International Standard 4381

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Plain bearings — Lead and tin casting alloys for multilayer plain bearings

Paliers lisses — Alliages moulés de plomb et d'étain pour paliers lisses multicouches

First edition — 1981-12-15

UDC 669.45.018.24 : 669.65.018.24 **Ref. No. ISO 4381-1981 (E)**

Descriptors : plain bearings, bearing alloys, lead alloys, tin alloys, designation, chemical composition, mechanical properties, physical properties.

Price based on 4 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4381 was developed by Technical Committee ISO/TC 123, *Plain bearings*, and was circulated to the member bodies in September 1979.

It has been approved by the member bodies of the following countries :

Australia	Italy	South Africa, Rep. of
Chile	Korea, Rep. of	Spain
Czechoslovakia	Libyan Arab Jamahiriya	Sweden
France	Mexico	United Kingdom
Germany, F.R.	Netherlands	USA
India	New Zealand	USSR
Ireland	Poland	Yugoslavia

No member body expressed disapproval of the document.

Printed in Switzerland

Plain bearings — Lead and tin casting alloys for multilayer plain bearings

1 Scope and field of application

This International Standard specifies requirements for bearing metals based on lead and tin casting alloys for multilayer plain bearings.

2 References

ISO 4384, *Plain bearings — Hardness testing of bearing metals.*

— *Part 1 : Compound materials.* [1]

— *Part 2 : Solid materials.* [1]

ISO 4386, *Plain bearings — Metallic multilayer plan bearings.*

— *Part 1 : Non-destructive ultrasonic testing of bond for bearing metal layer thicknesses* ⩾ 2 mm.

— *Part 2 : Destructive testing of bond for bearing metal layer thicknesses* ⩾ 2 mm.

3 Requirements

3.1 Chemical composition

The chemical composition shall be within the limits specified in tables 1 and 2, where single figures denote maximum values.

The chemical analysis is decisive for the acceptance of the bearing metals.

3.2 Material properties

Material properties shall be according to tables 1 and 2.

The Brinell hardness at 20 °C is regarded as the test and acceptance value. All other indicated values are mean values or ranges and are regarded as typical values for the designer. In view of the range of possible alloy compositions and the marked influence exerted by the cooling conditions on the mechanical properties, relatively large deviations from the indicated values must be expected in individual cases.

4 Designation

Example : Designation of the bearing metal having the symbol PbSb15Sn10 :

Bearing metal ISO 4381 — PbSb15Sn10

1) At present at the stage of draft.

Table 1 — Lead casting alloys

Chemical elements and properties		Chemical composition, % (m/m)			
		PbSb15SnAs	PbSb15Sn10	PbSb14Sn9CuAs	PbSb10Sn6
Pb		80,0 to 84,0	71,0 to 77,0	70,0 to 78,0	80,0 to 86,0
Sb		13,5 to 15,5	14,0 to 16,0	13,0 to 15,0	9,0 to 11,0
Sn		0,9 to 1,7	9,0 to 11,0	8,0 to 10,0	5,0 to 7,0
Cu		0,7	0,7	0,7 to 1,5	0,7
As		0,8 to 1,2	0,6	0,3 to 1,0	0,25
Cd		0,02	0,05	0,3 to 0,7	0,05
Ni		—	—	0,2 to 0,6	—
Bi		0,1	0,1	0,1	0,1
Fe		—	0,1	0,1	0,1
Al		0,005	0,005	0,005	0,005
Zn		0,005	0,005	0,005	0,005
Total others		0,2	0,2	0,2	0,2
Material properties of test bar					
Brinell hardness[1] HB10/250/180	20 °C min.	18	21	22	16
	50 °C ≈	15	16	22	16
	120 °C ≈	14	14	16	14
	150 °C ≈	10	10	10	8
0,2 % **Proof stress** $R_{p0,2}$ N/mm²	20 °C ≈	39	43	46	39
	50 °C ≈	37	32	39	32
	100 °C ≈	25	30	27	27
Bond strength R_{Ch} between bearing metal (limiting value; see ISO 4386/2) and steel with C = 0,1 % (m/m) bearing metal thickness ⩾ 6 mm N/mm² ≈		60	70	67	65
Rotating bending fatigue R_{rbf} 10^7 cycles N/mm² ≈		± 24	± 25	± 26	± 21
Thermal expansion α_l 10^{-6}/K ≈		25	24	24,7	25,3
Melting range °C ≈		240 to 350	240 to 270[2]	240 to 420	240 to 260[2]
Casting range °C ≈		450 to 500	480 to 520	480 to 520	480 to 520
Density ϱ kg/dm³ ≈		9,7	9,9	9,7	10,3

1) For hardness testing see ISO 4384 parts 1 and 2.

2) The liquid temperature will be 380 °C if the copper content is higher than 0,5 % (m/m).

Table 2 — Tin casting alloys

Chemical elements and properties		Chemical composition, % (m/m)		
		SnSb12Cu6Pb	SnSb8Cu4	SnSb8Cu4Cd
Sn		79,0 to 81,0	88,0 to 90,0	88,0 to 90,0
Sb		11,0 to 13,0	7,0 to 8,0	7,0 to 8,0
Cu		5,0 to 7,0	3,0 to 4,0	3,0 to 4,0
Cd		—	—	0,8 to 1,2
Pb		1,0 to 3,0	0,35	0,35
As		0,1[2]	0,1[3]	0,5
Ni		—	—	0,1 to 0,5
Bi		0,08	0,08	0,08
Fe		0,1	0,1	0,05
Al		0,005	0,005	0,005
Zn		0,005	0,005	0,005
Total others		0,4	0,2	0,2
Material properties of test bar				
Brinell hardness[1] HB10/250/180	20 °C min.	25	22	28
	50 °C ≈	20	17	25
	120 °C ≈	12	11	19
	150 °C ≈	8	8	13
0,2 % Proof stress $R_{p0,2}$ N/mm²	20 °C ≈	61	47	62
	50 °C ≈	60	44	44
	100 °C ≈	36	27	30
Bond strength R_{Ch} between bearing metal (limiting value; see ISO 4386/2) and steel with C = 0,1 % (m/m) bearing metal thickness ⩾ 6 mm N/mm² ≈		40	80	90
Rotating bending fatigue R_{rbf} 10^7 cycles N/mm² ≈		± 28	± 31	± 34
Thermal expansion α_l 10^{-6}/K ≈		22,7	23,9	23,9
Melting range °C ≈		183 to 400	233 to 360	233 to 360
Casting range °C ≈		480 to 520	440 to 460	440 to 460
Density ϱ kg/dm³ ≈		7,4	7,3	7,3

1) See page 2.

2) In special cases a maximum of 0,8 % (m/m) is permissible.

3) In special cases a maximum of 0,5 % (m/m) is permissible.

Table 3 — Guide for uses of bearing metals

Bearing alloys	Characteristics and principle uses
PbSb15SnAs	Suitable only for pure sliding stresses at low load and low sliding velocities in the hydrodynamic range; good embeddability. Nearly exclusively cast onto steel strip by means of continuous casting processes resulting in an extremely high cooling speed. Used for wrapped bushes and thin-walled bearing liners with a wall thickness of up to about 3 mm as well as for thrust washers. Bushes for camshafts in internal combustion engines, gear bushes, connecting rod and main bearings in smaller piston compressors.
PbSb15Sn10	Suitable for pure sliding stresses at mean loads and mean sliding velocities in the hydrodynamic range; low impact stress; good embeddability. Used at mean stresses for plain bearings, tilting pads, crossheads, and cone breakers.
PbSb14Sn9CuAs	Good sliding properties, use in mixed friction range possible, suitable for high to low sliding velocities in the hydrodynamic range; mean impact stress, less sensitive to edge compression, good heat conductor. Highest thermal loadability of lead-based bearing materials. Used for plain bearings for electric machines, gears, rolling mills, pinion gears, for segments and connecting rod bearings.
PbSb10Sn6	Suitable for pure sliding stresses at low load and mean sliding velocities in the hydrodynamic range, moderate impact stress; good embeddability.
SnSb12Cu6Pb	Good sliding properties at mean load and high to low sliding velocities in the hydrodynamic range, good impact stress, sensitive to reversed bending stress and edge compression; high wear resistance in the case of rough journals (grey cast iron). Used for plain bearings for turbines, compressors, electric machines, and pinion gears.
SnSb8Cu4	Good sliding properties, conformability and high toughness; good embeddability; suitable for high sliding velocities in the hydrodynamic range, mean load; impact stress at low frequency; insensitive to reversed bending stress. Used for high loaded rolling mill bearings; for the production of wrapped bushes, thin-walled bearing liners with a wall thickness of up to about 3 mm and thrust washers.
SnSb8Cu4Cd	Good sliding properties, suitable for high sliding velocities in the hydrodynamic range at high load, low sensitivity to edge compression, high impact stress at high frequency; insensitive to reversed bending stress; good embeddability. Used for main and connecting rod bearings, cross-head bearings for large piston engines and rolling mill bearings.