INTERNATIONAL STANDARD

ISO 5755

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Sintered metal materials — Specifications

Matériaux métalliques frittés — Spécifications

Reference number
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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5755 was prepared by Technical Committee ISO/TC 119, *Powder metallurgy,* Subcommittee SC 5, *Specifications for powder metallurgical materials (excluding hardmetals).*

This first edition of ISO 5755 cancels and replaces ISO 5755-1:1987, ISO 5755-2:1987 and ISO 5755-3:1987, which have been technically revised.

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Sintered metal materials — Specifications

1 Scope

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

When selecting powder metallurgical 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.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2738:—[1], *Permeable sintered metal materials — Determination of density, oil content and open porosity.*

ISO 2739:1973, *Sintered metal bushes — Determination of radial crushing strength.*

ISO 2740:—[2], *Sintered metal materials, excluding hardmetals — Tensile test pieces.*

ISO 2795:1991, *Plain bearings — Sintered bushes — Dimensions and tolerances.*

ISO 4498-1:1990, *Sintered metal materials, excluding hardmetals — Determination of apparent hardness — Part 1: Materials of essentially uniform section hardness.*

ISO 6892:—[3], *Metallic materials — Tensile testing at ambient temperature.*

1) To be published. (Revision of ISO 2738:1987)

2) To be published. (Revision of ISO 2740:1986)

3) To be published. (Revision of ISO 6892:1984)

3 Sampling

Sampling shall be carried out in accordance with the relevant International Standards.

4 Test methods

The following test methods shall be used to determine the normative properties given in tables 1 to 9.

4.1 Chemical analysis

Whenever possible, and always in the case 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.

4.2 Open porosity

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

4.3 Liquid-lubricant content

The liquid-lubricant content shall be determined in accordance with ISO 2738.

4.4 Ultimate tensile strength

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

4.5 Apparent hardness

The apparent hardness shall be determined in accordance with ISO 4498.

4.6 Mechanical properties

4.6.1 General

The values given in tables 1 to 9 shall be determined on pressed and sintered test pieces at mean chemical composition and are intended as a guide to initial selection of materials (see also clause 1). They may also be used as a basis for specifying any special tests which 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 9. If the customer requires that a specified level of mechanical properties shall be obtained by tests on the component, these shall be agreed with the supplier and shall be stated on the drawing and/or any specified technical documentation of the customer referred to on the drawing.

4.6.2 Tensile properties

The normative values for tensile strength shall be determined in accordance with ISO 6892, using pressed and sintered test pieces, or in the case of heat treated materials, machined test pieces, made in accordance with ISO 2740.

4.6.3 Apparent hardness

The normative values for apparent hardness (Vickers and Rockwell) shall be determined in accordance with ISO 4498-1.

If hardness values are specified in an agreed acceptance test (see 4.6.1), the hardness requirements shall be stated on the drawing of the component, together with the surface or surfaces to be subjected to the test.

4.6.4 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 with wall thicknesses outside this range, the specified radial crushing strength values are different and shall be agreed between customer and supplier.

5 Specifications

The chemical composition and mechanical properties are given in tables 1 to 9.

The liquid-lubricant content of materials for bearings, impregnated with liquid lubricant, shall be not less than 90 % of the measured open porosity.

For the purpose of specifying a material, the grade designation shall consist of six characters, the sixth (printed in the tables as a dash) being N or Z. N shall be used when the material has received no after-treatment and Z shall be used to indicate an after-treatment such as heat treatment, phosphating or steam treatment.

Table 1 — Materials for bearings impregnated with liquid lubricant — Iron, iron copper, iron bronze, iron carbon graphite, bronze, bronze with graphite

Material	Grade [1]	Mandatory values								Informative values (approximate)	
		Chemical composition						Mechanical and physical properties			
		C [2] (combined)	Cu	Fe	Sn	Graphite	Total other elements max.	Open porosity P	Radial crushing strength K	Density ρ	Coefficient of linear expansion α_l
		%	%	%	%	%	%	%	N/mm²	g/cm³	°C⁻¹ × 10⁻⁶
Iron	P1011Z P1012Z P1013Z	< 0,3	—	Balance	—	—	2	⩾ 27 ⩾ 22 ⩾ 17	⩾ 120 ⩾ 170 ⩾ 220	5,4 5,8 6,2	12
Iron copper	P2011Z P2012Z P2013Z	< 0,3	1 to 4	Balance	—	—	2	⩾ 27 ⩾ 22 ⩾17	⩾ 150 ⩾ 200 ⩾ 250	5,4 5,8 6,2	12
Iron bronze	P2082Z P2083Z	< 0,5	34 to 38	Balance	3,5 to 4,5	0,3 to 1,0	2	⩾24 ⩾19	90 to 265 120 to 330	5,8 6,2	14
Iron bronze	P2092Z P2093Z	< 0,5	43 to 47	Balance	4,0 to 5,0	< 1,0	2	⩾ 24 ⩾ 19	70 to 245 100 to 310	5,6 6,0	14
Iron carbon graphite	P1053Z P1054Z	< 0,5	—	Balance	—	2,0 to 3,5	2	⩾ 20 ⩾ 13	70 to 175 80 to 210	5,6 6,0	16
Bronze	P4011Z P4012Z P4013Z P4014Z	—	Balance	—	9 to 11	—	2	⩾ 27 ⩾ 22 ⩾ 15 ⩾ 10	⩾ 110 ⩾ 140 ⩾ 180 ⩾ 210	6,1 6,6 7,0 7,4	18
Bronze with graphite	P4021Z P4022Z P4023Z	—	Balance	—	9 to 11	0,5 to 2,0	2	⩾ 27 ⩾ 22 ⩾ 17	⩾ 90 ⩾ 120 ⩾ 160	5,9 6,4 6,8	18

1) The letter Z indicates that the sintered material has been subjected to a finishing treatment. In this table, it indicates that the material is impregnated with liquid lubricant.

2) On the basis of the iron phase only.

Table 2 — Ferrous materials for structural parts — Iron, carbon steel, copper steel, copper carbon steel

Material	Grade [1]	Mandatory values							Informative values (approximate)			
		Chemical composition				Mechanical and physical properties						
		C (combined)	Cu	Fe	Total other elements	Tensile strength	Apparent hardness		Density	Yield strength	Elongation	Apparent surface hardness after appropriate treatment
					max.	R_m min.	HV5 min.	Rockwell min.	ρ	$R_{p0,2}$	A	HV5 [2]
		%	%	%	%	N/mm²			g/cm³	N/mm²	%	
Iron	P1022-	< 0,3	—	Balance	2	70	30	n.m.	5,8	40	1	—
	P1023-					100	40	30 HRF	6,2	60	2	—
	P1024-					140	50	45 HRF	6,6	80	3	—
	P1025-					180	65	62 HRF	7,0	100	4	400
	P1026-					220	80	45 HRB	7,3	120	6	500
Carbon steel	P1033-	0,3 to 0,6	—	Balance	2	140	55	52 HRF	6,2	90	n.m	—
	P1034-					190	75	68 HRF	6,6	120	1	—
	P1035-					240	90	48 HRB	7,0	130	2	400
	P1042-	0,6 to 0,9	—	Balance	2	150	55	52 HRF	5,8	120	n.m.	—
	P1043-					200	80	45 HRB	6,2	160	n.m.	—
	P1044-					250	100	50 HRB	6,6	210	1	—
	P1045-					300	120	62 HRB	7,0	250	1	400
Copper steel	P2022-	< 0,3	1 to 4	Balance	2	120	45	38 HRF	5,8	90	n.m.	—
	P2023-					160	55	52 HRF	6,2	120	1	—
	P2024-					200	65	62 HRF	6,6	140	2	300
	P2025-					240	75	68 HRF	7,0	170	3	450
	P2032-	< 0,3	4 to 8	Balance	2	160	60	57 HRF	5,8	120	n.m.	—
	P2033-					200	75	68 HRF	6,2	140	n.m.	—
	P2034-					240	85	46 HRB	6,6	190	1	—
	P2035-					280	95	49 HRB	7,0	230	2	400

Table 2 — Ferrous materials for structural parts — Iron, carbon steel, copper steel, copper carbon steel (*concluded*)

Material	Grade [1]	Mandatory values							Informative values (approximate)			
		Chemical composition				Mechanical and physical properties						
		C (combined)	Cu	Fe	Total other elements	Tensile strength	Apparent hardness		Density	Yield strength	Elongation	Apparent surface hardness after appropriate treatment
					max.	R_m min.	HV5 min.	Rockwell min.	ρ	$R_{p0,2}$	A	HV5 [2]
		%	%	%	%	N/mm²			g/cm³	N/mm²	%	
Copper carbon steel	P2043-	0,3 to 0,6	1 to 4	Balance	2	220	80	45 HRB	6,2	190	n.m.	—
	P2044-					280	100	50 HRB	6,6	230	n.m.	350
	P2045-					350	120	62 HRB	7,0	280	1	450
	P2053-	0,6 to 0,9	1 to 4	Balance	2	270	100	50 HRB	6,2	210	n.m.	—
	P2054-					340	120	62 HRB	6,6	270	n.m.	350
	P2055-					420	140	69 HRB	7,0	330	n.m.	450
	P2063-	0,3 to 0,6	4 to 8	Balance	2	250	90	48 HRB	6,2	210	n.m.	—
	P2064-					320	110	57 HRB	6,6	260	n.m.	350
	P2073-	0,6 to 0,9	4 to 8	Balance	2	300	110	57 HRB	6,2	240	n.m.	—
	P2074-					360	130	65 HRB	6,6	280	n.m.	350

n.m. = not measurable

NOTE — These materials may be supplied with additives to increase machinability; the properties given remain unchanged.

1) Grades 1022 and 1023 and 2022 and 2023 have the same chemical composition and the same density as grades 1012Z and 1013Z and 2012Z and 2013Z, respectively, in table 1.

2) The hardness values are obtainable from materials that have undergone a suitable hardening process. The values of all other properties with the exception of density and copper content will not then apply.

Table 3 — Ferrous materials for structural parts — Phosphorus steels

Material	Grade	Mandatory values										Informative values (approximate)
		Chemical composition					Mechanical and physical properties					
		C (combined)	Cu	P	Fe	Total other elements	Tensile strength [1]	Apparent hardness [1]		Density	Yield strength [1]	Elongation [1]
							R_m	HV5	Rockwell	ρ	$R_{p0,2}$	A
						max.	min.	min.	min.			
		%	%	%	%	%	N/mm²			g/cm³	N/mm²	%
Phosphorus steel	P1064-	< 0,3	—	0,2 to 0,5	Balance	2	240	70	66 HRF	6,6	180	4
	P1065-						260	85	46 HRB	6,8	200	6
	P1066-						280	100	50 HRB	7,0	220	8
	P1084-	< 0,3	—	0,5 to 0,65	Balance	2	280	85	46 HRB	6,6	220	4
	P1086-						360	115	60 HRB	7,0	280	5
Phosphorus carbon steel	P1074-	0,3 to 0,6	—	0,2 to 0,5	Balance	2	320	100	50 HRB	6,6	260	2
	P1075-						360	110	57 HRB	6,8	280	3
	P1076-						400	120	62 HRB	7,0	300	4
	P1094-	0,3 to 0,6	—	0,5 to 0,65	Balance	2	370	120	62 HRB	6,6	310	2
	P1096-						460	140	69 HRB	7,0	400	5
Copper phosphorus steel	P2094-	< 0,3	1 to 4	0,2 to 0,5	Balance	2	300	100	50 HRB	6,6	270	2
	P2095-						340	110	57 HRB	6,8	290	3
	P2096-						380	120	62 HRB	7,0	310	5
	P2124-	< 0,3	1 to 4	0,5 to 0,65	Balance	2	320	100	50 HRB	6,6	280	2
	P2126-						400	120	62 HRB	7,0	320	5
Copper phosphorus carbon steel	P2104-	0,3 to 0,6	1 to 4	0,2 to 0,5	Balance	2	400	125	64 HRB	6,6	360	2
	P2105-						440	135	67 HRB	6,8	390	2
	P2106-						480	145	70 HRB	7,0	410	2
	P2134-	0,3 to 0,6	1 to 4	0,5 to 0,65	Balance	2	450	145	70 HRB	6,6	400	1
	P2136-						530	160	75 HRB	7,0	450	2

1) Properties obtained by sintering in an endo atmosphere.

Table 4 — Ferrous materials for structural parts — Nickel steels, nickel copper steels

Material	Grade	Mandatory values								Informative values (approximate)		
		Chemical composition					Mechanical and physical properties					
		C (combined)	Ni	Cu	Fe	Total other elements	Tensile strength	Apparent hardness		Density	Yield strength	Elongation
						max.	R_m min.	HV5 min.	Rockwell min.	ρ	$R_{p0,2}$	A
		%	%	%	%	%	N/mm²			g/cm³	N/mm²	%
Nickel steels [1) 2)]	P3014- - P3015-	< 0,2	1 to 3	< 0,8	Balance	2	200 250	50 60	45 HRF 57 HRF	6,6 7,0	140 170	6 8
	P3025	< 0,2	3 to 6	< 0,8	Balance	2	300	80	45 HRB	7,0	200	6
Nickel copper steels [2)]	P3034- P3035-	< 0,3	1 to 3	1 to 3	Balance	2	240 270	70 90	66 HRF 48 HRB	6,6 7,0	170 200	3 4
	P3044- P3045	0,3 to 0,6	1 to 3	1 to 3	Balance	2	300 360	100 120	50 HRB 62 HRB	6,6 7,0	260 300	1 2
	P3054- P3055	< 0,3	3 to 6	1 to 3	Balance	2	250 290	70 90	66 HRF 48 HRB	6,6 7,0	190 220	3 4
	P3064- P3065-	0,3 to 0,6	3 to 6	1 to 3	Balance	2	320 380	100 130	50 HRB 65 HRB	6,6 7,0	280 320	1 2

1) Weldable.
2) Heat-treatable.

Table 5 — Ferrous materials for structural parts — Nickel copper molybdenum steels

Material	Grade	Mandatory values									Informative values (approximate)		
		Chemical composition						Mechanical and physical properties					
		C (combined)	Ni	Cu	Mo	Fe	Total other elements	Tensile strength	Apparent hardness		Density	Yield strength	Elongation
								R_m	HV5	HRB	ρ	$R_{p0,2}$	A
							max.	min.	min.	min.			
		%	%	%	%	%	%	N/mm²			g/cm³	N/mm²	%
Nickel copper molybdenum steels [1]	P3074-	< 0,3	1 to 3	1 to 3	0,3 to 0,7	Balance	2	240	80	45	6,6	170	3
	P3075-							270	100	50	6,9	200	4
	P3076-							290	110	57	7,1	220	5
	P3084-	0,3 to 0,6	1 to 3	1 to 3	0,3 to 0,7	Balance	2	330	120	62	6,6	300	2
	P3085-							430	150	72	6,9	360	3
	P3086-							480	160	75	7,1	390	4
	P3094-	0,6 to 0,9	1 to 3	1 to 3	0,3 to 0,7	Balance	2	350	140	69	6,6	330	n.m.
	P3095							460	170	77	6,9	400	n.m.
	P3104-	0,3 to 0,6	3 to 6	1 to 3	0,3 to 0,7	Balance	2	410	150	72	6,6	350	n.m.
	P3105-							600	180	80	6,9	450	1
	P3106-							680	200	85	7,1	520	2

n.m. = not measurable

1) Heat-treatable.

Table 6 — Ferrous materials for structural parts — Prealloyed nickel molybdenum manganese steels — Heat-treated condition only (see note) — **Properties derived from machined test bars prepared in accordance with ISO 2740**

Material	Grade	Mandatory values: Chemical composition						Informative values (approximate): Mechanical and physical properties											
		C (combined)	Ni	Mo	Mn	Fe	Total other elements	Tensile strength	Apparent hardness		Density	Yield strength [1]	Elongation	Young's modulus	Compressive yield strength	Compressive Poisson's ratio	Unnotched Charpy impact strength	Matrix hardness		Transverse rupture strength
								R_m min.	HV10 min.	HRC min.	ρ	$R_{p0,2}$	A	E	$R_{p0,1}$			HV0,1	Knoop 0,981 N	R_{tr}
		%	%	%	%	%	% max.	N/mm²			g/cm³	N/mm²	%	N/mm²	N/mm²	N/mm²	J			N/mm²
Prealloyed nickel molybdenum manganese steel	P3114Z [2]	0,4 to 0,7	0,35 to 0,65	0,50 to 0,70	0,25 to 0,60	Balance	2	600	300	26	6,7	600	n.m.	121 500	655	0,25	5,1	780	685	1 015
	P3115Z							800	350	32	7,0	800	n.m.	140 000	965	0,26	5,4	780	685	1 275
	P3124Z	0,4 to 0,7	1,70 to 2,00	0,45 to 0,65	0,15 to 0,60	Balance	2	625	300	26	6,7	625	n.m.	121 500	745	0,25	5,8	780	685	1 075
	P3125Z							825	350	32	7,0	825	n.m.	140 000	1 000	0,26	6,7	780	685	1 390

n.m. = not measurable

NOTE — Austenitized for 30 min at 850 °C in a protective atmosphere with 0,6 % carbon potential, oil-quenched and tempered for 1 h at 180 °C.

1) The yield strength is not definable as it is different from the tensile strength determined on heat-treated test bars.

2) The letter Z indicates that the sintered material has been subjected to a finishing treatment. In this table, it indicates that the material has been heat-treated as in footnote 1.