
**Fine ceramics (advanced ceramics,
advanced technical ceramics) — Test
method for determining density of
ceramic coatings**

*Céramiques techniques (céramiques avancées, céramiques techniques
avancées) — Méthode d'essai pour déterminer la densité des
revêtements céramiques*

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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).

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

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.

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for determining density of ceramic coatings

1 Scope

This document specifies a testing method for determining the density of thick ceramic coatings at ambient temperature using the Archimedes method. Methods for test piece preparation, test modes, data collection and density calculation are addressed.

This document applies to ceramic coatings with a thickness > 0,1 mm including thermal barrier coatings, wear-resistance coatings and other thick coatings on metal or ceramic substrates.

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 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 18754, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Determination of density and apparent porosity*

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

volume

apparent solid volume, the sum of the respective volumes of the solid material

3.2

density

apparent solid density, the ratio of the mass of the dry material to its apparent solid volume

4 Principle

The density of ceramic coating on a substrate is determined by comparing the densities of the coated and uncoated sample, under the precondition that the interface between the coating and the substrate is continuous and without a debonding zone. The density of the ceramic coating is obtained from three parameters: i) the density of the uncoated substrate (ρ_S); ii) the equivalent density of the coated sample ($\bar{\rho}$); and iii) the ratio of the dry weight of the substrate to that of the coated sample ($k = m_S/m$). The values of ρ and $\bar{\rho}$ are determined by the Archimedes method according to ISO 18754, and they are related to the density of the coating via a unique formula.

5 Apparatus

5.1 Density testing apparatus

The apparatus for density tests shall conform to the requirements of ISO 18754.

5.2 Dimension measuring device

A vernier calliper with a precision of 0,02 mm according to ISO 3611 shall be used to measure the overall dimensions of the sample. The thickness of the coating and the substrate shall be measured by using an optical or electronic microscope with a magnification of 1 000 times or more.

6 Test pieces

6.1 Type of test piece

Test pieces are defined as two types according to test requirements and sample conditions.

Type A: rectangular parallelepiped test piece with a single face coating. The density test procedure shall be i) density tests for the coated test piece; ii) grind off the coating; iii) the density test of the remaining body (substrate or composite substrate).

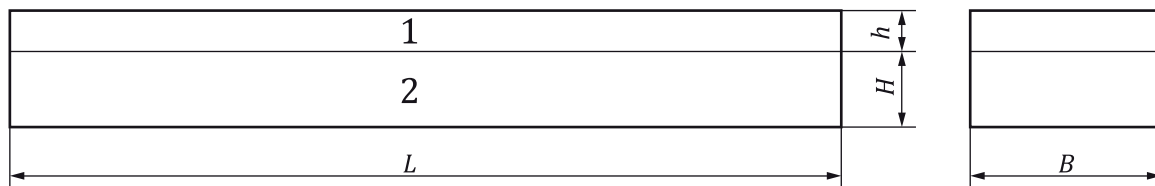
Type B: test piece with various shapes; it is impossible to grind off the coating. The test procedure shall be i) density tests for the substrate; ii) make coating on the substrate; iii) density tests for the coated piece.

The volume of each test piece shall conform to the requirements of ISO 18754. The volume of each individual test piece shall be not less than 0,36 cm³.

6.2 Test piece preparation

6.2.1 Type A test piece preparation

A rectangular parallelepiped test piece with single-face coating is required. For test pieces with multilayer coatings, the first layer of coatings (top layer) is considered as a single-layer coating and the rest is considered as the substrate. The geometrical dimensions of a coated sample are displayed in Figure 1. Table 1 shows the recommended dimensions of a type A test piece. The surfaces shall be ground using a fine grit (400 grit or finer).



Key

- 1 coating
- 2 substrate

Figure 1 — Schematic illustration of a rectangular parallelepiped test piece with ceramic coating