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Plain bearings — Multilayer materials for thin-walled plain bearings

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INTERNATIONAL

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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 4383 was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Sub-Committee SC 2, *Materials and lubricants, their properties, characteristics, test methods and testing conditions*.

This second edition cancels and replaces the first edition (ISO 4383:1981), of which it constitutes a technical revision.

Annexes A and B of this International Standard are for information only.

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Plain bearings — Multilayer materials for thin-walled plain bearings

1 Scope

This International Standard specifies requirements for multilayer materials for the manufacture of thin-walled plain bearings (half bearings, bushes, thrust washers). The multilayer material consists of a steel backing, the bearing layer (cast, sintered, roll bonded) and possibly an electrodeposited overlay.

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 4381:1991, *Plain bearings — Lead and tin casting alloys for multilayer plain bearings.*

ISO 4382-1:1991, *Plain bearings — Copper alloys — Part 1: Cast copper alloys for solid and multilayer thick-walled plain bearings.*

ISO 6691:1989, *Thermoplastics for plain bearings — Classification and designation.*

3 Requirements

3.1 Chemical composition

The chemical composition shall be within the limits specified in tables 1 to 5, where single figures denote maximum values.

3.2 Steel backings

The chemical composition of the steel for backings shall be the subject of agreement between manufacturer and purchaser. In general, low carbon steel will be used.

For bronze/polymer composite materials in accordance with table 4, copper-coated steel may be used.

3.3 Bearing layers

Bearing metals based on lead and tin shall be in accordance with table 1.

Bearing metals based on copper shall be in accordance with table 2.

Bearing metals based on aluminium shall be in accordance with table 3.

Bearing layers based on sintered porous bronze and polymers shall be in accordance with table 4.

3.4 Overlays

Overlays in accordance with table 5 may be applied for bearing metal layers as indicated in table A.2. The thickness of the overlay and any additional layers between the bearing metal layer and the overlay shall be the subject of agreement between the manufacturer and purchaser.

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3.5 Guide to properties and selection of materials

A guide to bearing metal hardness in strip form and uses of bearing metals is given in tables A.1 and A.2.

4 Designation

EXAMPLE

Designation of a multilayer material consisting of a steel backing, the bearing metal CuPb24Sn as cast (G) and the overlay PbSn10Cu2:

Bearing metal ISO 4383 - G - CuPb24Sn - PbSn10Cu2

Table 1 — Lead and tin alloys (see ISO 4381)

Chemical elements	Chemical composition, % (m/m)			
	PbSb10Sn6	PbSb15SnAs	PbSb15Sn10	SnSb8Cu4
Pb	Remainder	Remainder	Remainder	0,35
Sb	9 to 11	13,5 to 15,5	14 to 16	7 to 8
Sn	5 to 7	0,9 to 1,7	9 to 11	Remainder
Cu	0,7	0,7	0,7	3 to 4
As	0,25	0,8 to 1,2	0,6	0,1
Bi	0,1	0,1	0,1	0,08
Zn	0,01	0,01	0,01	0,01
Al	0,01	0,01	0,01	0,01
Fe	0,1	0,1	0,1	0,1
Total others	0,2	0,2	0,2	0,2

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Table 2 — Copper alloys

Chemical elements	Chemical composition, % (m/m)				
	CuPb10Sn10 ¹⁾ G - cast P - sintered	CuPb17Sn5 G - cast	CuPb24Sn4 G - cast P - sintered	CuPb24Sn G - cast P - sintered	CuPb30 P - sintered
Cu	Remainder	Remainder	Remainder	Remainder	Remainder
Pb	9 to 11	14 to 20	19 to 27	19 to 27	26 to 33
Sn	9 to 11	4 to 6	3 to 4,5	0,6 to 2	0,5
Zn	0,5	0,5	0,5	0,5	0,5
P	0,1	0,1	0,1	0,1	0,1
Fe	0,7	0,7	0,7	0,7	0,7
Ni	0,5	0,5	0,5	0,5	0,5
Sb	0,5	0,5	0,5	0,5	0,5
Total others	0,5	0,5	0,5	0,5	0,5
1) The chemical composition of this alloy differs from that of solid and multilayer thick-walled plain bearings (see ISO 4382-1).					

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Table 3 — Aluminium alloys

Chemical elements	Chemical composition, % (m/m)					
	AlSn20Cu	AlSn6Cu	AlSi4Cd	AlCd3CuNi	AlSi11Cu	AlZn5Si1,5Cu1Pb1Mg
Al	Remainder	Remainder	Remainder	Remainder	Remainder	Remainder
Cu	0,7 to 1,3	0,7 to 1,3	0,05 to 0,15	0,7 to 1,3	0,7 to 1,3	0,8 to 1,2
Sn	16,5 to 22,5	5,5 to 7	—	—	0,2	0,2
Ni	0,1	1,3	—	0,7 to 1,3	0,1	0,2
Cd	—	—	0,8 to 1,4	2,7 to 3,5	—	—
Si	0,7 ¹⁾	0,7 ¹⁾	3,5 to 4,5	0,7 ¹⁾	10 to 12	1 to 2
Fe	0,7 ¹⁾	0,7 ¹⁾	0,35	0,7 ¹⁾	0,3	0,6
Mn	0,7 ¹⁾	0,7 ¹⁾	0,2	0,7 ¹⁾	0,1	0,3
Ti	0,2	0,2	0,2	0,1	0,1	0,2
Pb	—	—	—	—	—	0,7 to 1,3
Zn	—	—	—	—	—	4,4 to 5,5
Mg	—	—	—	—	—	0,6
Total others	0,5	0,5	0,25	0,15	0,3	0,4

1) Total Si + Fe + Mn content shall not exceed 1,0 %.

Table 4 — Sintered bronze with polymer overlay

Chemical elements	Chemical composition, % (m/m)	
	CuSn10/PTFE	CuSn10/POM
Sintered porous bronze layer CuSn10	Porosity 20 % to 35 % (V/V)	
Cu	Remainder	
Sn	9 to 11	
P	0,3	
Total others	0,5	
Polymer overlay and impregnant (see ISO 6691)	PTFE (Polytetrafluoroethylene) with additions against wear and friction	POM (Polyoxymethylene)

Table 5 — Overlays

Chemical elements	Chemical composition, % (m/m)		
	PbSn10Cu2	PbSn10	PbIn7
Pb	Remainder	Remainder	Remainder
Sn	8 to 12	8 to 12	—
Cu	1 to 3	—	—
In	—	—	5 to 10
Total others	0,5	0,5	0,5

Annex A (informative)

Guide to properties and selection of materials

See tables A.1 and A.2.

Table A.1 — Guide to bearing metal hardness in strip form

Bearing alloys	As cast	Sintered	Rolled and annealed	Special treatments
PbSb10Sn6	19 to 23 HV	—	—	15 to 19 HV
PbSb15SnAs	16 to 20 HV	—	—	—
PbSb15Sn10	18 to 23 HV	—	—	—
SnSb8Cu4	17 to 24 HV	—	—	—
CuPb10Sn10	70 to 130 HB	60 to 90 HB	—	—
CuPb17Sn5	60 to 95 HB	—	—	—
CuPb24Sn4	60 to 90 HB	45 to 70 HB	—	—
CuPb24Sn	55 to 80 HB	40 to 60 HB	—	—
CuPb30	—	30 to 45 HB	—	—
AlSn20Cu	—	30 to 40 HB	—	—
AlSn6Cu	—	—	35 to 45 HB	—
AlSi4Cd	—	—	30 to 40 HB	50 to 70 HB
AlCd3CuNi	—	—	35 to 55 HB	—
AlSi11Cu	—	—	45 to 60 HB	—
AlZn5Si1,5Cu1Pb1Mg	—	—	45 to 70 HB	—

NOTE — Hardness values may be increased by skin-rolling; tests should be carried out according to ISO 4384-1.

Table A.2 — Guide to uses of bearing metals and for the hardness of the mating bearing part (shaft)

Bearing alloys (overlays)	Characteristics and principal uses in high-speed engines	Minimum hardness of the shaft ¹⁾
PbSb10Sn6	Soft; corrosion resistant; relatively good performance with marginal lubrication; low fatigue strength; operates with hard or soft shafts. Lightly loaded main and connecting rod bearings; bushes; thrust washers.	180 HB
PbSb15SnAs		
PbSb15Sn10		
SnSb8Cu4	Soft; good corrosion resistance; has the best performance of all bearing alloys under conditions of marginal lubrication; poor fatigue resistance; operates with hard or soft shafts. Lightly loaded main and connecting rod bearings; bushes; thrust washers.	220 HB
CuPb10Sn10	Very high fatigue strength and shock resistance; good corrosion resistance; hard shaft desirable. Wrapped bushes; thrust washers; small end bushes.	53 HRC
CuPb17Sn5	Very high fatigue strength and shock resistance; hard shaft desirable; normally overlay plated when used as a bearing. Highly loaded main and connecting rod bearings; wrapped bushes; thrust washers.	50 HRC
CuPb24Sn4	High fatigue strength and shock resistance; suitable for high-speed shafts, oscillating or rotating motion; hard shaft desirable; normally overlay plated when used as a bearing. Wrapped bushes; thrust washers; main and connecting rod bearings.	48 HRC
CuPb24Sn	High fatigue resistance with cast alloy; fair to high with sintered alloy; normally plated with an overlay when used in bearing applications and in this form may be operated with hard or soft shafts; susceptible to corrosion by degraded oil when not overlay plated. Main and connecting rod bearings; thrust washers.	45 HRC
CuPb30	Moderate fatigue resistance; susceptible to corrosion by degraded oil if not overlay plated; operates with hard shafts unless overlay plated. Main and connecting rod bearings; wrapped bushes.	270 HB
AlSn20Cu	Moderate fatigue strength; good corrosion resistance; relatively good performance in marginally lubricated conditions; may be operated with soft shafts. Main and connecting rod bearings; thrust washers and wrapped bushes.	250 HB
AlSn6Cu	Moderate to high fatigue strength; good corrosion resistance; normally plated with an overlay and used with hard shafts. Main and connecting rod bearings and wrapped bushes.	45 HRC
AlSi4Cd	Moderate to high fatigue strength; good corrosion resistance; normally used with plated overlays in bearing applications; runs against hard shafts. A heat-treated version has high fatigue strength. Main and connecting rod bearings; wrapped bushes and thrust washers.	48 HRC
AlCd3CuNi	Moderate to high fatigue strength; good corrosion resistance; normally used with plated overlays in bearing applications; runs against hard shafts. A version with a positive manganese addition has high fatigue resistance. Main and connecting rod bearings; occasionally wrapped bushes and thrust washers.	48 HRC
AlSi11Cu	High fatigue strength; normally used with plated overlays in bearing applications; runs against hard shafts; good corrosion resistance. Main and connecting rods.	50 HRC
AlZn5Si1,5Cu1Pb1Mg	High fatigue strength; normally used with plated overlays in bearing applications; operates with hard or soft shafts. Main and connecting rods.	45 HRC