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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for total electrical conductivity of conductive fine ceramics

Céramiques techniques — Méthode d'essai pour la conductivité électrique totale des céramiques techniques conductrices

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Foreword

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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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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*.

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) — Test method for total electrical conductivity of conductive fine ceramics

1 Scope

This document specifies the test method for the determination of total electrical conductivity of conductive fine ceramics by the DC (direct current) four-terminal method. The test method applies to conductive fine ceramics which have an ionic transference number of 0,01 or less. The applicable conductivity range is from 1 S cm^{-1} to 1 000 S cm^{-1} and the temperature range is up to 1 000 °C. The values expressed in the test method are in accordance with the International System of Units (SI).

This document is intended for industrial product quality control and material development of conductive fine ceramics used in electrodes, e.g. fuel cells, batteries and water electrolysis.

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 6145-7, *Gas analysis — Preparation of calibration gas mixtures using dynamic methods — Part 7: Thermal mass-flow controllers*

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*

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

ISO 80000-1, *Quantities and units — Part 1: General*

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
total electrical conductivity
electrical conduction where both electrons and ions carry the electrical charges

3.2
electronic conduction
electrical conduction where electrons (or holes) carry the electrical charges

3.3
conductive fine ceramic
substance whose electrical conduction is primarily governed by *electronic conduction* (3.2) rather than ionic conduction

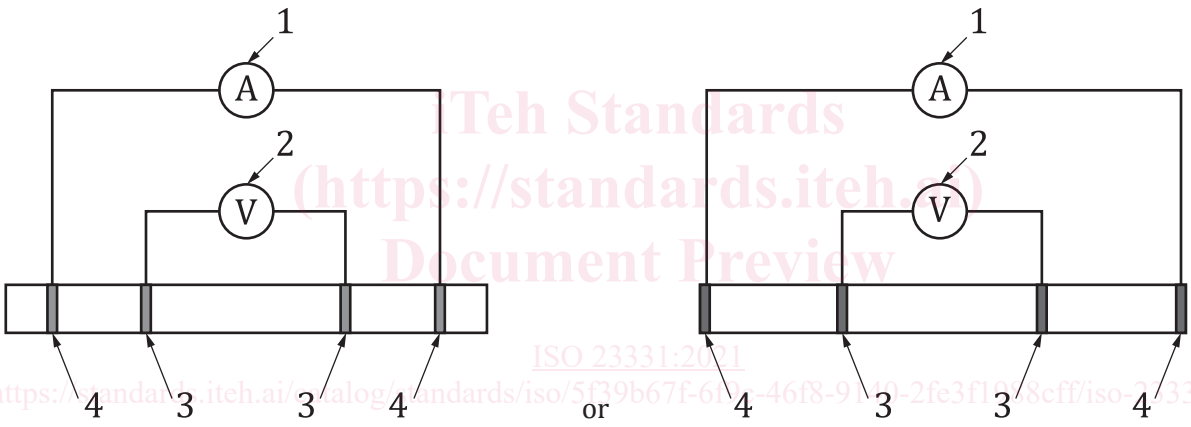
Note 1 to entry: In this document the term indicates a fine ceramic with an ionic transference number of 0,01 or less.

Note 2 to entry: If the ionic transference number is unknown, it shall be confirmed to be smaller than 0,01 using a proper method such as the potentiostatic polarization method, the galvanostatic polarization method or the electromotive force (EMF) method at a temperature range, prior to the measurements.

3.4
DC four-terminal method
method for measuring *total electrical conductivity* (3.1) using direct current (DC) with four terminals

Note 1 to entry: See Figure 1.

Note 2 to entry: Other electrode configurations are acceptable as well. Four wire electrodes are wrapped on a surface of the test piece. The two outer electrodes, called current terminals, supply DC to the test piece. The two inner electrodes, called voltage terminals, measure the voltage. Total electrical conductivity can be determined with the applied current, the measured voltage and the geometry of the test piece.



Key
1 DC supply
2 voltmeter
3 voltage terminal
4 current terminal

Figure 1 — DC four-terminal method

4 Symbols

Symbol	Designation	Unit
σ	Total conductivity	S cm^{-1}
L	Distance between voltage terminals	cm
R	Effective resistance	Ω
A	Cross-sectional area of the test piece	cm^2