
**Pore size distribution and porosity of
solid materials by mercury porosimetry
and gas adsorption —**

**Part 3:
Analysis of micropores by gas adsorption**

*Distribution des dimensions des pores et porosité des matériaux solides
par porosimétrie au mercure et par adsorption de gaz —*

Partie 3: Analyse des micropores par adsorption de gaz



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 15901-3 was prepared by Technical Committee ISO/TC 24, *Sieves, sieving and other sizing methods*, Subcommittee SC 4, *Sizing by methods other than sieving*.

ISO 15901 consists of the following parts, under the general title *Pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption*.

- *Part 1: Mercury porosimetry*
- *Part 2: Analysis of mesopores and macropores by gas adsorption*
- *Part 3: Analysis of micropores by gas adsorption*

Introduction

According to the IUPAC Recommendations, 1984 [42], micropores are defined as pores with internal widths of less than 2 nm. Different methods for the characterization of micropores are available, including spectroscopy, electron and tunnel microscopy and sorption methods. In view of the complexity of most porous solids, it is not surprising that the results obtained are not always in agreement and that no single technique can be relied upon to provide a complete picture of the pore structure. With regard to the application of microporous material as specific sorbents, molecular sieves and carriers for catalysts and biological active material, the field-proven methods of gas sorption are of special value. On account of the fractality of dispersed and porous materials, the results of adsorption measurements depend on the size of the gas molecules used (effective diameter and space required at the surface). Furthermore, micropores might not be accessible for larger molecules and, thus, exclusion effects can be observed.

The measuring techniques of the methods described in the present standard are similar to those of ISO 15901-2 and ISO 9277 for the measurement of gas adsorption at low temperature. From the measured isotherm, however, the very first part (i.e. relative pressures $< 10^{-1}$) is evaluated and thus the evaluation method is different.

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Pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption —

Part 3: Analysis of micropores by gas adsorption

1 Scope

This part of ISO 15901 describes methods for the evaluation of the volume of micropores (pores of internal width less than 2 nm) and the specific surface area of microporous material by low-temperature adsorption of gases [1],[2],[3],[4],[5],[6],[7]. These are comparative, non-destructive tests. The methods use physisorbing gases that can penetrate into the pores under investigation. The method is applicable to isotherms of type I, II, IV or VI of the IUPAC classification (see ISO 15901-2:—, Figure 1, and ISO 9277).

The methods in this part of ISO 15901 are not applicable when chemisorption or absorption takes place.

2 Normative references

The following referenced documents are indispensable for the application 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 3165, *Sampling of chemical products for industrial use — Safety in sampling*

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

ISO 9277:1995, *Determination of the specific surface area of solids by gas adsorption using the BET method*

ISO 15901-2:—, *Pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption — Part 2: Analysis of mesopores and macropores by gas adsorption*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

adsorbate

adsorbed gas

3.2

adsorption

enrichment of the adsorptive at the external and accessible internal surfaces of a solid

3.3

adsorptive

gas or vapour to be adsorbed