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**Metallic powders — Determination of  
envelope-specific surface area from  
measurements of the permeability to  
air of a powder bed under steady-state  
flow conditions**

*Poudres métalliques — Détermination de la surface spécifique  
d'enveloppe à partir de mesures de la perméabilité à l'air d'un lit de  
poudre dans des conditions d'écoulement permanent*



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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](http://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](http://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 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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Subcommittee SC 2, *Sampling and testing methods for powders (including powders for hardmetals)*.

This second edition cancels and replaces the first edition (ISO 10070:1991), which has been technically revised.

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

- introduction of an automated test device based on the Gooden and Smith method, including procedure and calibration.

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](http://www.iso.org/members.html).

## Introduction

The measurement of the permeability of a packed powder bed to a laminar gas flow is the basis of this document. The determination can be made either at constant pressure drop (steady-state flow) or at variable pressure drop (constant volume). This document deals only with determinations made under steady-state flow conditions.

The permeability measured is influenced by the porosity of the powder bed. For a given particle shape, the values of permeability and porosity can be used to calculate a specific surface area of the powder by means of different formulae.

The surface area so calculated includes only those walls of the pores in the powder bed which are swept by the gas flow. It does not take into account closed or blind pores. It is known as the envelope-specific surface area. It can be very different from the total surface area of particles as measured, for instance, by gas adsorption methods.

A single equation is used in the standard methods described in this document. It entails certain limitations with respect to the type of powder (particle shape) and the porosity of the powder bed for which the method is applicable. Consequently, this is not an absolute method, and the value obtained depends upon the procedure used and the assumptions made.

The specific surface area determined can be converted into a mean equivalent spherical diameter (see [Clause 3](#)).



# Metallic powders — Determination of envelope-specific surface area from measurements of the permeability to air of a powder bed under steady-state flow conditions

## 1 Scope

This document specifies a method of measuring the air permeability and the porosity of a packed bed of metal powder, and of deriving therefrom the value of the envelope-specific surface area. The permeability is determined under steady-state flow conditions, using a laminar flow of air at a pressure near atmospheric. This document does not include the measurement of permeability by a constant volume method.

Several different methods have been proposed for this determination, and several test devices are available commercially. They give similar, reproducible results, provided that the general instructions given in this document are respected, and the test parameters are identical.

This document does not specify a particular commercial test device and corresponding test procedure. However, for the convenience of the user, an informative annex has been included (see [Annex A](#)) which is intended to give some practical information on three specific methods:

- the Lea and Nurse method, involving a test device which can be built in a laboratory (see [A.1](#));
- the Zhang Ruifu method, using a similar test device (see [A.2](#));
- the Gooden and Smith method, involving a test device which can be built in a laboratory but for which a commercial test device also exists. (Two types of commercial test device exist; one of these is no longer available for purchase, but is still being used, see [A.3](#).)

These methods are given as examples only. Other test devices available in various countries are acceptable within the scope of this document.

This testing method is applicable to all metallic powders, including powders for hardmetals, up to 1 000  $\mu\text{m}$  in diameter, but it is generally used for particles having diameters between 0,2  $\mu\text{m}$  and 75,0  $\mu\text{m}$ . It is not intended to be used for powders composed of particles whose shape is far from equiaxial, i.e. flakes or fibres, unless specifically agreed upon between the parties concerned.

This testing method is not applicable to mixtures of different metallic powders or powders containing binders or lubricant.

If the powder contains agglomerates, the measured surface area can be affected by the degree of agglomeration. If the powder is subjected to a de-agglomeration treatment (see [Annex B](#)), the method used is to be agreed upon between the parties concerned.

## 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 3954, *Powders for powder metallurgical purposes — Sampling*

## 3 Terms and definitions

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