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# Fine ceramics (advanced ceramics, advanced technical ceramics) — Determination of absolute density of ceramic powders by pycnometer

*Céramiques techniques — Détermination de la masse volumique absolue des poudres céramiques à l'aide d'un pycnomètre*

Reference number
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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
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).

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

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

This second edition cancels and replaces the first edition (ISO 18753:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Clause 6 has been modified to include changes in list items d) and g) and to add a paragraph discussing factors affecting accuracy of test results;

— Table A.1 has been modified with new reference data for the absolute density of distilled water[1].


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# Fine ceramics (advanced ceramics, advanced technical ceramics) — Determination of absolute density of ceramic powders by pycnometer

## 1 Scope

This document specifies a method for determining the absolute particle density of fine ceramic powders or sintered parts using liquid pycnometry.

NOTE Other pycnometer methods like gas pycnometers (e.g. helium pycnometer), where a gas is used as media, also exist.

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

ISO 3507, *Laboratory glassware — Pyknometers*

ISO 6353-2, *Reagents for chemical analysis — Part 2: Specifications — First series*

ISO 6353-3, *Reagents for chemical analysis — Part 3: Specifications — Second series*

ISO 8213, *Chemical products for industrial use — Sampling techniques — Solid chemical products in the form of particles varying from powders to coarse lumps*

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 http://www.iso.org/obp

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

**3.1**
**absolute particle density**
**absolute density of ceramic powders**
density of an individual ceramic particle, a ceramic powder or sintered parts

Note 1 to entry: When an enclosed space occurs (pore) inside the particle or part, the space is considered to be part of the individual particle or part. The result of the test is then the absolute density of the ceramic particles or ceramic parts with closed porosity.

Note 2 to entry: If the intention of the test is to determine the absolute density of a ceramic material, the test is limited to particles or parts without closed porosity.

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**3.2**
**particle**
ceramic powder or an amount of small sintered ceramic parts

EXAMPLE Grinding balls or other small parts.

Note 1 to entry: When the examined material has closed porosity inside the particles, the measured density is not the absolute density of the material but of the examined part.

**3.3**
**pycnometry**
method of measuring absolute particle density using a pycnometer

# 4 Preparation of measurement

## 4.1 Sampling

A representative sample (of powder or small parts) for analysis shall be taken in accordance with ISO 8213.

The maximum size of particles or parts which will be analysed shall be smaller than the neck of the used pycnometer.

## 4.2 Drying of sample

The selected sample is thoroughly dried in an air bath at approximately 110 °C, and then cooled in a desiccator to room temperature. In the case of powders or parts requiring a long drying time, the sample is thoroughly spread and stirred lightly once or twice midway through the drying process.

When the material is not stable at the heating temperature, the sample should be dried under reduced pressure instead of heating.

If necessary, it is recommended to record the mass loss as a function of time to ensure that the sample has reached equilibrium.

## 4.3 Preparation of immersion liquid

The immersion liquid used for pycnometry shall not be reactive and shall not dissolve the sample. A liquid with good wetting properties and a low evaporation rate under vacuum conditions shall be selected.

The following liquids for immersion may be used: distilled water; xylene as specified in ISO 6353-3; ethanol (e.g. 95 % purity by volume fraction) as specified in ISO 6353-2; or 1-butanol as specified in ISO 6353-3.

The absolute density of the immersion liquid at the measured temperature shall be determined using pycnometry, in accordance with ISO 758.

# 5 Apparatus

**5.1 Pycnometer**, Gay-Lussac type made of glass, of capacity 25 ml or 50 ml (see Figure 1), as specified in ISO 3507, or other suitable type of pycnometer.


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