INTERNATIONAL STANDARD

ISO 20290-4

First edition
2019-11

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

Part 4: Determination of ten percent fines value (*TFV*)

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

Partie 4: Partie 4: Détermination de la valeur à dix pour cent de fines (TFV)

Reference number
ISO 20290-4:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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 4: Determination of ten percent fines value (TFV)

1 Scope

This document gives the test method for determination of ten percent fines value (*TFV*) of aggregates. This method gives a relative measure of the resistance of the aggregate crushing under the gradually applied compressive load.

It covers two sets of procedures:

— the first procedure is applicable for aggregates tested in dry condition; and

— the second procedure is applicable for aggregates tested in a soaked condition.

NOTE 1 Generally, the test can be done under dry conditions. However, the engineer in charge can choose to test them in soaked condition, if necessary.

The method is applicable to aggregates of different strengths covering both weak and strong aggregates. It is applicable to standards aggregates, i.e. passing a 14,0 mm test sieve and retained on 10,0 mm test sieve.

National standards can also exist for the aggregate size fraction to be taken for this test. In case this definite size fraction is not available, the test can be made on other sizes, given in Annex A. The comparison of results of non-standard sizes with standard size aggregates is not possible due to lack of available data.

NOTE 2 Minor variations in grading divisions can be allowed in respective national standards.

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
ten percent fines value
TFV
force required to produce ten percent fines with the percentage of material passing in the range 7,5 % to 12,5 %, from Formula (1):

$$TFV = \frac{14\,F_{max}}{m+4} \quad (1)$$

where

F_{max} is the maximum force (in kN);

m is the percentage of material passing the 2,36 mm test sieve at the maximum force.

4 Principle

A test sample of aggregates is compacted in a specified manner into a steel cylinder fitted with a freely moving plunger. The sample is then subjected to a load applied through the plunger. The aggregate gets crushed under this load. The degree of crushing depends on the crushing resistance of the aggregates, which is assessed by a sieving test on the crushed sample. The procedures repeated with various loads to determine the maximum force which generates a given sieve analysis. This maximum force is taken as the *TFV*.

5 Sampling

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

6 Apparatus

6.1 General apparatus

6.1.1 Compression testing machine, capable of applying any force up to 500 kN and which can be operated to give a uniform rate of loading so that this force is reached in 10 min (see 8.1.2).

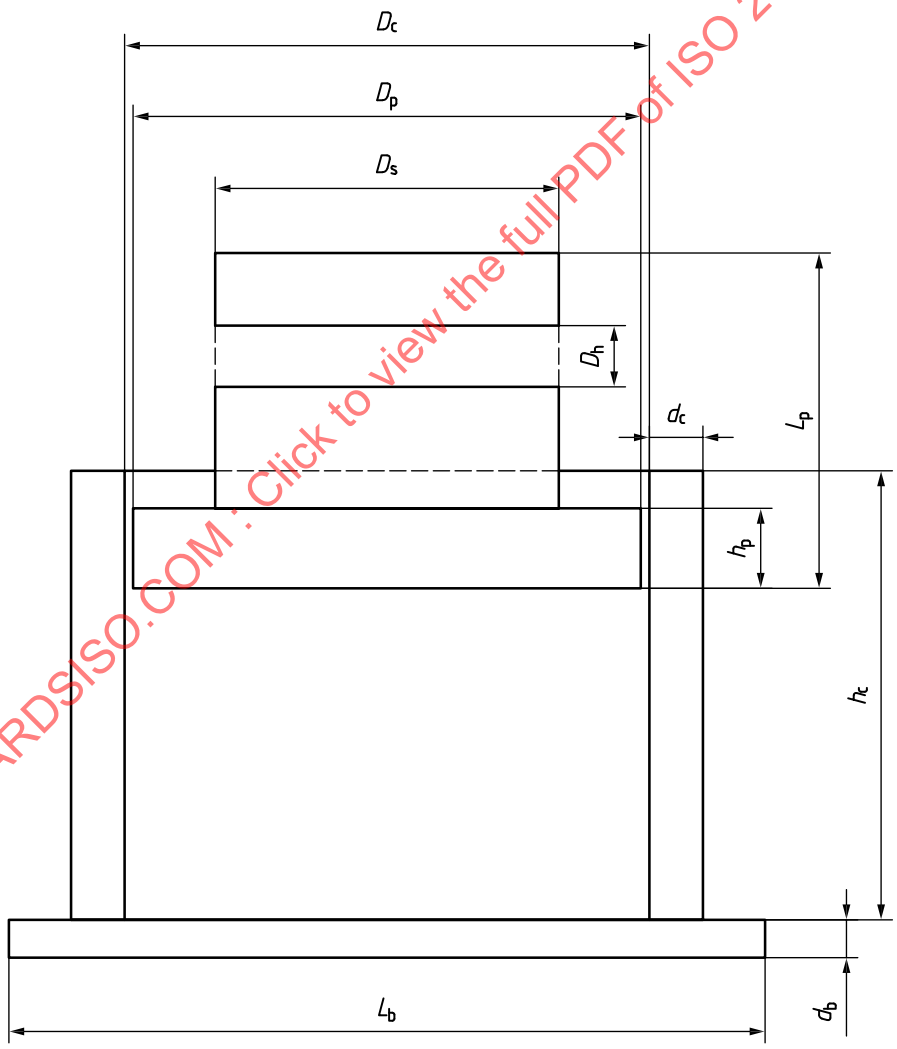
6.1.2 Steel cylinder and plunger, with an open-ended steel cylinder of nominal 150 mm internal diameter and with plunger and base plate as per Figure 1 and Table 1.

Table 1 — Principal dimensions of cylinder and plunger apparatus

Component	Dimensions (see Figure 1)	Nominal 150 mm internal dimeter of cylinder mm	Nominal 75 mm internal diameter of cylinder (see Annex A) mm
Cylinder	Internal diameter, D_c	154 ± 0,5	78,0 ± 0,5
	Internal depth, h_c	125 to 140	70,0 to 85,0
	Minimum wall thickness, d_c	16,0	8,0

Table 1 *(continued)*

Component	Dimensions (see Figure 1)	Nominal 150 mm internal dimeter of cylinder mm	Nominal 75 mm internal diameter of cylinder (see Annex A) mm
Plunger	Diameter of piston, D_p	152 ± 0,5	76,0 ± 0,5
	Diameter of stem, D_s	>95 to ≤D_p	>45 to ≤D_p
	Overall length of piston plus stem, L_p	100 to 115	60,0 to 80,0
	Minimum depth of piston, h_p	not less than 25,0	not less than 19,0
	Diameter of hole, D_h	20,0 ± 0,1	10,0 ± 0,1
Baseplate	Minimum thickness, d_b	10	10
	Length of each side of square, L_b	200 to 230	110 to 115



NOTE See Table 1.

Figure 1 — Outline form of cylinder and plunger apparatus for ten per cent fines test

The surfaces in contact with the aggregate shall be machined and maintained in a smooth condition and case hardened or otherwise treated to have a hardness value of 650 HV.

6.1.3 Tamping rod, made out of straight iron or steel bar of circular cross-section, (16 ± 1) mm diameter and (600 ± 5) mm long, with both end semi-spherical.

6.1.4 Balance, of at least 3 kg capacity readable to 1 g.

6.1.5 Cylindrical metal measure, for measuring the sample, of sufficient rigidity to retain its form under rough usage and having an internal diameter of (115 ± 1) mm and an internal depth of (180 ± 1) mm.

6.1.6 Test sieves with square-hole perforated plate of sizes 14,0 mm and 10,0 mm and a woven wire 2,36 mm test sieve. The test sieves shall comply with ISO 565.

6.1.7 Well-ventilated oven, thermostatically controlled at a temperature of (105 ± 5) °C.

6.1.8 Metal tray, of known mass large enough to contain 3 kg of aggregate.

6.1.9 Rubber mallet, of suitable handle and minimum weight of 400 g.

6.1.10 Brush, with stiff bristles.

NOTE Minor variations in apparatus ranges/dimensions can exist in national standards.

6.2 Additional apparatus

6.2.1 Drying cloths or absorbent paper, for the surface drying of the aggregate after it has been soaked in water, e.g. two hand towels of a size not less than 750 mm × 450 mm or rolls of absorbent paper of suitable size and absorbency.

6.2.2 One or more wire-mesh baskets, having apertures not larger than 6,5 mm or a perforated container of convenient size with hangers for lifting purposes.

6.2.3 Stout watertight container, in which the basket(s) can be immersed.

7 Preparation of test portions and specimens

7.1 Test portions

Reduce the laboratory sample using the standard procedures to produce a test portion of sufficient mass to produce three test specimens of 14 mm to 10 mm size fraction.

NOTE A single test specimen is that quantity of material required to fill the cylinder (see 8.1.1 and Table 2).

Table 2 — Guide to minimum mass of test: Portions required to obtain a suitable mass of material to determine the ten percent fine value

Grading of the aggregate mm	Minimum mass of the test portion[a] kg
All-in aggregate 40 max. size	60
All-in aggregate 20 max. size	45
Graded aggregate 40 to 5	40
Graded aggregate 20 to 5	25
Graded aggregate 14 to 5	15
[a] For normal density aggregates.	

NOTE In case of single size aggregates being supplied for the test, the minimum mass of the test portion can vary accordingly.

7.2 Test specimens in a dry condition

7.2.1 Thoroughly sieve the entire surface dry test portion on the 14 mm and 10 mm test sieves to remove the oversize and undersize fractions. Divide the resulting 14 mm to 10 mm fraction to produce three test specimens each of mass such that the depth of the material in the cylinder is approximately 100 mm after tamping as described in 8.1 (see NOTE).

NOTE The appropriate quantity of aggregate can be found conveniently by filling the cylindrical measure in three layers of approximately equal depth. Tamp each layer 25 times, from a height of approximately 50 mm above the surface of the aggregate, with the rounded end of the tamping rod. Level off using the tamping rod as a straight edge.

7.2.2 Dry the test specimens by heating at a temperature of (105 ± 5) °C for a period of not more than 4 h. Cool to room temperature before testing. For temperature-sensitive recycled aggregates, a drying temperature of (40 ± 5) °C shall be used. Record the mass of material comprising the test specimens.

7.3 Test specimens in a soaked condition

7.3.1 Prepare the test specimens using the procedure described in 7.2 except that the test portion is tested in the as-received condition and not as oven-dried material. Place each test specimen (see NOTE) in the wire basket and immerse it in the water in the container with a cover of at least 50 mm of water above the top of the basket.

Immediately after immersion remove the entrapped air from the specimen by lifting the basket 25 mm above the base of the container and allowing it to drop 25 times at a rate of about once a second. Keep the basket and aggregate completely immersed during the operation and for a subsequent period of between (24 ± 2) h and maintain the water temperature at (20 ± 5) °C [(27 ± 5) °C for tropical countries].

NOTE The appropriate quantity of aggregate to use can be found as described in 7.2.

7.3.2 After soaking, remove the specimen of aggregate from the basket and blot the free water from the surface with the absorbent cloths. Test specimens in a soaked condition shall be tested immediately after this operation.

8 Procedure

8.1 Aggregates in dry condition

8.1.1 Place the cylinder of the test apparatus in position on the baseplate and add the test specimen in three layers, each layer being subjected to 25 strokes of the tamping rod distributed evenly over the surface of the layer and dropping from a height approximately 50 mm above the surface of the aggregate.

The particles of some aggregates can break down when tamped in this way. If this occurs, it should be reported.

Carefully level the surface of the aggregate and insert the plunger so that it rests horizontally on this surface. Take care to ensure that the plunger does not jam in the cylinder.

8.1.2 Place the apparatus, with the test specimen and plunger in position, between the platens of the compression-testing machine. Apply force at a rate as uniform as possible (see NOTE 1) so as to cause, in 10 min with a tolerance of ±30 s, a total penetration of the plunger of approximately:

a) 15 mm for rounded or partially rounded aggregates, e.g. uncrushed gravels;

b) 20 mm for normal crushed aggregates;

c) 24 mm for vesicular (honeycombed) aggregates, e.g. some slags.

NOTE 1 When, during the early stages of the test, there is a significant deformation, it may not be possible to maintain the required loading rate and variations in the loading rate can occur especially at the beginning of the test. These variations should be kept to a minimum with the principal object of completing the test in the overall time of 10 min with a tolerance of ±30 s.

NOTE 2 These figures can vary according to the extent of the rounding or honeycombing.

8.1.3 Record the maximum force, F_{max}, applied to produce the required penetration. Release the force and remove the crushed material by holding the cylinder over a clean tray of known mass and hammering on the outside of the cylinder with the rubber mallet until the particles are sufficiently disturbed to enable the mass of the specimen to fall freely on to the tray.

NOTE If this fails to remove the compacted aggregate other methods can be used but take care not to cause further crushing of the particles. Transfer any particles adhering to the inside of the cylinder, the baseplate and the underside of the plunger to the tray by means of a stiff bristle brush.

Weigh the tray and the aggregate and record the mass of aggregate used, M_1, to the nearest gram.

8.1.4 Sieve the whole of the specimen in the tray on the 2,36 mm test sieve until no further significant amount passes during a further period of 1 min. Weigh and record the masses of the fractions passing and retained on the sieve to the nearest gram (M_2 plus M_3 respectively). If the total mass (M_2 plus M_3) differs from the initial mass, M_1, by more than 10 g, discard the result and test a further specimen.

The percentage of material, m, passing the sieve, is calculated from Formula (2):

$$m = \frac{M_2}{M_1} \times 100 \tag{2}$$

If it does not fall within the range 7,5 % to 12,5 %, test a further specimen, using an adjusted maximum test loading to bring the percentage of fines within the range and record the value of m obtained.

NOTE In the operations described in 7.1.3 and 7.1.4, take care to avoid loss of fines.

8.1.5 Repeat the complete test procedure with the same mass of aggregate at the same force that gave a percentage fines value within the range 7,5 % to 12,5 %.

8.2 Aggregates in a soaked condition

Follow the procedure described in 8.1 except that after the crushed specimen has been removed from the cylinder (see 8.1.3) dry it in the oven at a temperature of (105 ± 5) °C either to constant mass or for a minimum period of 12 h. For temperature-sensitive recycled aggregates, a drying temperature of (40 ± 5) °C shall be used. Allow the dried material to cool and weigh to the nearest gram, M_1.

Complete the procedure as described in 8.1.4 and 8.1.5.

9 Calculations and expression of results

9.1 Calculate the force, *TFV*, in kN, to the nearest whole number, required to produce 10 % of fines for each test specimen, with the percentage of material passing in the range 7,5 % to 12,5 %, from Formula (1).

9.2 Calculate the mean of the two results to the nearest 10 kN for forces of 100 kN or more, or to the nearest 5 kN for forces of less than 100 kN. Report the mean as the ten per cent fines value, unless the individual results differ by more than 10 kN and by more than 0,1 times the mean value. In this case, repeat the test on two further specimens, calculate the median of the four results to the nearest 10 kN for forces of 100 kN or more, or to the nearest 5 kN for forces of less than 100 kN, and report the median, as the ten percent fines value.

NOTE The median of four results is calculated by excluding the highest and the lowest result and calculating the mean of the two middle results.

10 Test report

The report shall affirm that the ten percent fines value of the dry aggregate and/or soaked aggregate was determined in accordance with this document and state whether or not a certificate of sampling is available. If available, a copy of the certificate shall be provided. The test report shall contain the following additional information:

a) sample identification and sample description;

b) the condition in which the aggregate was tested, i.e. dry or soaked;

c) the ten per cent fines value of the dry aggregate; and/or

d) the ten per cent fines value of the soaked aggregate;