INTERNATIONAL STANDARD

ISO 20290-5

First edition
2023-02

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

Part 5: Determination of particle size distribution by sieving method

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

Partie 5: Détermination de la granularité par tamisage

Reference number
ISO 20290-5:2023(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
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*.

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

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.

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

Part 5: Determination of particle size distribution by sieving method

1 Scope

This document describes the reference washing and dry sieving method used for testing and in case of dispute, for determination of the particle size distribution of aggregates. Other methods can be used provided that an appropriate working relationship with the reference method has been established. It applies to all aggregates, including lightweight aggregates, up to 90 mm nominal size, but excluding filler.

NOTE Dry sieving without washing can be used for aggregates free from particles which cause agglomeration.

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*

ISO 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

ISO 3310-2, *Test sieves — Technical requirements and testing — Part 2: Test sieves of perforated metal plate*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
aggregate
granular material used in construction which can be natural or manufactured

3.2
test portion
sample used as a whole in a single test

3.3
constant mass
mass determined by successive weighing's performed at least 1 h apart and not differing by more than 0,1 %

Note 1 to entry: In many cases, constant mass can be achieved after a test portion has been dried for a pre-determined period in a specified oven (see Clause 6) at 100 °C to 115 °C. Test laboratories may determine the time required to achieve constant mass for specific types and sizes of sample dependent upon the drying capacity of the oven used.

4 Principle

The test consists of dividing and separating a material into several particle size classifications of decreasing sizes by means of a series of sieves. The aperture sizes and the number of sieves are selected in accordance with the nature of the sample and the accuracy required.

The method adopted is washing and dry sieving. When washing can alter the physical properties of a lightweight aggregate, dry sieving shall be used and the procedure specified in 7.1 shall not be applied.

The mass of the particles retained on the various sieves is related to the initial mass of the material. The cumulative percentages passing each sieve are reported in numerical form and, when required, in graphical form.

5 Apparatus

5.1 Test sieves, with apertures conforming to the requirements of ISO 3310-1 and ISO 3310-2. For aperture size of 4,00 mm and above, perforated plate sieves may be used. For nominal sizes of openings of sieves, ISO 565 shall apply.

5.2 Tightly fitting pan and lid, for the sieves.

5.3 Ventilated oven, thermostatically controlled to maintain a temperature of 100 °C to 115 °C, or other suitable equipment for drying the aggregates, if it does not cause any particle size breakdown.

5.4 Washing equipment

5.5 Balances or scales, accurate to ±0,1 % of the test portion mass.

5.6 Trays, brushes

5.7 Sieving machine, (optional).

6 Preparation of test portions

Samples shall be reduced by the use of a sample divider or by quartering to produce the required number of test portions with masses as specified in Table 1.

NOTE It can be necessary to moisten samples containing substantial amounts of fines before reduction to minimize segregation and loss of dust.

Table 1 — Minimum size of test portions

Aggregate size D [a] (maximum) mm	Mass of aggregates [b, c] kg	Volume of lightweight aggregates [d] l
90	80	-
32	10	2,1
16	2,6	1,7
8	0,6	0,8
≤ 4	0,2	0,3

[a] For aggregates of other sizes below 90 mm, the minimum test portion mass can be interpolated from the masses given in Table 1 using the following formula: $M = (D/10)^2$

where

M is the minimum mass of test portion in kg;

D is the aggregate size in mm.

[b] The precision of the test method can be reduced if the test portion size is less than the value in Table 1. In such a case, the test portion size should be stated in the test report.

[c] For aggregates of particle density higher than 3,00 mg/m^3, an appropriate correction can be applied to the test portion masses given in Table 1 based on the density ratio, in order to produce a test portion of approximately the same volume as those for aggregates of normal density.

[d] For lightweight aggregates, the volume column can be used to choose the appropriate minimum size of test portions. The volume for other aggregate sizes may be interpolated.

Sample reduction shall yield a test portion of size larger than the minimum but not of an exact predetermined value.

Dry the test portion by heating at a temperature of 100 °C to 115 °C to constant mass. Allow to cool, weigh and record the mass as M_1 (see 8.1).

For some types of aggregate, drying at 110 °C binds particles together sufficiently strongly to prevent separation of single particles during subsequent washing and/or sieving procedures. For such aggregates, the procedure given in Annex A shall be followed.

7 Procedure

7.1 Washing

Place the test portion in a container and add sufficient water to cover the test portion.

A storage period of 24 h under water is helpful in breaking down lumps. A dispersion agent can be used.

Agitate the sample with sufficient vigour to result in complete separation and suspension of the fines.

Wet both sides of a 0,063 mm sieve reserved for use in this test only and fit a guard sieve (e.g. 1 mm or 2 mm) on top. Mount the sieves in such a way that the suspension passing the test sieve can be run to waste or, when required, collected in a suitable vessel. Pour the contents of the container on to the top sieve. Continue washing until the water passing the 0,063 mm test sieve is clear.

Care should be taken to prevent overloading, overflowing or damaging the 0,063 mm test sieve or the guard sieve. For some aggregates, it is necessary to pour only the suspended fines from the container onto the 0,063 mm guarded test sieve, continuing to wash the coarse residue in the container and decanting the suspended fines onto the guard sieve until the water passing the 0,063 mm test sieve is clear.

Dry the residue retained on the 0,063 mm sieve at 100 °C to 115 °C to constant mass. Allow to cool, weigh and record as M_2 (see 8.1).

7.2 Sieving

Pour the washed and dried material (or directly the dry sample) into the sieving column. The column comprises a number of sieves fitted together and arranged, from top to bottom, in order of decreasing aperture sizes with the pan and lid. Washing does not always remove all the fines. It is therefore necessary to incorporate a 0,063 mm test sieve in the series.

Shake the column, manually or mechanically. Then remove the sieves one by one, commencing with the largest aperture size opening. Shake each sieve manually ensuring no material is lost by using a pan and lid for example. The effectiveness of mechanical sieving is influenced by the aggregate type, the sieving time, the loading on the sieve and the parameters of the shaking movement such as amplitude and frequency. The mechanical sieving time should hence be carefully chosen.

Transfer all the material which passes each sieve onto the next sieve in the column before continuing the operation with that sieve. Sieve overloading shall be avoided. To avoid overloading of sieves, the fraction of normal weight aggregates retained at the end of the sieving operation on each sieve (expressed in grams) should not exceed:

$$A \times \sqrt{d} \,/\, 300$$

where

A is the area of the sieve, in square millimetres;

d is the aperture size of the sieve, in millimetres.

If overloading occurs, one of the following procedures shall be used:

a) divide the fraction into smaller portions and sieve these one after the other;

b) divide the portion of the sample passing the next largest sieve with the aid of a sample divider or by quartering, and continue the sieve analysis on the reduced test portion, making due allowance in subsequent calculations for the reductions.

The sieving process shall be considered as finished when additional sieving does not lead to a change of mass of the retained material on any sieve by more than 1,0 % by mass.

NOTE 1 Depending on the aggregate characteristics, the sieving process can be considered completed when the retained material does not change more than 1,0 % during 1 min.

NOTE 2 For lightweight aggregates, no more than one layer of particles can be retained on each sieve at the end of the sieving operation.

7.3 Weighing

Weigh the retained material for the sieve with the largest aperture size and record its mass as R_1.

Carry out the same operation for the sieve immediately below and record the mass retained as R_2.

Continue with the same operation for all the sieves in the column, in order to obtain the masses of the various lots of retained materials and record these masses as R_3, R_4, R_i, R_n (see 8.2).

Weigh the screened material, if any, remaining in the pan and record its mass as P (see 8.2).

8 Calculation and expression of results

8.1 Calculations

Record the various masses on a test data sheet. Calculate the mass retained on each sieve as a percentage of the original dry mass M_1.

Calculate the cumulative percentage of the original dry mass passing each sieve down to the 0,063 mm sieve exclusive.

Calculate the percentage of fines f passing the 0,063 mm sieve in accordance with Formula (1):

$$f = \frac{(M_1 - M_2) + P}{M_1} \times 100 \quad (1)$$

where

M_1 is the dried mass of the test portion, in kilograms;

M_2 is the dried mass of the residue retained on the 0,063 mm sieve, in kilograms;

P is the mass of the screened material remaining in the pan, in kilograms.

For dry sieving:

$f = 100\ P/M_1$

8.2 Validating the results

If the sum of the masses R_i and P differs by more than 1 % from the mass M_2, the test shall be repeated.

9 Test report

9.1 Required data

The test report shall include the following information:

a) a reference to this document, i.e. ISO 20290-5:2023;

b) the identification of the sample;

c) the identification of the laboratory;

d) the sample reception date;

e) the method of analysis (washing and sieving or dry sieving);

f) the cumulative percentage of the mass of the test portion passing each of the sieves to the nearest single decimal place for the 0,063 mm sieve and to the nearest whole number for other sieves;

g) the result(s), including a reference to the clause which explains how the results were calculated;

h) the date of the test;

i) any deviations from the procedure;

j) any unusual features observed.