SLOVENSKI STANDARD
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Prepustne sintrane kovine - Ugotavljanje prepuščanja tekočin (ISO/FDIS 4022:2018)

Permeable sintered metal materials - Determination of fluid permeability (ISO/FDIS 4022:2018)

Durchlässige Sintermetallwerkstoffe - Bestimmung der Flüssigkeitsdurchlässigkeit (ISO/FDIS 4022:2018)

Matériaux métalliques frittés perméables - Détermination de la perméabilité aux fluides (ISO/FDIS 4022:2018)

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Permeable sintered metal materials — Determination of fluid permeability

Matériaux métalliques frittés perméables — Détermination de la perméabilité aux fluides

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 119, *Powder metallurgy*, Subcommittee SC 3 *Sampling and testing methods for sintered metal materials (excluding hardmetals)*.

This third edition cancels and replaces the second edition (ISO 4022:1987), of which it constitutes a minor revision with the following changes:

— Clause 3 and Clause 4 order reversed, and Clause 3 split into 3.1 and 3.2;

— 3.1.3, 3.1.4, 3.1.5, 3.1.13 and 3.1.14 editorially revised;

— Clause 3: Terminological entries ‘length’ and ‘dynamic viscosity’ removed;

— 6.1.1 and 6.1.2, Figures 1 and 2 and keys editorially revised;

— 7.1.2, first Formula removed and Formula (2) corrected, “l” changed to “1”;

— 8.3, Formula (12) corrected, “ρ” changed to “ϱ”.

Permeable sintered metal materials — Determination of fluid permeability

1 Scope

This document specifies a method for the determination of the fluid permeability of permeable sintered metal materials in which the porosity is deliberately continuous or interconnecting, testing being carried out under such conditions that the fluid permeability can be expressed in terms of viscous and inertia permeability coefficients (see Annex A).

This document does not apply to very long hollow cylindrical test pieces of small diameter, in which the pressure drop of the fluid in passing along the bore of the cylinder might not be negligible compared with the pressure drop of the fluid passing through the wall thickness (see Annex A, Clause A.5).

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 2738, *Sintered metal materials, excluding hardmetals — Permeable sintered metal materials — Determination of density, oil content and open porosity*

3 Terms, definitions, symbols and units

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

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 Terms and definitions

3.1.1
permeability
ability of a porous metal to pass a fluid under the action of a pressure gradient

3.1.2
test area
area of a porous metal normal to the direction of the fluid flow

3.1.3
thickness
dimension of the test piece in the direction of fluid flow

Note 1 to entry: For flat test pieces it is equal to the thickness.

Note 2 to entry: For hollow cylinders it is given by Formulae (2) to (6).

3.1.4
viscous permeability coefficient
volume flow rate at which a fluid of unit viscosity is transmitted through unit area of porous metal permeated under the action of unit pressure gradient when the resistance to fluid flow is due only to viscous losses

Note 1 to entry: It is independent of the quantity of porous metal considered.

3.1.5
inertia permeability coefficient
volume flow rate at which a fluid of unit density is transmitted through unit area of porous metal permeated under the action of unit pressure gradient when the resistance to fluid flow is due only to inertia losses

Note 1 to entry: It is independent of the quantity of porous metal considered.

3.1.6
volume flow rate
mass flow rate of the fluid divided by its density

3.1.7
upstream pressure
pressure upstream of the test piece

3.1.8
downstream pressure
pressure downstream of the test piece

3.1.9
mean pressure
half the sum of the upstream and downstream pressures

3.1.10
pressure drop
difference between the pressures on the upstream and downstream surfaces of the porous test piece

3.1.11
pressure gradient
pressure drop divided by the thickness of the porous test piece

3.1.12
velocity
ratio of the volumetric flow rate to the test area

3.1.13
density
quotient of mass divided by volume of the test fluid at the mean temperature and pressure

3.1.14
apparatus correction
pressure difference observed between the upstream and downstream pressure tappings when the test apparatus is used without a porous test piece in position

Note 1 to entry: The apparatus correction is to be subtracted from the observed pressure drop.

Note 2 to entry: It varies with the flow rate through the apparatus and arises from venturi effects at the pressure tappings and other causes.

3.1.15
mean absolute temperature
half the sum of the temperatures of the fluid at the upstream side and the downstream side of the test piece

3.2 Symbols and units

Symbol	Term	Unit
A	Test area	m^2
e	Thickness	m
ψ_v	Viscous permeability coefficient	m^2
ψ_i	Inertia permeability coefficient	m
Q	Volume flow rate	m^3/s
p_1	Upstream pressure	N/m^2
p_2	Downstream pressure	N/m^2
p	Mean pressure	N/m^2
Δp	Pressure drop	N/m^2
$\Delta p/e$	Pressure gradient	N/m^3
Q/A	Velocity	m/s
ϱ	Density	kg/m^3
T	Mean absolute temperature	K

4 Principle

Passage of a test fluid of known viscosity and density through a test piece, and measurement of the pressure drop and the volumetric flow rate.

Determination of the viscous and inertia permeability coefficients, which are parameters of a formula describing the relationship between the pressure drop, the volumetric flow rate, the viscosity and density of the test fluid and the dimensions of the porous metal test piece permeated by this fluid.

5 Test piece

Before testing with gas, all liquid shall be removed from the pores of the test piece. Oil and grease shall be removed by using a suitable solvent with the extraction method given in ISO 2738. The test piece shall be dried before testing.

6 Apparatus

6.1 Equipment

The choice of apparatus is mainly dictated by the size, shape and physical characteristics of the test piece.

This document refers to two different types of apparatus suitable for determining the fluid permeability of porous test pieces.

6.1.1 Guard ring test head for flat test pieces.

This is a type of test apparatus which is recommended for carrying out non-destructive testing of partial areas of flat porous sheets.

The permeable metal sheet is clamped between two pairs of flexible seals. The inner pair, corresponding to the test area, has a mean diameter of D_1. The outer pair, of mean diameter D_2, forms a guard ring surrounding the test-area, which is pressurized to prevent side leakage from the test area (see Figure 1).

The width of the annulus formed by the guard ring test head shall be not less than the thickness of the sheet, see Formula (1):

$$\frac{D_2 - D_1}{2} \geq e \tag{1}$$

The guard ring test head minimizes side leakage by ensuring that the pressure is the same in the inner and outer chambers. On the upperstream face of the test piece, this is achieved by arranging that the port area connecting the upper chambers (as shown in Figure 1) is as large as possible. On the downstream face of the test piece, the inner chamber leads to a flowmeter, usually subject to a small back pressure, and the outer chamber leads to atmosphere via a pressure-equalizing valve. This valve is adjusted to equalize the pressure in the inner and outer chambers. The fitting of a restrictor between the test piece and the flowmeter, to increase the back pressure and thus permit more stable control of the pressure-equalizing valve, is allowed.

However, ideally, the pressure on the downstream face of the test piece should be as near as possible to atmospheric pressure and a restrictor should not be used unless necessary for the adjustment of the pressure drop in the flowmeter.

Toroidal sealing rings ("O"-rings) are recommended for the inner seals.

The seals shall be sufficiently flexible to overcome all surface imperfections and lack of flatness of the porous metal. In some instances it might be necessary to load the inner and outer seals separately to ensure leak-free sealing.

Two upper and two lower seals are required and these shall be in line with each other.