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Sintered metal materials, excluding hardmetals – Permeable sintered metal materials – Determination of density, oil content and open porosity (ISO 2738:1999)

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Swedish Standards corresponding to documents referred to in this Standard are listed in "Catalogue of Swedish Standards", issued by SIS. The Catalogue lists, with reference number and year of Swedish approval, International and European Standards approved as Swedish Standards as well as other Swedish Standards.

Sintermetaller, utom hårdmetall – Icke yttäta sintrade metalliska material – Bestämning av densitet, oljehalt och öppen porositet (ISO 2738:1999)

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ICS 77.160

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EUROPEAN STANDARD
NORME EUROPÉENNE
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EN ISO 2738

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English version

**Sintered metal materials, excluding hardmetals - Permeable
sintered metal materials - Determination of density, oil content
and open porosity (ISO 2738:1999)**

Matériaux métalliques frittés, à l'exclusion des métaux durs
- Matériaux métalliques frittés perméables - Détermination
de la masse volumique, de la teneur en huile et de la
porosité ouverte (ISO 2738:1999)

This European Standard was approved by CEN on 8 October 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Foreword

The text of the International Standard ISO 2738:1999 has been prepared by Technical Committee ISO/TC 119 "Powder metallurgy" in collaboration with CEN/CS.

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 May 2000, and conflicting national standards shall be withdrawn at the latest by May 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

NOTE FROM CEN/CS: The foreword is susceptible to be amended on reception of the German language version. The confirmed or amended foreword, and when appropriate, the normative annex ZA for the references to international publications with their relevant European publications will be circulated with the German version.

Endorsement notice

The text of the International Standard ISO 2738:1999 was approved by CEN as a European Standard without any modification.

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

1 Scope

This international Standard specifies methods of determining the density, oil content and open porosity of permeable sintered metal materials.

It applies in particular to porous metal bearings and to structural parts produced by pressing and sintering metal powders.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 758, *Liquid chemical products for industrial use — Determination of density at 20 °C*.

ISO 13944, *Lubricated metal-powder mixes — Determination of lubricant content — Modified Soxhlet extraction method*.

3 Symbols and designations

Table 1 — Symbols and designations

Symbol	Designation	Unit
m_1	Initial mass of the test piece	g
m_2	Mass of the test piece after oil extraction and drying	g
m_3	Mass of the fully impregnated test piece	g
m_a	Mass of the fully or partially impregnated test piece plus supporting device (for example suspension wire) weighed in air	g
m_w	Mass of the fully or partially impregnated test piece plus supporting device (for example suspension wire) weighed in water	g
V	Volume of the test piece	cm ³
ρ_w	Density of the water used	g/cm ³
ρ_1	Density of the oil initially in the test piece ^a	g/cm ³
ρ_2	Density of the impregnating oil used ^a	g/cm ³
^a The oil density is assumed to be known or, if not, to be determined in accordance with ISO 758.		

4 Terms and definitions

For the purposes of this International Standard the following terms and definitions apply.

4.1 density

the density of the test piece may be expressed in two ways:

4.1.1 dry density

the mass, after drying, divided by the volume

4.1.2 fully impregnated density (wet density)

the fully impregnated mass divided by the volume

4.2 oil content

the oil content of the test piece may be expressed in two ways:

4.2.1 percentage by volume

the volume of the oil divided by the volume of the test piece and multiplied by 100

4.2.2 percentage of the volume of the open porosity

the volume of the oil divided by the volume of the open porosity and multiplied by 100

4.3 open porosity (of the test piece)

the oil content after full impregnation divided by the volume of the test piece and multiplied by 100 expressed as a percentage by volume

4.4 volume (of the test piece)

total volume including the pores

5 Test procedures

Depending upon which of the properties is to be determined, some or all of the test procedures in clause 8 are carried out. Table 2 shows the test procedures that are carried out for the property to be determined. The values obtained for the various parameters are inserted in the respective formulae given in clause 9 to obtain the desired property.

Table 2 — Test procedures

Test procedure	Symbol for result obtained	Properties to be determined				
		Density		Oil content		Open porosity
		Dry	Fully impregnated	% (V/V)	% of open porosity	
Initial weighing of the test piece (see 8.1)	m_1			×	×	
Extraction of the oil contained in the pores of the test piece (see 8.2)		×		×	×	×
Determination of the mass of the test piece after oil extraction and drying (see 8.3)	m_2	×		×	×	×
Full impregnation of the test piece with an oil of known density (see 8.4)			×		×	×
Determination of the mass of the fully impregnated test piece (see 8.5)	m_3		×		×	×
Determination of the volume of the test piece (see 8.6)	V	×	×	×		×

6 Equipment

6.1 Analytical balance, of sufficient capacity and accurate to 0,01 %.

6.2 Soxhlet extractor, with oil solvent.

6.3 Device for weighing the test piece in air and in liquid

NOTE The liquid is usually water (see Figures 1, 2 and 3).

6.4 Vessel, large enough to accommodate the test piece and the device (6.3) for weighing it, containing distilled or deionized, and preferably degassed water, with 0,05 % (V/V) to 0,10 % (V/V) wetting agent added.

6.5 Apparatus for vacuum impregnation of the test piece with oil

6.6 Impregnation oil, of known density (see ISO 758 for the determination of the density of liquids).

6.7 Thermometer, accurate to $\pm 0,5$ °C.

7 Test piece

7.1 Usually the test piece is tested whole. If this is not possible, the test piece may be cut or broken into smaller parts to facilitate the various operations. It is often most appropriate to test only a critical section of a component.

7.2 If the test piece has a mass less than 5 g a number of test pieces shall be tested together to obtain the average value.

7.3 The surface of the test piece shall be free of adhering dirt, grease or other foreign material.

7.4 The surface of the test piece shall be free from surplus oil. When removing any such surplus oil with an oil-absorbent material, care shall be taken to avoid removing oil contained in the pores.

NOTE The presence of surplus oil on the surface of the test piece is most likely to occur after the full impregnation treatment.

8 Test procedures

8.1 Determination of the initial mass of the test piece

Weigh the test piece in the condition in which it was received, to obtain m_1 .

NOTE If the test piece is known to contain no oil, the procedures described in 8.2 and 8.3 are omitted. In this case, m_1 is substituted for m_2 in the formulae given in 9.1 and 9.3.

8.2 Removal of oil from the test piece by solvent extraction

Approximately 3 h of soaking and about ten solvent changes are required to remove the oil from test pieces of average density and small wall thickness. For thick walls and high density, up to 24 h are sometimes required.

NOTE 1 The Soxhlet extractor is a convenient apparatus for soaking the test piece in warm, freshly distilled oil solvent. The distillation rate determines the number of cycles and hence the number of solvent changes that occur. A suitable Soxhlet unit is described in ISO 13944.

Continue the extraction to constant mass after evaporation of the solvent left in the pores.

NOTE 2 Experience will indicate the best extraction time and distillation rate to use.

Dry the test piece to constant mass (i.e. until the reduction in mass produced by the last extraction does not exceed 0,01 % at a temperature of 20 °C above the boiling point of the solvent) then cool in a desiccator and weigh.

Choose the solvent so that complete dissolution of the oil in question is ensured. This requirement shall be tested for separately. The solvent used shall be stated in the test report.

For practical control purposes, other methods for removing the oil may be used (such as heating well below sintering temperatures in a protective atmosphere). In cases of dispute, the modified Soxhlet extraction method shall be the reference method (see ISO 13944).

8.3 Determination of the mass of the dried test piece

Weigh the test piece after solvent extraction and drying to obtain m_2 .