



MATERIALS FOR **SINTERED STRUCTURAL COMPONENTS** AND **SELF-LUBRICATING BEARINGS**



The GKN Sinter Metals List of Materials provides an overview of PM alloys that are commonly used for powder metal structural components and self-lubricating bearings including selected material properties. Other compositions can be supplied by GKN Sinter Metals when agreed with sales and technology. Modifications and supplements to the

list materials will be introduced without reference or notification. This does not refer to the duty of information on the current supply of parts. Additional information and references are given in the brochures related to special processes or products and in the GKN Sinter Metals General Brochure.

Remarks Referring to the Tables

The tables are divided into the main sections "Admissible Range" and "Informative Values".

Admissible ranges of density and porosity as well as the range of chemical composition are given in the left section. Also included are minimum hardness values that are attained even at the lowest possible density and with unfavourable chemical compositions within the admissible range. These hardness values can be verified on the finished components.

The section on the right contains informative values of selected material properties representing a given **specified density value** and a certain chemical composition within the range specified in the section on the left. These properties should **not** be regarded as guaranteed properties in a legal sense.

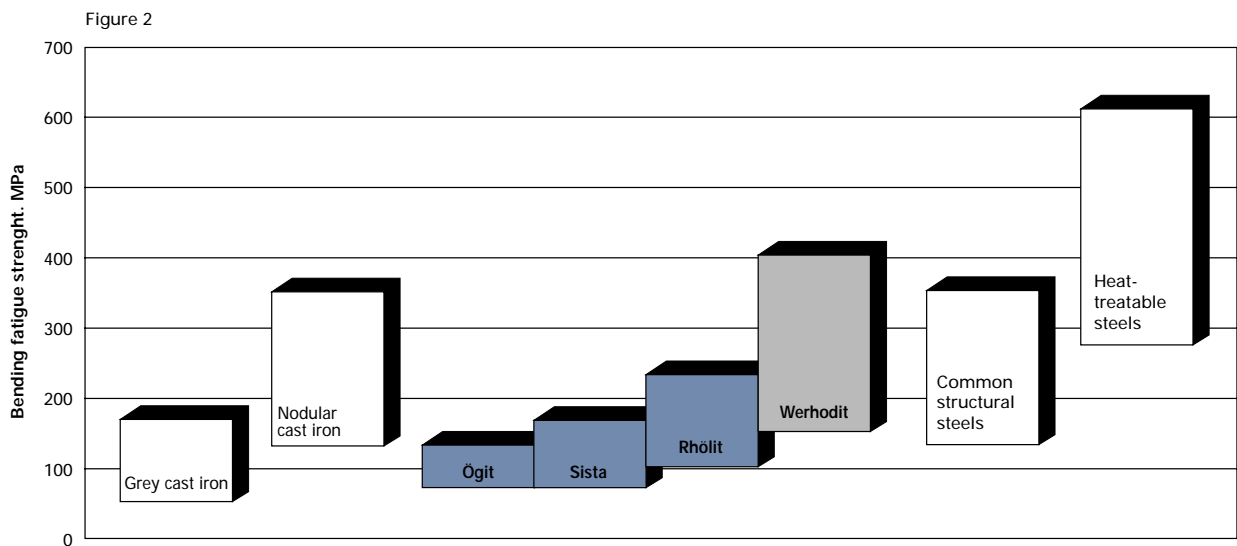
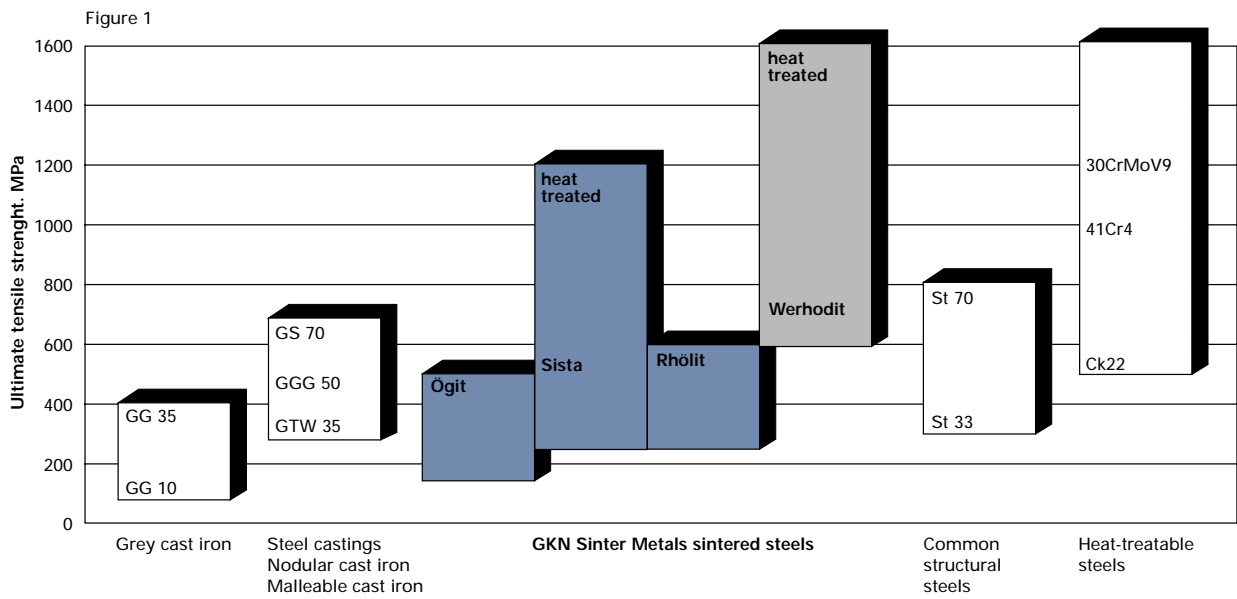
Informative property values have been determined on test bars (ISO 2740) in the **as-sintered** state; therefore they cannot be verified on the finished component. The use of micro tensile test bars cut out of a supplied component is not allowed nor can the tensile strength be deducted from a hardness measurement.

Many material properties are positively affected by subsequent sizing or heat treatment. It is strongly recommended to inquire the consequences of these processes on mechanical and physical properties as well as on part dimensions from the supplying plant.

Determination of Properties

Mechanical and physical properties stated in the tables have been determined on the basis of Sinter Test Standards (DIN 30910 Part 1, Part 3 and Part 4). Further details are given in DIN 30910 Part 1 Section 6.

The chemical composition is determined according to the respective standards. Where these are not applicable, suitable test methods should be agreed.



Comparison of sintered steels and conventional steels with respect to ultimate tensile strength (Figure 1) and bending fatigue strength (Figure 2)

PM Materials for Structural Components

● Standard materials (should be preferred)

Sintered steels	Equiv. to 30910 Sint-	Admissible ranges								Chemical composition			
		Density	Chemical composition ¹⁾ (mass percentage)						Hardness	Density	Chemical composition (mass)		
		ρ	C	Cu	Ni	Mo	P	Fe	HB	ρ	C	Cu	Ni
		g/cm ³	%	%	%	%	%	%		g/cm ³	%	%	%
● Ögit 15	C 00	6.4 – 6.8	< 0.3	< 1	–	–	–	bal.	> 35	6.6	–	–	–
● Ögit 20	C 10	6.4 – 6.8	< 0.3	1 – 5	–	–	–	bal.	> 40	6.6	–	1.5	–
● Ögit 25	C 01	6.4 – 6.8	0.3 – 0.6	< 1	–	–	–	bal.	> 70	6.6	0.5	–	–
● Ögit 26	C 30	6.4 – 6.8	< 0.3	1 – 5	1 – 5	< 0.8	–	bal.	> 55	6.6	0.3	1.5	4.0
● Ögit 29	C 35	6.4 – 6.8	< 0.3	< 1	–	–	0.3 – 0.6	bal.	> 70	6.6	–	–	–
● Ögit 36	C 36	6.4 – 6.8	< 0.3	1 – 5	–	–	0.3 – 0.6	bal.	> 80	6.6	–	2.0	–
● Ögit 40	C 11	6.4 – 6.8	0.4 – 1.5	1 – 5	–	–	–	bal.	> 80	6.6	0.8	1.5	–
● Ögit 50	C 39	6.4 – 6.8	0.3 – 0.6	1 – 3	1 – 5	< 0.8	–	bal.	> 90	6.6	0.5	1.5	4.0
● Sista 25	D 00	6.8 – 7.2	< 0.3	< 1	–	–	–	bal.	> 45	6.9	–	–	–
● Sista 30	D 10	6.8 – 7.2	< 0.3	1 – 5	–	–	–	bal.	> 50	6.9	–	1.5	–
● Sista 33	D 01	6.8 – 7.2	0.3 – 0.6	< 1	–	–	–	bal.	> 90	6.9	0.5	–	–
● Sista 34	D 35	6.8 – 7.2	< 0.3	< 1	–	–	0.3 – 0.6	bal.	> 80	6.9	–	–	–
● Sista 40	D 36	6.8 – 7.2	< 0.3	1 – 5	–	–	0.3 – 0.6	bal.	> 90	6.9	–	2.0	–
● Sista 45	–	6.8 – 7.2	< 0.3	1 – 5	1 – 3	< 0.8	–	bal.	> 60	6.9	0.3	1.5	1.8
● Sista 50	D 11	6.8 – 7.2	0.4 – 1.5	1 – 5	–	–	–	bal.	> 95	6.9	0.6	1.5	–
● Sista 55	D 30	6.8 – 7.2	< 0.3	1 – 5	1 – 5	< 0.8	–	bal.	> 60	6.9	0.3	1.5	4.0
● Sista 60	D 39	6.8 – 7.2	0.3 – 0.6	1 – 3	1 – 5	< 0.8	–	bal.	> 120	6.9	0.5	1.5	4.0
● Sista 80	–	6.9 – 7.2	0.2 – 0.8	< 5	1 – 7	< 3	–	bal.	> 180	7.1	0.6	1.5	4.0
● Sista 100	–	6.8 – 7.3	0.3 – 0.8	< 5	1 – 7	< 3	–	bal.	> 180	7.2	0.6	1.5	4.0
● Rhölit 25	E 00	> 7.2	< 0.3	< 1	–	–	–	bal.	> 60	7.4	–	–	–
● Rhölit 30	–	> 7.2	< 0.3	< 1	–	–	–	bal.	> 70	7.4	0.3	–	–
● Rhölit 35	E 10	> 7.2	< 0.3	1 – 5	–	–	–	bal.	> 80	7.3	–	1.5	–
● Rhölit 60	E 30	> 7.2	< 0.3	1 – 5	1 – 5	< 0.8	–	bal.	> 90	7.3	0.3	1.5	4.0

All values given apply to the as-sintered. not re-pressed condition

¹⁾ In addition to the elements mentioned. further alloying elements up to 2% are admitted.

²⁾ Sizing will reduce the elongation.

³⁾ Bending load. $2 \cdot 10^6$ cycles, notch factor $\alpha_k = 1.0$ (ref. 30912 Part 6).

Please note "Remarks Referring to the Tables" and "Determination of Properties" on page 2

Informative values										Properties / applications	
Chemical composition ¹⁾ (in percentage)				Hardness	UTS	Yield strength	Elongation	Young's modulus	Bending fatigue strength		
Mo	P	Fe	andere	HB	RM	R _{p 0.1}	A ²⁾	E · 10 ³	σ _D · ³⁾		
%	%	%	%		MPa	MPa	%	MPa	MPa		
-	-	bal.	< 0.5	40	130	60	4	100	65	Ögit is a group of materials used for normally loaded parts. The porosity can be impregnated with oil for reduced friction.	
-	-	bal.	< 0.5	55	230	160	3	100	90		
-	-	bal.	< 0.5	80	260	180	3	100	75		
0.5	-	bal.	< 0.5	105	390	310	2	100	100		
-	0.45	bal.	< 0.5	100	310	290	5	100	85		
-	0.45	bal.	< 0.5	100	360	290	5	100	90		
-	-	bal.	< 0.5	125	460	320	2	100	100		
0.5	-	bal.	< 0.5	150	520	370	2	100	115		
-	-	bal.	< 0.5	50	130	90	10	130	80		Sista is a group of materials for higher mechanical loading.
-	-	bal.	< 0.5	85	300	210	6	130	120		
-	-	bal.	< 0.5	100	320	310	3	130	100		
-	0.45	bal.	< 0.5	90	330	230	12	130	110		
-	0.45	bal.	< 0.5	105	380	320	6	130	115		
0.5	-	bal.	< 0.5	110	450	280	8	130	140		
-	-	bal.	< 0.5	150	570	400	2	130	130		
0.5	-	bal.	< 0.5	130	510	370	3	130	150		
0.5	-	bal.	< 0.5	180	600	410	2	130	150		
0.5	-	bal.	< 0.5	240	800	430	2	140	160		
0.5	-	bal.	< 0.5	300	1000	430	2	150	180		
-	-	bal.	< 0.5	60	250	140	20	160	110	Rhölit is suitable for every high mechanical loading applications. It combines high toughness and good dynamic properties.	
-	-	bal.	< 0.5	80	300	180	12	160	150		
-	-	bal.	< 0.5	100	350	240	10	160	160		
0.5	-	bal.	< 0.5	120	600	420	5	160	170		

PM Materials for Structural Components

- Standard materials (should be preferred)

		Equiv. to 30910	Admissible ranges									
			Density	Chemical composition ¹⁾ (mass percentage)						Hardness	Density	
			ρ	C _{tot}	Sn	Pb	Zn	Fe	Cu	HB	ρ	C _{ges}
Copper base alloys	Sint-		g/cm³	%	%	%	%	%	%		g/cm³	%
Ögit SB 15		C 50	7.2 – 7.7	< 0.2	9 – 11	–	–	–	bal.	> 35	7.4	–
Densit SB 18		D 50	7.7 – 8.1	< 0.2	9 – 11	–	–	–	bal.	> 45	7.9	–

Corrosion resistant sintered steel			ρ	C _{ges}	Cr	Ni	Mo	Cu	Fe	HB	ρ	C _{ges}
			g/cm³	%	%	%	%	%	%	%		g/cm³
Ögit R 20		C 40	6.4 – 6.8	< 0.1	16 – 19	10 – 14	2 – 4	< 3	bal.	> 95	6.6	0.06
Ögit R 45		C 42	6.4 – 6.8	< 0.1	16 – 19	–	–	< 4	bal.	> 140	6.6	0.06
Ögit R 50		C 43	6.4 – 6.8	0.1 – 0.3	11 – 13	–	–	< 4	bal.	> 165	6.6	0.20
Sista R 30		D 40	6.8 – 7.2	< 0.1	16 – 19	10 – 14	2 – 4	< 3	bal.	> 125	6.9	0.06

Sintered aluminium			ρ	Cu	Mg	Si	Al	HB	ρ	Cu
			g/cm³	%	%	%	%		g/cm³	%
Alumix 123		E 73	2.55 – 2.65	4 – 6	< 1	< 1	bal.	> 65	2.6	4.5
Alumix 123		F 73	> 2.65	4 – 6	< 1	< 1	bal.	> 100	2.7	4.5
Alumix 231		E 73 / Si	2.45 – 2.55	2 – 3	< 1	13 – 16	bal.	> 80	2.5	2.5
Alumix 231		F 73 / Si	> 2.55	2 – 3	< 1	13 – 16	bal.	> 110	2.6	2.5

All values given apply to the as-sintered. not re-pressed condition.

¹⁾ In addition to the elements mentioned, further alloying elements up to 2% are admitted.

²⁾ Sizing will reduce the elongation.

³⁾ Corrosion resistance depending on temperatur and medium.

Please note "Remarks Referring to the Tables" and "Determination of Properties" on page 2

Informative values											Properties / applications
Chemical composition ¹⁾ (mass percentage)						Hardness	UTS	Yield strength	Elongation	Young's modulus	
Sn	Pb	Zn	Fe	Cu	others	HB	R _m	R _{p 0.1}	A	E · 10 ³	
%	%	%	%	%	%		MPa	MPa	%	MPa	
10	-	-	-	bal.	< 0.5	40	150	90	4	50	Corrosion resistant ³⁾ , low friction. high ductility.
10	-	-	-	bal.	< 0.5	55	220	120	6	70	

Cr	Ni	Mo	Cu	Fe	others	HB	R _m	R _{p 0.1}	A	E · 10 ³	Properties / applications
%	%	%	%	%	%		MPa	MPa	%	MPa	
18	13	2.5	-	bal.	< 0.5	110	330	250	1	100	
19	-	-	3	bal.	< 0.5	140	450	330	1	100	
11	-	-	-	bal.	< 0.5	170	420	330	1	100	
18	13	2.5	-	bal.	< 0.5	135	510	370	1	130	

Mg	Si	Al	others	HB	R _m	R _{p 0.1}	A	E · 10 ³	Properties / applications
%	%	%	%		MPa	MPa	%	MPa	
0.5	0.7	bal.	< 0.5	80	200	150	1	50	
0.5	0.7	bal.	< 0.5	110	250	220	1	60	
0.5	14	bal.	< 0.5	90	140		0	50	
0.5	14	bal.	< 0.5	120	180		0	60	

PM Materials for Structural Components

- Standard materials (should be preferred)

	Equiv. to 30910	Density	Chemical composition ²⁾ (mass percentage)			Coercive force ³⁾	Hardness	Density	Cf
			ρ	C _{ges}	P				
Soft magnetic materials ⁵⁾	Sint-	g/cm ³	%	%	%	%		g/cm ³	%
Perma-Ögit 70	C 38	6.4 – 6.8	< 0.1	0.3 – 0.6	bal.	< 155	> 55	6.6	–
Perma-Ögit 160	C 02	6.4 – 6.8	< 0.1	–	bal.	< 175	> 35	6.6	–
● Perma-Densit 60	D 38	6.8 – 7.2	< 0.1	0.3 – 0.6	bal.	< 150	> 65	7.0	–
Perma-Densit 130	D 02	6.8 – 7.2	< 0.1	–	bal.	< 170	> 40	7.0	–
Perma-Rhölit 55	–	7.2 – 7.5	< 0.1	0.3 – 0.6	bal.	< 145	> 75	7.3	–
Perma-Rhölit 90	E 02	7.2 – 7.5	< 0.1	–	bal.	< 165	> 50	7.3	–

Powder forged steels ¹⁾	Equiv. to 30910	Admissible ranges										Density	Chemical composition (mass)			
		Density	Porosity	Chemical composition ²⁾ (mass percentage)						Hardness			Density	C	Mn	Ni
		ρ	$\frac{\Delta V}{V} \cdot 100$	C	Mn	Ni	Mo	Cr	Fe	HB						
		g/cm ³	%	%	%	%	%	%	%	As forged	Heat treated		g/cm ³	%	%	%
Werhodit 60	F 00	> 7.5	< 4.5	0.3 – 0.5	0.3 – 0.4	–	–	–	bal.	> 140	> 220	7.8	0.4	0.35	–	
Werhodit 70	F 30	> 7.5	< 4.5	0.3 – 0.5	0.3 – 0.4	0.2 – 0.4	0.2 – 0.4	0.1 – 0.25	bal.	> 160	> 260	7.8	0.4	0.35	0.3	
Werhodit 80	F 31	> 7.5	< 4.5	0.3 – 0.5	0.2 – 0.3	1.8 – 2.0	0.5 – 0.6	–	bal.	> 180	> 300	7.8	0.4	0.25	1.9	
Werhodit 90	–	> 7.5	< 4.5	0.2 – 0.6	–	–	0.8 – 1.5	–	bal.	> 180	–	7.8	0.6	–	–	

All values given to the as-sintered. not re-pressed condition.

¹⁾ Powder forged steels are manufactured as case hardening steels with 0.15 to 0.3% C or as heat-treatable steels with 0.4 to 0.6% C. They can be case hardened or quench-and-temper heat treated like wrought steels. The mechanical properties may be affected by modifications of the heat treatment parameters; details should be agreed with us.

²⁾ In addition to the elements mentioned, further alloying elements up to 2% are admitted.

³⁾ Bending load. $2 \cdot 10^6$ cycles, notch factor $\alpha_k = 1.0$ (ref. 30912 Part 6).

⁴⁾ Austenitized at 900°C, 60 minutes - oil quenched; tempered at 600°C, 60 minutes, protective gas.

Please note "Remarks Referring to the Tables" and "Determination of Properties" on page 2

Chemical composition ²⁾ (mass percentage)			Coercive force ³⁾	Max. permea- bility ⁴⁾	Magnetic induction		Spec. resis- tant	UTS	Elonga- tion	Young's modulus
P	Fe	others	Hc	μ_{Rmax}	B 0.5	B 5		Rm	A	E · 10 ³
%	%	%	A/m		T	T	$\mu\Omega$ cm	MPa	%	MPa
0.45	bal.	< 0.3	90	4600	-	1.25	22	250	2	100
-	bal.	< 0.3	135	2900	0.8	1.1	17	150	4	100
0.45	bal.	< 0.3	85	5600	1.0	1.35	22	230	4	130
-	bal.	< 0.3	120	3800	1.0	1.3	16	200	13	130
0.45	bal.	< 0.3	55	8000	1.2	1.45	20	330	5	160
-	bal.	< 0.3	105	4400	1.2	1.45	14	240	10	160

Informative values											Properties / applications	
Chemical composition ²⁾ (mass percentage)				State	UTS	Yield strenght	Elonga- tion	Red. of area	Hard- ness	Impact strenght		Bending fatigue strenght ³⁾
Mo	Cr	Fe	others		R _m	R _{p 0.1}	A	Z	HB	A _r		σ_{D^3}
%	%	%	%		MPa	MPa	%	%		Joule		MPa ²
-	-	bal.	< 0.2	as forged	600	380	17	38	180	40	200	Werhodit Iloys put powder metallurgy in the position to supply components for even the highest dynamic strenght requirements. e.g. in engines/transmissions.
				heat treated ⁴⁾	720	600	14	30	260	37	250	
0.3	0.15	bal.	< 0.2	as forged	700	470	15	35	200	35	270	
				heat treated ⁴⁾	950	800	11	21	320	35	320	
0.55	-	bal.	< 0.2	as forged	770	570	14	30	250	35	300	
				heat treated ⁴⁾	1150	1000	9	25	380	30	350	
1.5	-	bal.	< 0.2	as forged	1000	690	11	n.b.	320	n.b.	400	

⁵⁾ Annealing is required after a machining operation or sizing (ref. DIN 30911 Part 7).

⁴⁾ Mere material properties, valid for closed magnetic circuits. The effective permeability may be lower in circuits with an air gap.

PM Materials for Structural Components

	Admissible ranges												
	Density	Chemical composition ²⁾ (mass percentage)								Hardness	Density		
	ρ	C _{ges}	Cr	Ni	Ti	Al	Co	Cu	Fe	HV	ρ	C _{ges}	Cr
	g/cm ³	%	%	%	%	%	%	%	%		g/cm ³	%	%
Superalloy ¹⁾		0.04	18		1.8	1							
Nimonic 80 A	- 8.1	-	-	bal.	-	-	< 2	< 0.2	< 1.5	-	8.05	0.1	19
		0.16	21		2.7	1.8							

PM Materials for Tools and High Wear Applications

	Admissible ranges									
	Density	Chemical composition ²⁾ (mass percentage)								Hardness
	ρ	C _{ges}	Cr	W	Mo	V	Co	V	HRC	
	g/cm ³	%	%	%	%	%	%	%		
S 6-5-2 AISI M 2	8.0 – 8.1	0.95 – 1.05	3.8 – 4.5	6.0 – 6.7	4.7 – 5.2	1.7 – 2.0	-	bal.	> 62	
S 6-5-2-5 AISI M 35	8.0 – 8.1	0.85 – 0.95	3.8 – 4.5	6.0 – 6.7	4.7 – 5.2	1.7 – 2.0	4.5 – 5.0	bal.	> 63	
S 6-5 AISI M 3	8.0 – 8.1	1.17 – 1.27	3.8 – 4.5	6.0 – 6.7	4.7 – 5.2	2.7 – 3.2	-	bal.	> 62	
S 10-4-3-10 AISI T 42	8.0 – 8.2	1.2 – 1.35	3.8 – 4.5	9.0 – 10.0	3.2 – 3.9	3.0 – 3.5	9.5 – 10.5	bal.	> 65	
S 12-1-5-5 AISI T 15	8.1 – 8.3	1.45 – 1.60	3.8 – 4.5	11.5 – 12.5	0.7 – 1.0	4.5 – 5.0	4.5 – 5.0	bal.	> 63	
X 180 Cr WV 201	7.7 – 7.8	1.70 – 1.90	19 – 21	0.9 – 1.1	-	0.7 – 0.8	-	bal.	> 60	

¹⁾ Properties in the heat treated condition.

²⁾ In addition to the elements mentioned, further alloying elements up to 2.5% are admitted.

³⁾ Corrosion resistance depending on temperatur and medium.

Please note "Remarks Referring to the Tables" and "Determination of Properties" on page 2

Informative values ³⁾												Applications / properties
Chemical composition ²⁾ (mass percentage)							hard- ness	UTS	Yield strenght	Elonga- tion	Young's modulus	
Ni	Ti	Al	Co	Cu	Fe	Si	HV	R _m	R _{p0.1}	A	E	
%	%	%	%	%	%	%		MPa	MPa	%	MPa	
bal.	2.5	1.3	-	-	1.5	0.5	310	900	550	15	200	High temperatur resistant. corrosion resistant ³⁾

Informative values											Applications / properties
Density	Chemical composition ²⁾ (mass percentage)									Hard- ness	
ρ	C _{ges}	Cr	W	Mo	V	Co	Fe	others	HRC		
g/cm ³	%	%	%	%	%	%	%	%			
8.1	0.9	4	6	5	2	-	bal.	< 0.5	65	Cutting tools, like cutting inserts, drill tips, trimming dies, shaping dies, wear parts.	
8.1	0.9	4	6	5	2	5	bal.	< 0.5	65		
8.1	1.25	4	6	5	3	-	bal.	< 0.5	65		
8.3	1.3	4	10	4	3	10	bal.	< 0.5	67	Applications with high wear, pumps.	
8.2	1.6	4	12	1	5	5	bal.	< 0.5	66		
7.75	1.8	20	1	-	0.75	-	bal.	< 0.5	60		

PM Materials for Self-lubricating Bearings

- Standard materials (should be preferred)

Designation	Equiv. to 30910	Admissible ranges								
		Density	Porosity ²⁾	Chemical composition ¹⁾ (mass percentage)					Radial crushing strenght ³⁾	Hardness ³⁾
		ρ	$\frac{\Delta V}{V} \cdot 100$	Cu	Sn	C	MoS ₂	Fe	K	HB
		Sint- g/cm ³	%	%	%	%	%	%	MPa	
Large lubricant reservoir										
● Ferro-Porit A 00	A 00	5.6 – 6.0	25 ± 2.5	< 1	–	< 0.3	–	bal.	> 150	> 25
Ferro-Porit A 10	A 10	5.6 – 6.0	25 ± 2.5	1 – 5	–	< 0.3	–	bal.	> 160	> 35
Ferro-Porit A 20	A 20	5.8 – 6.2	25 ± 2.5	15 – 25	–	< 0.3	–	bal.	> 180	> 30
Bronze-Porit A 50	A 50	6.4 – 6.8	25 ± 2.5	bal.	9 – 11	< 0.2	–	–	> 120	> 25
● Ferro-Porit B 00	B 00	6.0 – 6.4	25 ± 2.5	< 1	–	< 0.3	–	bal.	> 180	> 30
● Bronze-Porit B 50	B 50	6.8 – 7.2	25 ± 2.5	bal.	9 – 11	< 0.2	–	–	> 170	> 30
Incorporating solid lubricant										
● Bronze-Porit A 51	A 51	6.0 – 6.5	25 ± 2.5	bal.	9 – 11	0.5 – 2	–	–	> 100	> 20
● Bronze-Porit B 51	B 51	6.5 – 7.0	20 ± 2.5	bal.	9 – 11	0.5 – 2	–	–	> 150	> 25
● Ögit SB C	C 51	7.0 – 7.5	15 ± 2.5	bal.	9 – 11	0.5 – 2	–	–	> 170	> 30
Bronze-Moly-Porit		6.8 – 7.2	20 ± 2.5	bal.	9 – 11	–	3 – 4	–	> 100	> 30
Ferro-Moly-Porit		6.4 – 6.8	17.5 ± 2.5	20 max	–	< 0.4	2.5 – 3	bal.	> 600	> 110
High loading capacity										
Ferro-Porit B 10	B 10	6.0 – 6.4	20 ± 2.5	1 – 5	–	< 0.3	–	bal.	> 190	> 40
Ferro-Porit B 11	B 11	6.0 – 6.4	20 ± 2.5	1 – 5	–	0.4 – 1	–	bal.	> 270	> 70
Ferro-Porit B 20	B 20	6.2 – 6.6	20 ± 2.5	15 – 25	–	< 0.3	–	bal.	> 200	> 45
● Ögit 15	C 00	6.4 – 6.8	15 ± 2.5	< 1	–	< 0.3	–	bal.	> 220	> 40
● Ögit 20	C 10	6.4 – 6.8	15 ± 2.5	1 – 5	–	< 0.3	–	bal.	> 230	> 55
● Ögit SB 15	C 50	7.2 – 7.7	15 ± 2.5	bal.	9 – 11	< 0.2	–	–	> 200	> 35

Designation	Admissible ranges									
	Density	Porosity ²⁾	Chemical composition ¹⁾ (mass percentage)					Radial crushing strenght ³⁾	Hardness ³⁾	
	ρ	$\frac{\Delta V}{V} \cdot 100$	C	Cr	Ni	Mo	BN	Fe	K	HB
	Corrosion resistan ³⁾ alloys g/cm ³	%	%	%	%	%	%	%	MPa	
Chroni-Porit	6.0 – 6.4	20 ± 2.5	< 0.03	15 – 18	11 – 14	2 – 2.5	–	bal.	> 200	> 40
Rhölit R 24 B	6.2 – 6.6	15 ± 2.5	< 0.03	16 – 18	–	–	1 – 2	bal.	> 200	> 30

¹⁾ In addition to the elements mentioned, further alloying elements up to 2% are admitted.

²⁾ The oil content is at least 90% of the open porosity.

³⁾ Values determined after sizing.

Please note "Remarks Referring to the Tables" and "Determination of Properties" on page 2

Informative values

Density	Porosity ²⁾	Chemical composition ¹⁾ (mass percentage)						Radial crushing strenght ³⁾	Hard- ness ³⁾	Compr. strenght	Heat conduc- tivity
		Cu	Sn	C	MoS ₂	Fe	andere				
ρ	$\frac{\Delta V}{V} \cdot 100$	%	%	%	%	%	%	MPa		MPa	W/mK
g/cm ³	%	%	%	%	%	%	%	MPa		MPa	W/mK
5.9	25	-	-	-	-	bal.	< 0.2	160	30	130	37
5.9	25	2.0	-	-	-	bal.	< 0.2	170	40	150	37
6.0	25	20	-	-	-	bal.	< 0.2	200	40	140	41
6.6	25	bal.	10	-	-	-	< 0.2	180	30	100	32
6.3	20	-	-	-	-	bal.	< 0.2	190	40	160	43
7.0	20	bal.	10	-	-	-	< 0.2	100	35	130	32
6.3	25	bal.	10	1.5 ⁴⁾	-	-	< 0.2	120	25	80	20
6.7	20	bal.	10	1.5 ⁴⁾	-	-	< 0.2	155	30	100	26
7.1	15	bal.	10	1.5 ⁴⁾	-	-	< 0.2	175	35	120	32
7.0	20	bal.	10	-	3.5	-	< 0.2	120	35	100	32
6.6	17.5	20	-	0.2 ⁴⁾	2.5	bal.	< 0.2	720	120	240	45
6.3	20	2.0	-	-	-	bal.	< 0.2	200	50	170	37
6.3	20	2.0	-	0.6 ⁴⁾	-	bal.	< 0.2	280	80	160	28
6.4	20	20	-	-	-	bal.	< 0.2	220	50	160	47
6.7	15	-	-	-	-	bal.	< 0.2	230	50	180	48
6.7	15	2.0	-	-	-	bal.	< 0.2	240	65	200	42
7.4	15	bal.	10	-	-	-	< 0.2	210	40	160	37

Thermal expansion coefficient: α (independent of the density): sintered iron and steel: $\alpha \sim 12 \cdot 10^{-6}/K$ Sinterbronz: $\alpha \sim 18 \cdot 10^{-6}/K$

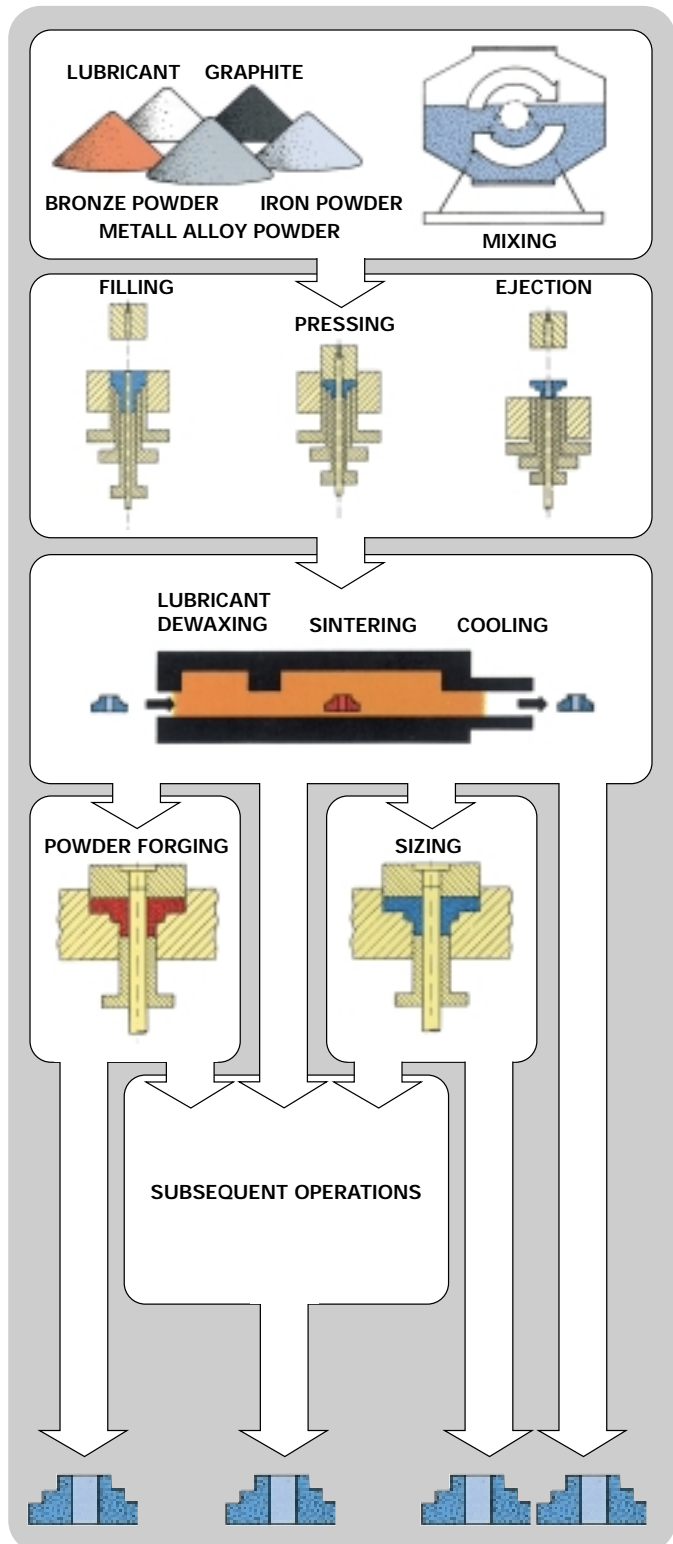
Informative values

Density	Porosity ²⁾	Chemical composition ¹⁾ (mass percentage)						Radial crushing strenght ³⁾	Hard- ness ³⁾	Compr. strenght	Heat conduc- tivity	
		C	Cr	Ni	Mo	BN	Fe					andere
ρ	$\frac{\Delta V}{V} \cdot 100$	%	%	%	%	%	%	%	MPa		MPa	MPa
g/cm ³	%	%	%	%	%	%	%	%	MPa		MPa	MPa
6.2	20	0.025	17	12	2.3	-	bal.	< 0.2	220	70	160	n.b.
6.4	15	0.025	17	-	-	1.5	bal.	< 0.2	250	35	180	n.b.

⁴⁾ Carbon in the form of free graphite.

⁵⁾ Corrosion resistance depending on temperature and medium.

Processing steps





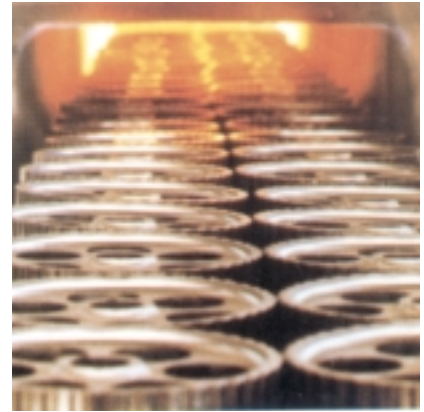
1. Mixing

Raw materials in powder form are mixed to the desired alloy composition. Instead of mixes of single components it is possible to mix alloy powder, too.



2. Pressing

Parts are pressed in suitably designed compaction tools. Depending on the compaction pressure, which is usually between 400 MN/m^2 and 800 MN/m^2 , the density and porosity can be varied.



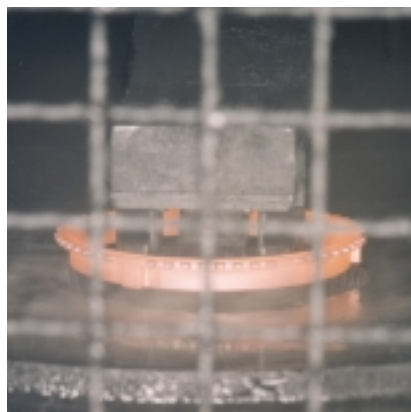
3. Sintering

The green compacts attain their required strength in the subsequent sintering process – a heat treatment which is exactly controlled with respect to time, temperature and protective atmosphere. The sintering process, carried out slightly below the melting temperature of the main alloy constituent, serves to achieve a metallic microstructure without changing the shape of the compact due to diffusion and recrystallization processes.



4. Sizing

During sintering the compacts undergo slight dimensional changes. Components with very close dimensional tolerances are therefore sized to dimensions in special sizing tools. The sized surface has a very low roughness.



5. Powder Forging

If not only dimensions are to be corrected, but also substantial strength increases are required, a forging step at elevated temperature is added instead of sizing at ambient temperature.



6. Subsequent Operations

A variety of subsequent machining, heat treatment or surface treatment operations can be applied to extend the freedom of parts design, improve the dimensional accuracy, increase the material hardness and the resistance against wear and corrosion.

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