



## 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 C 131; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

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

### 1. Scope \*

1.1 This test method covers a procedure for testing sizes of coarse aggregate smaller than 37.5 mm (1½ 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 (¾ in.) is covered in Test Method C 535.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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:

C 125 Terminology Relating to Concrete and Concrete Aggregates<sup>2</sup>

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates<sup>2</sup>

C 535 Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine<sup>2</sup>

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials<sup>2</sup>

C 702 Practice for Reducing Samples of Aggregate to Testing Size<sup>2</sup>

D 75 Practice for Sampling Aggregates<sup>3</sup>

E 11 Specification for Wire-Cloth and Sieves for Testing Purposes<sup>4</sup>

### 3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology C 125.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.20 on Normal Weight Aggregates.

Current edition approved Aug. 10, 2001. Published October 2001. Originally published as C 131 – 37 T. Last previous edition C 131 – 96.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.03.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.02.

### 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

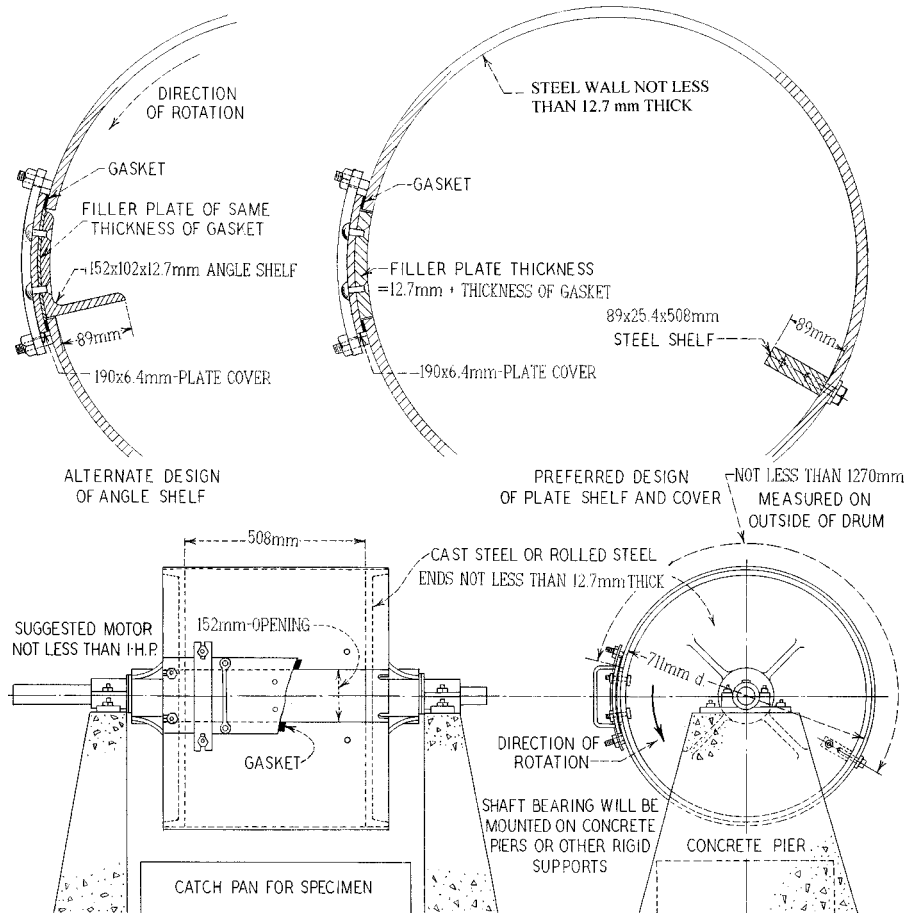
5.1 This test has been widely used as an indicator of the relative quality or competence of various sources of aggregate having similar mineral compositions. The results do not automatically permit valid comparisons to be made between sources distinctly different in origin, composition, or structure.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

### 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, 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 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 may be rotated 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 charge will not fall on the cover, or come in

\*A Summary of Changes section appears at the end of this standard.

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**Inch Equivalents**

|     |     |      |      |    |     |     |     |     |     |      |
|-----|-----|------|------|----|-----|-----|-----|-----|-----|------|
| mm  | 6.4 | 12.7 | 25.4 | 89 | 102 | 152 | 190 | 508 | 711 | 1270 |
| in. | ¼   | ½    | 1    | 3½ | 4   | 6   | 7½  | 20  | 28  | 50   |

**FIG. 1 Los Angeles Testing Machine**

contact with it 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 2) 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 2—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 substantially uniform peripheral speed

(Note 3). 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 3—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 E 11.

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 averaging approximately 46.8 mm ( $1\frac{7}{32}$  in.) in diameter and each having a mass of between 390 and 445 g.

6.4.1 The charge, (Note 4) 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                | 4584 ± 25         |
| C       | 8                 | 3330 ± 20         |
| D       | 6                 | 2500 ± 15         |

NOTE 4—Steel ball bearings 46.0 mm ( $1\frac{3}{16}$  in.) and 47.6 mm ( $1\frac{7}{32}$  in.) in diameter, having a mass of approximately 400 and 440 g each, respectively, are readily available. Steel spheres 46.8 mm ( $1\frac{7}{32}$  in.) in diameter having a mass of approximately 420 g may also be obtainable.



**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 (1½ in.)             | 25.0 mm (1 in.) | 1 250 ± 25                 | ...        | ...        | ...        |
| 25.0 mm (1 in.)              | 19.0 mm (¾ in.) | 1 250 ± 25                 | ...        | ...        | ...        |
| 19.0 mm (¾ in.)              | 12.5 mm (½ in.) | 1 250 ± 10                 | 2 500 ± 10 | ...        | ...        |
| 12.5 mm (½ in.)              | 9.5 mm (⅜ in.)  | 1 250 ± 10                 | 2 500 ± 10 | ...        | ...        |
| 9.5 mm (⅜ in.)               | 6.3 mm (¼ in.)  | ...                        | ...        | 2 500 ± 10 | ...        |
| 6.3 mm (¼ 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 |

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 D 75, and reduce the field sample to adequate sample size in accordance with Practice C 702.

### 8. Test Sample Preparation

8.1 Wash and oven dry the reduced sample at 110 ± 5°C (230 ± 9°F) to substantially constant mass (see 9.1.1), 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 5) 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 the finer portion on a 1.70-mm sieve in a manner conforming to Test Method C 136. Wash the material coarser than the 1.70-mm sieve and oven-dry at 110 ± 5°C (230 ± 9°F) to substantially constant mass (see 9.1.1), and determine the mass to the nearest 1 g (Note 6).

9.1.1 If the aggregate is essentially free of adherent coatings and dust, the requirement for washing after test may be waived, but drying before the test is always required. However, in the case of referee testing, the washing procedure shall be performed.

NOTE 5—Valuable information concerning the uniformity of the sample under test may be obtained by determining the loss after 100 revolutions. This loss should be determined without washing the material coarser than the 1.70-mm sieve. 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 6—Elimination of washing after test will seldom reduce the measured loss by more than about 0.2 % of the original sample mass.

### 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 7).

NOTE 7—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 C 535.

### 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 (¾-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>5</sup> Therefore, results of two properly conducted tests from two different laboratories on samples of the same coarse aggregates should not differ from each other by more than 12.7 %<sup>5</sup> of their average. The single-operator coefficient of variation has been found to be 2.0 %.<sup>5</sup> Therefore, results of two properly conducted tests by the same operator on the same coarse aggregate should not differ from each other by more than 5.7 % of their average.<sup>5</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>5</sup> These numbers represent, respectively, the (1S%) and (D2S%) limits as described in Practice C 670.



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## **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 (1¼ 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 deter-

mine 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**

This section identifies the location of changes to this test method that have been incorporated since the last issue.

(1) References to notes were updated.

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