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

*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*

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Foreword

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International Standard ISO 2738 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 2738:1987) which has been technically revised.

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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.