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# Evaluation of pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption —

## Part 1: Mercury porosimetry

*Evaluation de la distribution de taille des pores et la porosité des  
matériaux solides par porosimétrie à mercure et l'adsorption des gaz —  
Partie 1: Porosimétrie à mercure*



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## Contents

	Page
<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Symbols and abbreviated terms</b> .....	<b>4</b>
<b>5 Principles</b> .....	<b>5</b>
<b>6 Apparatus and material</b> .....	<b>6</b>
6.1 Sample holder .....	6
6.2 Porosimeter .....	7
6.3 Mercury .....	7
<b>7 Procedures for calibration and performance</b> .....	<b>7</b>
7.1 General .....	7
7.2 Pressure signal calibration .....	7
7.3 Volume signal calibration .....	7
7.4 Vacuum transducer calibration .....	7
7.5 Verification of porosimeter performance .....	8
<b>8 Procedures</b> .....	<b>8</b>
8.1 Sampling .....	8
8.1.1 Obtaining a test sample .....	8
8.1.2 Quantity of sample .....	8
8.2 Method .....	9
8.2.1 Sample pre-treatment .....	9
8.2.2 Filling of the sample holder and evacuation .....	9
8.2.3 Filling the sample holder with mercury .....	9
8.2.4 Measurement .....	10
8.2.5 Completion of test .....	10
8.2.6 Blank and sample compression correction .....	10
<b>9 Evaluation</b> .....	<b>11</b>
9.1 Determination of the pore size distribution .....	11
9.2 Determination of the specific pore volume .....	11
9.3 Determination of the specific surface area .....	12
9.4 Determination of the bulk and skeleton densities .....	12
9.5 Determination of the porosity .....	13
<b>10 Reporting</b> .....	<b>13</b>
<b>Annex A (informative) Mercury porosimetry analysis results</b> .....	<b>14</b>
<b>Annex B (informative) Recommendations for the safe handling of mercury</b> .....	<b>17</b>
<b>Bibliography</b> .....	<b>19</b>

## 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](http://www.iso.org/directives)).

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For an explanation on 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](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is ISO/TC 24, *Particle characterization including sieving*, Subcommittee SC 4, *Particle characterization*.

This second edition cancels and replaces the first edition (ISO 15901-1:2005), which has been technically revised. It also incorporates the Corrigendum ISO 15901-1:2005/Cor 1:2007.

ISO 15901 consists of the following parts, under the general title *Evaluation of 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*

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## Introduction

In general, different pores (micro-, meso-, and macropores) may be pictured as either apertures, channels or cavities within a solid body or as space (i.e. interstices or voids) between solid particles in a bed, compact or aggregate. Porosity is a term which is often used to indicate the porous nature of solid material and in this International Standard is more precisely defined as the ratio of the total pore volume of the accessible pores and voids to the volume of the particulate agglomerate. In addition to the accessible pores, a solid may contain closed pores which are isolated from the external surface and into which fluids are not able to penetrate. The characterization of closed pores is not covered in this International Standard.

Porous materials may take the form of fine or coarse powders, compacts, extrudates, sheets or monoliths. Their characterization usually involves the determination of the pore size distribution as well as the total accessible pore volume or porosity. For some purposes it is also necessary to study the pore shape and interconnectivity and to determine the internal and external specific surface area.

Porous materials have great technological importance, for example in the context of the following:

- controlled drug release;
- catalysis;
- gas separation;
- filtration including sterilization;
- materials technology;
- environmental protection and pollution control;
- natural reservoir rocks;
- building materials;
- polymers and ceramic.

It is well established that the performance of a porous solid (e.g. its strength, reactivity, permeability) is dependent on its pore structure. Many different methods have been developed for the characterization of pore structure. 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. The choice of the most appropriate method depends on the application of the porous solid, its chemical and physical nature and the range of pore size.

The most commonly used methods are as follows:

- a) Mercury porosimetry, where the pores are filled with mercury under pressure. This method is suitable for many materials with pores in the approximate diameter range of 0,004  $\mu\text{m}$  to 400  $\mu\text{m}$ .
- b) Meso- and macropore analysis by gas adsorption, where the pores are characterized by adsorbing a gas, such as nitrogen at liquid nitrogen temperature. The method is used for pores in the approximate diameter range of 0,002  $\mu\text{m}$  to 0,1  $\mu\text{m}$  (2 nm to 100 nm).
- c) Micropore analysis by gas adsorption, where the pores are characterized by adsorbing a gas, such as nitrogen at liquid nitrogen temperature. The method is used for pores in the approximate diameter range of 0,4 nm to 2 nm.