
International Standard



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Coarse aggregates for concrete — Determination of particle density and water absorption — Hydrostatic balance method

Gros granulats pour béton — Détermination de la masse volumique réelle et de l'absorption d'eau — Méthode de la balance hydrostatique

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6783 was developed by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, and was circulated to the member bodies in January 1980.

It has been approved by the member bodies of the following countries:

Australia	Greece	Romania
Austria	India	South Africa, Rep. of
Brazil	Ireland	Spain
Canada	Israel	Sweden
Chile	Italy	Switzerland
China	Korea, Rep. of	Thailand
Denmark	Netherlands	USA
Egypt, Arab Rep. of	New Zealand	USSR
France	Norway	
Germany, F.R.	Poland	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Belgium
Bulgaria
Czechoslovakia
United Kingdom

Coarse aggregates for concrete — Determination of particle density and water absorption — Hydrostatic balance method

1 Scope and field of application

This International Standard specifies a method for the determination of the particle density and water absorption of coarse aggregates, having a nominal size greater than 4 mm, for concrete.

2 References

ISO 565, *Test sieves — Woven metal wire cloth and perforated plate — Nominal sizes of apertures.*

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 metal perforated plate.*

ISO 4847, *Concrete — Sampling of normal weight aggregates.*¹⁾

ISO 6274, *Concrete — Sieve analysis of aggregates.*

3 Definitions

3.1 particle density²⁾ (ρ_p) : The ratio of the mass of a sample of aggregate particles to the volume it occupies (including both permeable and impermeable pores normal to the particles).

It is expressed as mass per unit volume, i.e. kilograms per cubic metre (kg/m³).

3.2 water absorption : The increase in mass of a sample due to the penetration of water into the permeable pores of dry aggregate particles.

It is expressed as a percentage of the dry mass.

4 Apparatus and materials

4.1 Balance, of adequate capacity (3 kg or more, depending on the sample size) and accurate to within 0,1 % of the mass of the material to be weighed. It shall permit the basket (4.2) containing the sample to be suspended and weighed in water.

4.2 Wire basket, of mesh approximately 1 to 3 mm or a perforated container (perforations of diameter approximately 1 to 3 mm) of convenient size, preferably chromium plated and polished, with wire hangers (not thicker than 1 mm) to allow suspension from the balance.

4.3 Watertight tank, in which the basket (4.2) may be freely suspended.

4.4 Two dry soft absorbent cloths.

4.5 Closeable container, of similar capacity to the basket.

4.6 Test sieve (wire cloth or perforated plate), of aperture size 4,0 or 4,75 or 5,0 mm³⁾ complying with the requirements of ISO 3310/1 or ISO 3310/2.

4.7 Water, free from any impurity (for example dissolved air) that would significantly affect its density.

In case of doubt, distilled water, or tap water which has been freshly boiled and cooled to room temperature, shall be used.

5 Sampling

Sample the aggregate in accordance with ISO 4847.

Prior to testing, thoroughly wash the sample on the 4,0 or 4,75 or 5,0 mm test sieve (4.6), as appropriate, to remove all finer particles, particularly clay, silt and dust, which would be lost during the test and thus affect the results, and drain.

1) At present at the stage of draft.

2) In some countries, the terms "bulk specific gravity" or "relative density" are used.

3) Depending on the sieve series according to ISO 6274, as used in the laboratory.

For normal weight aggregates, the minimum mass of the sample, in grams, shall be 100 times the maximum nominal size of the aggregate in millimetres.

For lightweight and heavyweight aggregates, the minimum mass of the sample, in grams, shall be as given by the formula

$$m_{\min.} = \frac{d_{\max.} \times \rho_p}{25}$$

where

$d_{\max.}$ is the maximum nominal size of the aggregate, in millimetres;

ρ_p is the estimated particle density, in kilograms per cubic metre.

6 Procedure

Place the prepared test sample in the wire basket, and immerse it in sufficient water (4.7), at a constant temperature between 15 and 25 °C, to ensure that there is at least 50 mm of water above the top of the basket.

Immediately after immersion, remove the entrapped air from the sample by raising the basket 25 mm above the base of the tank, ensuring that the basket and aggregate remain completely immersed, and allowing it to drop 25 times at a rate of about once per second. Leave the basket and aggregate completely immersed for a period of 24 h. If, for special purposes, immersion periods differing by more than 4 h from that specified are used, this shall be stated in the test report.

Jolt the basket and sample, and weigh them in water at a temperature of 20 ± 5 °C. If it is necessary to transfer the basket to a different tank for weighing, jolt them 25 times as described above in the new tank before weighing (mass m_2).

Remove the basket and aggregate from the water and allow them to drain for a few minutes, after which gently empty the aggregate from the basket on to one of the dry cloths, and return the empty basket to the water. Jolt it 25 times and weigh it in water (mass m_3).

Using the cloth, gently surface-dry the aggregate, transferring it to a second dry cloth when the first will remove no further moisture. Then spread it out no more than one stone deep on the second cloth, and leave it exposed to the atmosphere away from direct sunlight or any other source of heat until all visible films of water are removed, but the aggregate still has a damp appearance. Weigh (mass m_1).

When it is desired to determine the density on an oven-dried basis, place the aggregate in an oven in a shallow tray at a temperature of 105 ± 5 °C and dry it to constant mass (this usually requires 24 h). Remove it from the oven, cool it in the closed container, and weigh (mass m_4).

7 Expression of results

7.1 The particle density on an oven-dried basis, ρ_{po} , is given by the formula

$$\rho_{po} = \frac{m_4}{m_1 - (m_2 - m_3)} \times \rho_w$$

7.2 The particle density on a saturated and surface-dried basis, ρ_{ps} , is given by the formula

$$\rho_{ps} = \frac{m_1}{m_1 - (m_2 - m_3)} \times \rho_w$$

7.3 The water absorption, a , expressed as a percentage of the dry mass, is given by the formula

$$a = \frac{100 \times (m_1 - m_4)}{m_4}$$

7.4 In the preceding formulae

m_1 is the mass in air, in grams, of the saturated surface-dried aggregate;

m_2 is the apparent mass in water, in grams, of the basket containing the sample of saturated aggregate;

m_3 is the apparent mass in water, in grams, of the empty basket;

m_4 is the mass in air, in grams, of the oven-dried aggregate;

ρ_w is the density, in kilograms per cubic metre, of water at the test temperature.

7.5 Values of particle density shall be reported in kilograms per cubic metre to the nearest 1 kg/m³. Values for water absorption shall be reported to the nearest 0,2 % (m/m).

8 Test report

The test report shall include the following information :

- a) a reference to this International Standard;
- b) identification of the sample;
- c) the type and maximum size of the aggregate;
- d) the moisture condition of the sample when received;
- e) the mass of the sample;
- f) a clear indication of whether the values for the particle density or densities reported are on an oven-dried or on a saturated surface-dried basis, or both;
- g) the immersion period, if this was other than 24 ± 4 h;
- h) the results.