

SVENSK STANDARD

SS-EN ISO 10070:2020

Metalliska pulver – Bestämning av omsvept specifik ytarea från mätningar av luftpermeabilitet hos pulverbädd under konstant flödesförhållande (ISO 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 10070:2019)



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EUROPEAN STANDARD

EN ISO 10070

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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 (ISO 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 10070:2019)

Metallpulver - Bestimmung der spezifischen Außenoberfläche durch Messung der Permeabilität von Luft in einem Pulverbett unter gleichförmigen Strömungsbedingungen (ISO 10070:2019)

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European foreword

This document (EN ISO 10070:2019) has been prepared by Technical Committee ISO/TC 119 "Powder metallurgy" in collaboration with Technical Committee CEN/SS M11 "Powder metallurgy" the secretariat of which is held by CCMC.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2020, and conflicting national standards shall be withdrawn at the latest by June 2020.

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The text of ISO 10070:2019 has been approved by CEN as EN ISO 10070:2019 without any modification.

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 μm in diameter, but it is generally used for particles having diameters between 0,2 μm and 75,0 μm . 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.

SS-EN ISO 10070:2020 (E)

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 envelope density

mass of a powder bed divided by its *envelope volume* (3.3)

Note 1 to entry: The envelope density may be less than the solid density when particles contain pores that do not contribute to the gas flow through the powder bed.

3.2 envelope-specific surface area

specific surface area of a powder as determined by gas permeametry

3.3 envelope volume

volume occupied by the particles in a powder bed, excluding the volume of the *interstices* (3.5)

Note 1 to entry: 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 document, as being equal to the effective volume, as determined by pyknometry.

3.4 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* (3.9)

3.5 interstices

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

3.6 mass-specific surface area

surface area of a powder divided by its mass

Note 1 to entry: This area depends on the type of method used for its determination.

3.7 permeability

ability of a porous material to allow a fluid to flow through it

Note 1 to entry: to entry In this document, the fluid used is dry air.

3.8 permeable porosity

volume of *interstices* (3.5) divided by the volume of the powder bed

3.9 volume-specific surface area

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

4 Symbols

Table 1 — Symbols used in the text

Symbol	Meaning	Unit	Observations
	Powder bed		
A	Cross-sectional area	m^2	Area of whole cross-section of powder 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		$\varepsilon_p = 1 - \frac{m}{AL\rho_e}$
ε	Total porosity		$\varepsilon = 1 - \frac{m}{AL\rho}$
	Gas flow		
q	Volume flow rate	m^3/s	Converted to standard conditions (STP - 0 °C, 1 atm)
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	$M = 0,029 \text{ kg/mol}$ for air
R	Molar gas constant	$\frac{J}{mol K}$	$R = 8,31 \frac{J}{mol K}$
	Calculation		
K	Kozeny-Carman factor		For the purposes of this document, $K = 5,0$
δK_0	Compound constant		For the purposes of this document, the generally accepted value of 2,25 is used
S_w	Mass-specific surface area	m^2/kg	
S_K	Kozeny term	m^{-1}	Formula (3)
S_m	Slip flow term	m^{-1}	Formula (4)
S_V	Volume-specific surface area	m^{-1}	$S_V = \rho_e S_w$
Φ	Permeability	m^2	
D	Equivalent sphere diameter	m	$D = \frac{6}{S_V} = \frac{6}{\rho_e S_w}$