
**Aggregates for concrete — Test
methods for mechanical and physical
properties —**

**Part 2:
Method for determination of
resistance to fragmentation by Los
Angeles Test (LA-Test)**

*Granulats pour béton — Méthodes d'essai relatives aux propriétés
mécaniques et physiques —*

*Partie 2: Partie 2: Méthode de détermination de la résistance à la
fragmentation par l'essai Los Angeles*



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Foreword

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This document was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 1, *Test methods for concrete*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

A list of all parts in the ISO 20290 series can be found on the ISO website.

Aggregates for concrete — Test methods for mechanical and physical properties —

Part 2: Method for determination of resistance to fragmentation by Los Angeles Test (LA-Test)

1 Scope

This document describes the Los Angeles test, for determining the resistance to fragmentation of coarse aggregates.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

Los Angeles coefficient

LA

percentage of the *test portion* (3.1) passing a pre-determined sieve after completion of the test

3.2

test portion

sample used as a whole in a single test

3.3

laboratory sample

reduced sample derived from a bulk sample for laboratory testing

3.4

constant mass

series of successive weighings after drying at least 1 h apart not differing by more than 0,1 %

Note 1 to entry: In many cases, constant mass can be achieved after a *test portion* (3.1) has been dried for a pre-determined period in a specified oven (see 5.1.3) at (105 ± 5) °C. Test laboratories may determine the time required to achieve constant mass for specific types and sizes of sample dependent on the drying capacity of the oven used.

4 Sampling

The sample used for the test (the laboratory sample) may be taken in accordance with the procedure described in the relevant national standards.

5 Apparatus

5.1 General

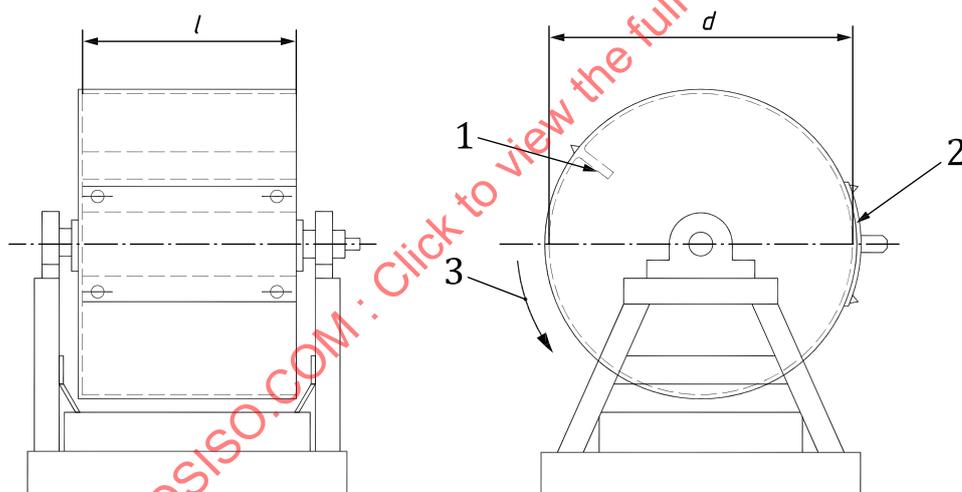
5.1.1 Test sieves, conforming to ISO 565 or relevant national standards with aperture sizes as 1,6 mm, 10 mm, 11,2 mm (or 12,5 mm), 14 mm and 20 mm.

5.1.2 Balance, capable of weighing the test portion to an accuracy of 0,1 % of the mass of the test portion.

5.1.3 Ventilated oven, controlled to maintain a temperature of $(105 \pm 5) ^\circ\text{C}$.

5.1.4 Equipment, for reducing the laboratory sample to a test portion. National standards may be referred.

5.2 Los Angeles test machine — [Figure 1](#) shows a typical Los Angeles machine.



Key

- d internal diameter (711 ± 5) mm
- l internal length (508 ± 5) mm
- 1 shelf
- 2 cover and opening
- 3 rotation

Figure 1 — A typical Los Angeles machine

5.2.1 Hollow drum, made of structural steel plate thickness within the range 11,5 mm to 13 mm and, conforming to suitable grade so that it can be formed without undue stress, and can be welded without significant distortion.

The drum shall be closed at both ends. It shall have an internal diameter of (711 ± 5) mm and an internal length of (508 ± 5) mm. The drum shall be supported on two horizontal stub axles fixed to its two

end walls but not penetrating inside the drum. The drum shall be mounted so that it rotates about a horizontal axis.

An opening (150 ± 3) mm wide shall be provided, preferably over the whole length of the drum, to facilitate insertion and removal of the sample after the test. During the test, the opening shall be sealed so that it is dust-proof, by using a removable cover which enables the inside surface to remain cylindrical.

The cylindrical inner surface shall be interrupted by a projecting shelf, placed between 380 mm and 820 mm from the nearest edge of the opening. The distance shall be measured along the inside of the drum in the direction of rotation. The shelf shall have a rectangular cross section [length equal to that of the drum, width (90 ± 2) mm, thickness (25 ± 1) mm]. It shall also be placed in a diametrical plane, along a generating line, and shall be rigidly fixed in place.

The shelf shall be replaced when its width at any point wears to less than 86 mm and its thickness at any point along the front edge wears to less than 23 mm.

The base of the machine shall be supported directly on a level concrete or stone block floor.

The removable cover should be made of the same steel as the drum. The projecting shelf should be made of the same steel or a harder grade.

5.2.2 Ball load, consisting of 11 spherical steel balls, each with a diameter of between 45 mm and 49 mm. Each ball shall weigh between 400 g and 445 g, and the total load shall weigh between 4 690 g and 4 860 g.

NOTE 1 The nominal mass of the charge with new balls is 4 840 g. A positive tolerance of 20 g allows for manufacturing variation and a negative tolerance of 150 g allows for ball wear in use.

NOTE 2 Steel balls with different combinations of number and mass can be used in national standards.

5.2.3 Motor, imparting a rotational speed to the drum of between 30 revolutions per minute and 33 revolutions per minute.

5.2.4 Tray, for recovering the material and the ball load after testing.

5.2.5 Revolution counter, which automatically stops the motor after the required number of revolutions.

6 Determination of resistance to fragmentation by the Los Angeles test method

6.1 Principle

A sample of aggregate is rolled with steel balls in a rotating drum. After rolling is complete, the quantity of material retained on a 1,7 mm sieve is determined.

6.2 Preparation of test portion

The mass of the sample sent to the laboratory shall have at least 15 kg of particles in the 10 mm to 20 mm size range.

The test shall be carried out on aggregate passing the 20 mm test sieve and retained on the 10 mm test sieve.

In addition, the grading of the test portion shall comply with one of the following requirements:

- a) between 60 % and 70 % passing a 12,5 mm test sieve; or
- b) between 30 % and 40 % passing a 11,2 mm test sieve.

The additional grading requirements allow the test portion to be created from product sizes other than 10/20. The test portion for the product sizes other than 10/20 shall be done as per [Annex A](#) and [Annex B](#).

NOTE 1 Grading divisions as per respective national standards can be used.

Sieve the laboratory sample using the 10 mm, 11,2 mm (or 12,5 mm) and 20 mm test sieves to give separate fractions in the ranges 10 mm to 11,2 mm (or 12,5 mm) and 11,2 mm (or 12,5 mm) to 20 mm. Wash each fraction separately and dry them to constant mass.

NOTE 2 For temperature-sensitive recycled aggregates, a drying temperature of (40 ± 5) °C is used.

Allow the fractions to cool to ambient temperature. Mix the two fractions to provide a modified 10 mm to 20 mm laboratory sample which complies with the appropriate additional grading requirement given above. Reduce the modified laboratory sample prepared from the mixed fractions to test portion size. The test portion shall have a mass of $(5\ 000 \pm 5)$ g.

6.3 Test procedure

Check that the drum is clean before loading the sample. Carefully place the balls in the machine, then the test portion. Replace the cover and rotate the machine for 500 revolutions at a constant speed between 30 revolutions per min and 33 revolutions per min.

Pour the aggregate into a tray placed under the apparatus, taking care that the opening is just above the tray in order to avoid losing any material. Clean out the drum, removing all fines, paying particular attention around the projecting shelf. Carefully remove the ball load from the tray, taking care not to lose any aggregate particles.

Analyse the material from the tray by washing and sieving using a 1,6 mm sieve. Dry the portion retained on the 1,7 mm sieve at a temperature of (105 ± 5) °C (or lower, see NOTE 3 to [6.2](#)) until a constant mass is achieved.

6.4 Calculation and expression of results

Calculate the Los Angeles coefficient, *LA*, from [Formula \(1\)](#):

$$LA = \frac{5\ 000 - m}{50} \quad (1)$$

where *m* is the mass retained on the 1,7 mm sieve, in grams.

Report the result to the nearest whole number.

6.5 Test report

The test report shall include at least the following information:

- a) confirmation that the Los Angeles test was carried out in accordance with this document (i.e. ISO 20290-2);
- b) name and origin of sample;
- c) size fractions from which the test portion was obtained;
- d) Los Angeles coefficient, *LA*.

Annex A (normative)

Determination of the resistance to fragmentation of aggregates for larger size aggregates

A.1 Apparatus

A.1.1 General

[Clause 5](#) applies with the following modifications.

A.1.1.1 Test sieves, conforming to ISO 565 with aperture sizes as 31,5 mm (or 25 mm); 40 mm; 50 mm.

A.1.1.2 Ball load, consisting of 12 spherical steel balls instead of 11. The total load shall weigh $(5\,210 \pm 90)$ g.

A.2 Determination of the resistance to fragmentation by the Los Angeles test method

[Clause 6](#) applies with the following modifications.

A.2.1 Preparation of test portion

The mass of the sample sent to the laboratory shall have at least 15 kg of particles in the 31,5 mm (or 25 mm) to 50 mm size range. The test shall be carried out on aggregates passing the 50 mm test sieve and retained on the 31,5 mm (or 25 mm) test sieve. Sieve the laboratory sample using the 31,5 mm (or 25 mm), 40 mm and 50 mm test sieves to give separate fractions in the ranges 31,5 mm (or 25 mm) to 40 mm and 40 mm to 50 mm. Wash each fraction separately and dry them in the oven at (105 ± 5) °C to constant mass. Allow the fractions to cool to ambient temperature.

Reduce the mass of the fractions. Each fraction shall have a mass of $(5\,000 \pm 50)$ g. Mix the two fractions to provide a 31,5 mm (or 25 mm) to 50 mm test portion. The test portion shall have a mass of $(10\,000 \pm 100)$ g.

A.2.2 Test procedure

Rotate the machine for 1 000 revolutions instead of 500.

A.2.3 Calculation and expression of results

Calculate the Los Angeles coefficient, *LA* from [Formula \(A.1\)](#):

$$LA = \frac{10\,000 - m}{100} \quad (\text{A.1})$$

A.2.4 Test report

The test report shall affirm that the Los Angeles test was carried out in accordance with this annex. It shall include the following information:

c) size fraction used in the test.