SLOVENSKI STANDARD
SIST EN ISO 5755:2022

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Nadomešča:
SIST EN ISO 5755:2012

Sintrane kovine - Specifikacije (ISO 5755:2022)

Sintered metal material - Specifications (ISO 5755:2022)

Sintermetallwerkstoffe - Anforderungen (ISO 5755:2022)

Matériaux métalliques frittés - Spécifications (ISO 5755:2022)

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English Version

Sintered metal material - Specifications (ISO 5755:2022)

Matériaux métalliques frittés - Spécifications (ISO 5755:2022)

Sintermetallwerkstoffe - Anforderungen (ISO 5755:2022)

This European Standard was approved by CEN on 8 May 2022.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN ISO 5755:2022) has been prepared by Technical Committee ISO/TC 119 "Powder metallurgy" in collaboration with 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of an identical text or by endorsement, at the latest by April 2023, and conflicting national standards shall be withdrawn at the latest by April 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 5755:2022 has been approved by CEN as EN ISO 5755:2022 without any modification.

INTERNATIONAL STANDARD

ISO 5755

Fourth edition
2022-10

Sintered metal material — Specifications

Matériaux métalliques frittés — Spécifications

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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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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 ISO/TC 119, *Powder metallurgy,* Subcommittee SC 5, *Specifications for powder metallurgical materials (excluding hardmetals)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/SS M11, *Powder metallurgy,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 5755:2012), which has been technically revised.

The main changes are as follows:

— Annex B has been updated to include information on metallography of sintered materials;

— a new Annex C has been added to include tables of equivalences of the materials of the standard with the materials of other international standards of habitual use.

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.

Sintered metal material — Specifications

1 Scope

This document specifies the requirements for the chemical composition and the mechanical and physical properties of sintered metal materials used for bearings and structural parts.

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 1099, *Metallic materials — Fatigue testing — Axial force-controlled method*

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

ISO 2739, *Sintered metal bushings — Determination of radial crushing strength*

ISO 2740, *Sintered metal materials, excluding hardmetals — Tensile test pieces*

ISO 2795, *Plain bearings — Sintered bushes — Dimensions and tolerances*

ISO 3325, *Sintered metal materials, excluding hardmetals — Determination of transverse rupture strength*

ISO 3954, *Powders for powder metallurgical purposes — Sampling*

ISO 4498, *Sintered metal materials, excluding hardmetals — Determination of apparent hardness and microhardness*

ISO 5754, *Sintered metal materials, excluding hardmetals — Unnotched impact test piece*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 7625, *Sintered metal materials, excluding hardmetals — Preparation of samples for chemical analysis for determination of carbon content*

ISO 14317, *Sintered metal materials excluding hardmetals — Determination of compressive yield strength*

ASTM E228, *Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer*

ASTM E1875, *Standard Test Method for Dynamic Young's Modulus, Shear Modulus, and Poisson's Ratio by Sonic Resonance*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
tensile strength
R_m
ability of a test specimen to resist fracture when a pulling force is applied in a direction parallel to its longitudinal axis

Note 1 to entry: It is equal to the maximum load divided by the original cross-sectional area.

Note 2 to entry: It is expressed in MPa.

3.2
tensile yield strength
$R_{p0,2}$
load at which the material exhibits a 0,2 % offset from proportionality on a stress-strain curve in tension, divided by the original cross-sectional area

Note 1 to entry: It is expressed in MPa.

3.3
Young's modulus
E
ratio of normal stress to corresponding strain for tensile or compressive stresses below the proportional limit of the material

Note 1 to entry: It is expressed in GPa.

3.4
Poisson's ratio
v
absolute value of the ratio of transverse strain to the corresponding axial strain, resulting from uniformally distributed axial stress below the proportional limit of the material

3.5
impact energy
measurement of the energy absorbed when fracturing a specimen with a single blow

Note 1 to entry: It is expressed in Joules (J).

3.6
compressive yield strength
stress at which a material exhibits a specified permanent set

Note 1 to entry: It is expressed in MPa.

3.7
transverse rupture strength
stress, calculated from the bending strength formula, required to break a specimen of a given dimension

Note 1 to entry: It is expressed in MPa.

3.8
fatigue strength
maximum alternating stress that can be sustained for a specific number of cycles without failure, the stress being reversed with each cycle unless otherwise stated

Note 1 to entry: It is expressed in MPa.

3.9
radial crushing strength
radial stress required to fracture a hollow cylindrical part of specified dimensions

Note 1 to entry: It is expressed in MPa.

3.10
density
mass per unit volume of the material

Note 1 to entry: It is expressed in g/cm^3.

3.11
apparent hardness
resistance of a powder metallurgical (PM) material to indentation, tested under specified conditions

Note 1 to entry: For PM materials, it is a function of the density of the material.

3.12
open porosity
oil content after full impregnation, divided by the volume of the test piece, and multiplied by 100

Note 1 to entry: It is expressed as a volume percentage.

3.13
coefficient of linear expansion
change in length per unit length per degree change in temperature

Note 1 to entry: It is expressed in $10^{-6}\ K^{-1}$.

4 Sampling

Sampling of powders to produce standard test pieces shall be carried out in accordance with ISO 3954.

5 Test methods for normative properties

5.1 General

The following test methods shall be used to determine the normative properties given in Tables 1 to 18.

5.2 Chemical analysis

The chemical composition table for each material lists the principal elements by minimum and maximum mass percentage before any additional process, such as oil impregnation, resin impregnation or steam treatment, has taken place. “Other elements” may include minor amounts of elements added for specific purposes and is reported as a maximum percentage.

Whenever possible, and always in cases of dispute, the methods of chemical analysis shall be those specified in the relevant International Standards. If no International Standard is available, the method may be agreed upon and specified at the time of enquiry and order.

Samples for the determination of total carbon content shall be prepared in accordance with ISO 7625. Determination of the total carbon content can be in accordance with ISO 437.

5.3 Open porosity

The open porosity shall be determined in accordance with ISO 2738.

5.4 Mechanical properties

5.4.1 General

The as-sintered mechanical properties given in Tables 1 to 18 were determined on pressed and sintered test pieces with a mean chemical composition. The heat-treated mechanical properties given in Tables 1

to 18 were determined on test bars which were either pressed and sintered or machined from pressed and sintered blanks. They are intended as a guide to the initial selection of materials . When selecting powder metallurgical (PM) materials, it should be taken into account that the properties depend not only on the chemical composition and density, but also on the production methods. The properties of sintered materials giving satisfactory service in particular applications may not necessarily be the same as those of wrought or cast materials that might otherwise be used. Therefore, liaison with prospective suppliers is recommended They may also be used as a basis for specifying any special tests that may be indicated on the drawing.

The mechanical properties shall neither be calculated from hardness values nor be determined on tensile test pieces taken from a component and used for verifying the values given in Tables 1 to 18. If the customer requires that a specified level of mechanical properties be obtained by tests on the component, these shall be agreed with the supplier and shall be stated on the drawing and/or any technical documentation of the customer referred to on the drawing.

5.4.2 Tensile properties

The ultimate tensile strength and the yield strength shall be determined in accordance with ISO 2740 and ISO 6892-1. For heat-treated materials, tensile strength and yield strength are approximately equal and, in this case, tensile strength is specified.

The normative yield strengths (as-sintered condition) and ultimate tensile strengths (heat-treated condition) are shown as minimum values. These strengths may be used in designing PM part applications. To select a material which is optimum in both properties and cost-effectiveness, it is essential that the part application be discussed with the PM parts manufacturer.

The minimum values were developed from tensile specimens prepared specifically for evaluating PM materials.

Tensile specimens machined from commercial parts may differ from those obtained from prepared tensile specimens. To evaluate the part strength, it is recommended that static or dynamic proof-testing be agreed between the purchaser and the manufacturer and carried out on the first production lot of parts. The results of testing to failure can be used statistically to determine a minimum breaking force for future production lots.

Acceptable strength can also be demonstrated by processing tensile specimens prepared specifically for evaluating PM materials manufactured from the same batch of powder as the production parts and processed with them.

As indicated above, the testing of test bars machined from the PM component is the least desirable method for demonstrating minimum properties.

For heat-treated properties, the test bars were quench-hardened and tempered to increase the strength, hardness and wear resistance. Tempering is essential to develop the properties given in this document. Heat-treat equipment that utilizes a gas atmosphere or vacuum is recommended. The use of liquid salts is not recommended due to entrapment of the salts in the porosity causing “salt bleed-out” and “internal corrosion”. Some materials may be heat-treated directly after the sintering process by controlling the cooling rate within the sintering furnace. This process is usually known as “sinter hardening”. Materials processed by this route also require tempering to develop their optimum strengths.

5.4.3 Radial crushing strength

The radial crushing strength shall be determined in accordance with ISO 2739. The wall thicknesses of test pieces to be used shall be in the range covered by ISO 2795. For test pieces outside this range, the specified radial crushing strength values are different and shall be agreed between the customer and the supplier.

6 Test methods for informative properties

6.1 General

Typical values are given for each material; these include tensile and yield strengths. These typical values are given for general guidance only. They should not be used as minimum values.

These typical properties should be achievable through normal manufacturing processing. Again, any specific tests on components should be discussed and agreed between the purchaser and the manufacturer.

6.2 Density

The density shall be determined in accordance with ISO 2738. Density is normally determined after the removal of any oils or non-metallic materials from the porosity and is known as the "dry density". The "wet density" is sometimes reported on production bearings or parts, this is the mass per unit volume, including any oil or non-metallic material that has impregnated the component.

6.3 Tensile strength

The tensile strength shall be determined in accordance with ISO 2740 and ISO 6892-1.

6.4 Tensile yield strength

The tensile yield strength shall be determined in accordance with ISO 2740 and ISO 6892-1.

6.5 Elongation

Elongation (plastic) shall be determined in accordance with ISO 6892-1. It is expressed as a percentage of the original gauge length (usually 25 mm), and is determined by on measuring the increase in gauge length after the fracture, providing the fracture takes place within the gauge length. Elongation can also be measured with a break-away extensometer on a tensile specimen. The recorded stress/strain curve displays total elongation (elastic and plastic). The elastic strain shall be subtracted from the total elongation to give the plastic elongation (this can sometimes be provided with the test machine's software).

6.6 Young's modulus

Young's modulus shall be determined in accordance with ASTM E1875. Data for the elastic constants in this document were generated from resonant frequency testing. Formula (1) relates the three elastic constants:

$$v = (E / 2G) - 1 \tag{1}$$

where

v is Poisson's ratio;

E is Young's modulus;

G is the shear modulus.

6.7 Poisson's ratio

Poisson's ratio shall be determined in accordance with ASTM E1875.