SLOVENSKI STANDARD
oSIST prEN ISO 10070:2019

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Kovinski prah - Ugotavljanje specifične ovojne površine z merjenjem zračne prepustnosti nasute plasti prašnih delcev pri ustaljenem toku zraka skoznjo (ISO/DIS 10070:2019)

Metallic powders - Determination of envelope-specific surface area from measurements of the permeability to air of a powder bed under steady-state flow conditions (ISO/DIS 10070:2019)

Metallpulver - Ermittlung der spezifischen Außenoberfläche durch Messung der Luftdurchlässigkeit einer Pulverprobe unter gleichförmigen Strömungsbedingungen (ISO/DIS 10070:2019)

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 (ISO/DIS 10070:2019)

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77.160	Metalurgija prahov	Powder metallurgy

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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).

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).

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.

This document was prepared by Technical Committee *[or Project 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 apparatus 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.

Introduction

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

The permeability measured is influenced by the porosity of the 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 equations of different types.

The surface area so calculated includes only those walls of the pores in the bed which are swept by the gas flow. It does not take into account closed or blind pores. It is defined as the envelope-specific surface area. It may 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 and this 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 definitions, 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 International Standard 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 International Standard does not include the measurement of permeability by a constant volume method.

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

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

— the Lea and Nurse method, involving an apparatus which can be built in a laboratory (see A.1);

— the Zhang Ruifu method, using similar equipment (see A.2);

— the Gooden and Smith method, involving an apparatus which can be built in a laboratory but for which ~~a~~ commercial apparatus also exists. (Two types of commercial apparatus 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 equipment available in various countries is acceptable within the scope of this International Standard.

This testing method is applicable to all metallic powders, including powders for hardmetals, up to 1 000 µm in diameter, but it is generally used for particles having diameters between 0,2 µm and ~~50~~ 75 µm. It should not 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 may be affected by the degree of agglomeration. If the powder is subjected to a de-agglomeration treatment (see annex B), the method used shall 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 3954:1977, *Powders for powder metallurgical purposes — Sampling*

3 Terms and definitions

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

3.1
permeability
ability of a porous material to allow a fluid to flow through it.

NOTE 1 to entry In this standard, the fluid used is dry air.

3.2
interstices
spaces between particles in a powder bed, through which the air flows

3.3
permeable porosity
volume of interstices divided by the volume of the bed.

3.4
envelope volume
volume occupied by the particles in a powder bed, excluding the volume of the interstices. In permeametry, the envelope volume comprises the volume of the solid matter plus the volume of all the pores which do not contribute to gas flow (closed pores, blind pores, micropores, surface micropores, surface roughness, etc.). Since this volume cannot be measured by any known method, it is taken, for the purposes of this International Standard, as being equal to the effective volume, as determined by liquid pyknometry.

3.5
envelope density
mass of a powder bed divided by its envelope volume. The envelope density may be less than the solid density when particles contain pores that do not contribute to the gas flow through the bed.

3.6
mass-specific surface area
the surface area of a powder divided by its mass. This area depends on the type of method used for its determination.

3.7
envelope-specific surface area
the specific surface area of a powder as determined by gas permeametry in accordance with this International Standard

3.8
volume-specific surface area
the surface area of a powder divided by its effective volume (i.e. by its envelope volume)

3.9
equivalent sphere diameter
diameter of theoretical non-porous spherical particles of identical size, with which the same method of permeametry as that used for the powder under examination would give the same volume-specific surface area.

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/

4 Symbols and their meaning

Table 1 — Symbols used in text

Symbol	Meaning	Unit	Observations
	Powder bed		
A	Cross-sectional area	m^2	Area of whole cross-section of bed perpendicular to flow direction: $A = \frac{\pi d^2}{4}$
d	Diameter of measuring cell	m	
L	Thickness (or height)	m	
m	Mass of powder	kg	
ϱ_e	Envelope density	kg/m^3	
ϱ	Solid density	kg/m^3	
ε_p	Permeable porosity		$\varepsilon_p = 1 - \frac{m}{AL\varrho_e}$
ε	Total porosity		$\varepsilon = 1 - \frac{m}{AL\varrho}$
	Gas flow		
q	Volume flow rate	m^3/s	Converted to standard conditions (STP)
p	Mean gas pressure	N/m^2	
Δp	Pressure drop	N/m^2	
η	Viscosity of gas	Ns/m^2	
T	Temperature of gas	K	
M	Molar mass of gas	kg/mol	M = 0,029 kg/mol for air
R	Molar gas constant Calculation	$\frac{J}{mol\ K}$	$R = 8{,}31 \frac{J}{mol\ K}$
	Calculation		
K	Kozeny-Carman factor		For the purposes of this International Standard, K = 5,0
δK_0	Compound constant		For the purposes of this International Standard, the generally accepted value of 2,25 is used
S_w	Mass-specific surface area	m^2/kg	
S_V	Volume-specific surface area	m^{-1}	$S_V = \varrho_e S_w$
Φ	Permeability	m^2	
D	Equivalent sphere diameter	m	$D = \frac{6}{S_V} = \frac{6}{\varrho_e S_w}$

5 General principles

5.1 Permeability

Basically, permeametry is the experimental determination of the permeability Φ of a powder bed, the porosity of which is known.