
**Fine ceramics (advanced ceramics,
advanced technical ceramics) —
Determination of density and
apparent porosity**

*Céramiques techniques — Détermination de la masse volumique et de
la porosité apparente*

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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

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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).

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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 206, *Fine ceramics*.

This third edition cancels and replaces the second edition (ISO 18754:2013), which has been technically revised. The main changes compared to the previous edition are as follows:

- clarification of the different methods covered by the document;
- extension of the applicability field of the method to ceramic matrix composites (including the fibre reinforced matrix);
- incorporation of specific requirements in terms of geometry and sizes of the test specimens in this case.

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.

Fine ceramics (advanced ceramics, advanced technical ceramics) — Determination of density and apparent porosity

1 Scope

This document specifies methods for the determination of the apparent solid density, bulk density, apparent porosity and geometric bulk density of fine ceramics, including all ceramic matrix composites.

Two methods are described and are designated as Methods A and B, as follows:

- Method A: Determination of bulk density, apparent solid density and apparent porosity by liquid displacement (Archimedes' method).

NOTE 1 This method is not appropriate for the determination of an apparent porosity greater than 10 %. For materials with higher porosity, the accuracy of the measurement might not be satisfactory. This method might also not give a satisfactory open porosity result if it is less than 0,5 %.

NOTE 2 This method is also not suitable for materials which are known to have an average pore size of greater than 600 µm.

- Method B: Determination of bulk density only, by measurement of geometric dimensions and mass.

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 386, *Liquid-in-glass laboratory thermometers — Principles of design, construction and use*

ISO 758, *Liquid chemical products for industrial use — Determination of density at 20 °C*

ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Design and metrological characteristics of callipers*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

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

open pore

pore that is penetrated by an immersion liquid, or that is connected to the atmosphere, either directly or via one another

3.2

closed pore

pore that is not penetrated by the immersion liquid, or that is not connected to the atmosphere

3.3

bulk volume

V_b
sum of the respective volumes of the solid material, the *open pores* (3.1) and the *closed pores* (3.2) in a porous body

3.4

apparent solid volume

V_a
sum of the respective volumes of the solid material and the *closed pores* (3.2) in a porous body

3.5

bulk density

ρ_b
ratio of the mass of the dry material of a porous body to its *bulk volume* (3.3)

3.6

apparent solid density

ρ_a
ratio of the mass of the dry material of a porous body to its *apparent solid volume* (3.4)

3.7

apparent porosity

π_a
ratio of the total volume of the *open pores* (3.1) in a porous body to its *bulk volume* (3.3)

3.8

theoretical density

density of pore-free material

3.9

geometric bulk density

bulk density (3.5) of a porous body, the *bulk volume* (3.3) of which being calculated from linear dimensions

4 Method by liquid displacement (Method A)

4.1 Principle

The mass of the dry test piece, then its apparent mass when immersed in a liquid with which it has been impregnated, and finally its mass in air while still soaked with the impregnation liquid are determined by weighing. From the masses above, the bulk density, the apparent solid density and the apparent porosity are determined by calculation.

Impregnation of the test piece can be achieved either by maintaining it in a liquid under boiling conditions (Method A1) or under vacuum (Method A2).

4.2 Apparatus

4.2.1 Drying oven, capable of being controlled at $(110 \pm 5) ^\circ\text{C}$.

4.2.2 Balance, accurate to 0,1 mg for a test piece under 10 g and 0,001 % of the mass of a test specimen for a specimen over 10 g.