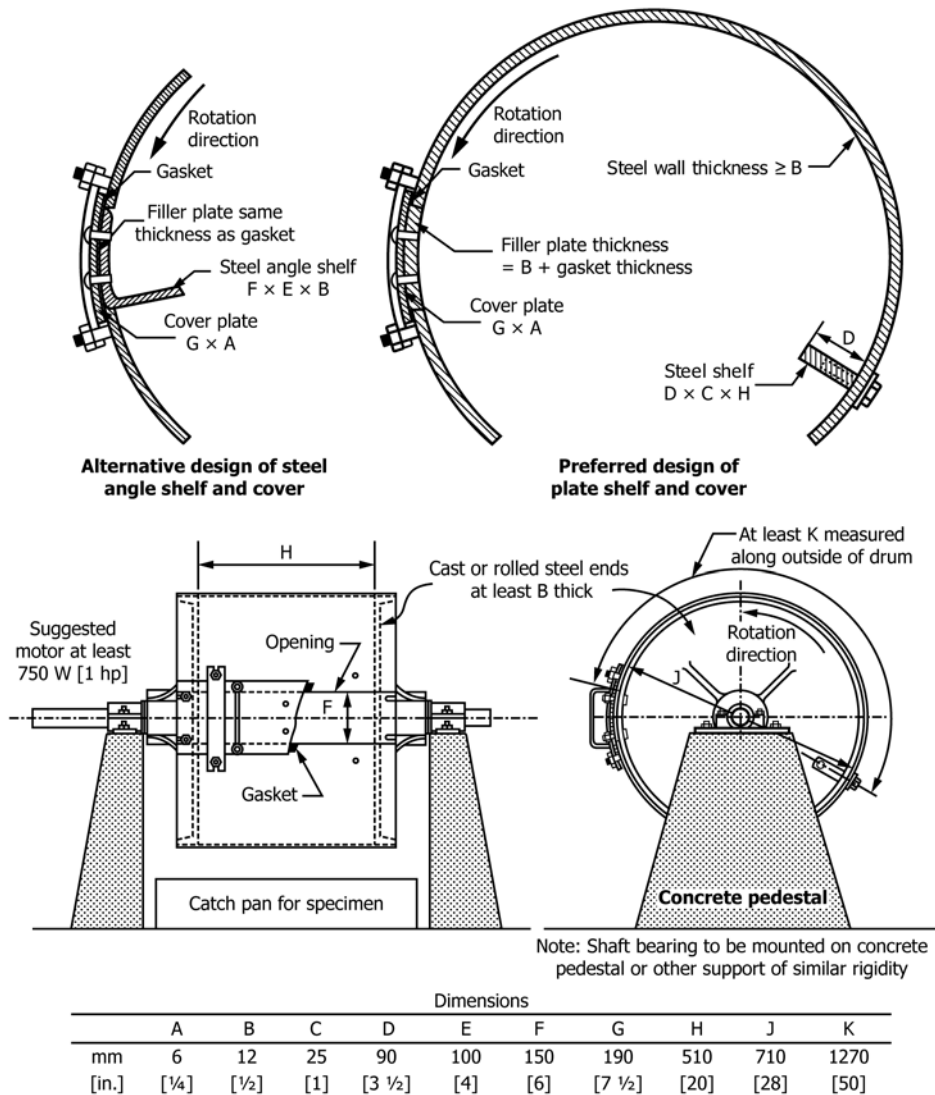
<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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 Angeles machine, conforming in all essential characteristics to the design shown in Fig. 1, shall be used. The machine shall consist of a hollow steel cylinder, with a wall thickness of at least 12 mm [ $\frac{1}{2}$  in.] (Note 3) closed at both ends, conforming to the dimensions shown in Fig. 1, having an inside diameter of  $711 \pm 5$  mm [ $28 \pm 0.2$  in.], and an inside length of  $508 \pm 5$  mm [ $20 \pm 0.2$  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  $89 \pm 2$  mm [ $3.5 \pm 0.1$  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. 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



**FIG. 1 Los Angeles Testing Machine**



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 [ $1\frac{13}{16}$  in.] and 48 mm [ $1\frac{7}{8}$  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 [ $1\frac{13}{16}$  in.] and 47.6 mm [ $1\frac{7}{8}$  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 [ $1\frac{27}{32}$  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.

## 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.

## 8. Test Sample Preparation

8.1 Wash the reduced sample (see 9.1.1) and oven dry at  $110 \pm 5^\circ\text{C}$  [ $230 \pm 9^\circ\text{F}$ ] 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  $110 \pm 5^\circ\text{C}$  [ $230 \pm 9^\circ\text{F}$ ] 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.

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.

$$\text{Percent Loss} = [(C - Y) / C] \times 100 \quad (1)$$

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 ( $1\frac{1}{2}$ in.)	25.0 mm (1 in.)	1 250 ± 25	...	...	...
25.0 mm (1 in.)	19.0 mm ( $\frac{3}{4}$ in.)	1 250 ± 25	...	...	...
19.0 mm ( $\frac{3}{4}$ in.)	12.5 mm ( $\frac{1}{2}$ in.)	1 250 ± 10	2 500 ± 10	...	...
12.5 mm ( $\frac{1}{2}$ in.)	9.5 mm ( $\frac{3}{8}$ in.)	1 250 ± 10	2 500 ± 10	...	...
9.5 mm ( $\frac{3}{8}$ in.)	6.3 mm ( $\frac{1}{4}$ in.)	...	...	2 500 ± 10	...
6.3 mm ( $\frac{1}{4}$ in.)	4.75-mm (No. 4)	...	...	2 500 ± 10	...
4.75-mm (No. 4)	2.36-mm (No. 8)	...	...	...	5 000 ± 10
Total		5 000 ± 10	5 000 ± 10	5 000 ± 10	5 000 ± 10



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; and

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

## 12. Precision and Bias

12.1 For nominal 19.0-mm ( $\frac{3}{4}$ -in.) maximum size coarse aggregate with percent losses in the range of 10 to 45 %, the multilaboratory coefficient of variation has been found to be

4.5 %.<sup>3</sup> Therefore, results of two properly conducted tests from two different laboratories on samples of the same coarse aggregates are not expected to differ from each other by more than 12.7 %<sup>3</sup> (95 % probability) of their average. The single-operator coefficient of variation has been found to be 2.0 %.<sup>3</sup> Therefore, results of two properly conducted tests by the same operator on the same coarse aggregate are not expected to differ from each other by more than 5.7 % (95 % probability) of their average.<sup>3</sup>

12.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for this procedure, no statement on bias is being made.

## 13. Keywords

13.1 abrasion; aggregate (coarse; small size); degradation; impact; Los Angeles machine

<sup>3</sup> These numbers represent, respectively, the (1s%) and (d2s%) limits as described in Practice [C670](#).

## APPENDIX

### (Nonmandatory Information)

#### X1. MAINTENANCE OF SHELF

X1.1 The shelf of the Los Angeles machine is subject to severe surface wear and impact. With use, the working surface of the shelf is peened by the balls and tends to develop a ridge of metal parallel to and about 32 mm [ $1\frac{1}{4}$  in.] from the junction of the shelf and the inner surface of the cylinder. If the shelf is made from a section of rolled angle, not only may this ridge develop but the shelf itself may be bent longitudinally or transversely from its proper position.

X1.2 The shelf should be inspected 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, the shelf should be repaired or replaced before further tests are made. The influence on the test result of the ridge developed by peening of the working face of the shelf is not known. However, for uniform test conditions, it is recommended that the ridge be ground off if its height exceeds 2 mm [0.1 in.].

## SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this standard since the last issue (C131 – 06) that may impact the use of this standard. (Approved July 1, 2014.)

(1) Revised the standard into a dual measurement system with the units of measurement now stated in either SI units or inch-pound units.

(2) Revised Sections 1, 5, 6, 8, 9.

(3) Revised Notes 1, 3, and 6.

(4) Added Note 2.

(5) Repositioned Notes 7 and 8.

(6) Added Eq. 1.

(7) Replaced Fig. 1.



## **C131/C131M – 14**

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