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Plain bearings — Multilayer materials for thin-walled plain bearings

Paliers lisses — Matériaux multicouches pour paliers lisses minces

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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

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

This fourth edition cancels and replaces the third edition (ISO 4383:2000), which has been technically revised.

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 overlay. The chemical composition refers to the original unprocessed material and is intended to be measured on representative samples. Testing results on final bearings can be due to the influence of bearing production. Therefore, these results cannot be compared with data given in this International Standard.

NOTE Environmental concerns will, in the future, restrict the use of some materials such as lead.

2 Normative references

The following referenced documents are indispensable for the application 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 4381, *Plain bearings — Tin casting alloys for multilayer plain bearings*

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

ISO 6691, *Thermoplastic polymers for plain bearings — Classification and designation*

ISO 6280, *Plain bearings — Requirements on backings for thick-walled multilayer bearings*

3 Requirements

3.1 Chemical composition

The chemical composition of alloy elements shall be within the limits specified in Tables 1 to 5.

3.2 Steel backings

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

For bronze/polymer composite materials listed in Table 4, copper-coated steel may be used. Backings shall conform to ISO 6280.

3.3 Bearing layers

Bearing metals based on 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.

NOTE There is a new class of aluminium-based materials containing both aluminium and silicon or manganese as well as a "soft" material, such as lead or tin. Detailed information is available from individual manufacturers.

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.

Despite the electroplated overlays, sputtered and polymer overlays are used for engine bearings. For the chemical composition of sputtered overlays, see Table 6. Polymer overlays consist of a polymer matrix (e.g. PAI) and fillers. The detailed compositions are defined in specific data sheets of the bearing manufacturers.

3.5 Guidance on and selection of materials

Guidance of hardness for bearing metal in strip form and use of bearing metals are given in Annex A.

4 Designation

EXAMPLE A multilayer material consisting of a steel backing, the bearing metal CuPb24Sn as cast (G) and the overlay PbSn10Cu2 is designated as follows: **Bearing metal** ISO 4383 - G —CuPb24Sn — PbSn10Cu2

Table 1 — Tin alloys[a]

Chemical element	**Chemical composition** mass fraction, %
	SnSb8Cu4
Component	
Sn	Remainder
Sb	7 to 8
Cu	3 to 4
Impurity	
Pb	< 0,35
As	< 0,1
Bi	< 0,08
Zn	< 0,01
Al	< 0,01
Fe	< 0,1
Cd	< 0,05
Total others	0,2

[a] Tin alloys shall conform to ISO 4381.

Table 2 — Copper alloys

Chemical element	Chemical composition mass fraction, %				
	CuPb10Sn10[a]	CuPb17Sn5	CuPb24Sn4	CuPb24Sn	CuPb30
	G — cast P — sintered	G — cast	G — cast P — sintered	G — cast P — sintered	P — sintered
Components					
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
Impurity					
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

[a] The chemical composition of this alloy differs from that of solid and multilayer thick-walled plain bearings in accordance with ISO 4382-1.

Table 3 — Aluminium alloys

Chemical element	Chemical composition mass fraction, %				
	AlSn20Cu	AlSn6Cu	AlSi11Cu	AlSn12SiCu	AlZn5Si1, 5Cu1Pb1Mg
Component					
Al	Remainder	Remainder	Remainder	Remainder	Remainder
Cu	0,7 to 1,3	0,7 to 1,3	0,7 to 1,3	0,7 to 1,6	0,8 to 1,2
Sn	16,5 to 22,5	5,5 to 7	—	10,0 to 15,0	—
Ni	—	1,3	—	—	—
Si	—	—	10 to 12	1,8 to 3,6	1 to 2
Pb	—	—	—	—	0,7 to 1,3
Zn	—	—	—	—	4,4 to 5,5
Mg	—	—	—	—	0,6
Impurity					
Sn	—	—	<0,2	—	<0,2
Mg	—	—	—	—	—
Ni	<0,1	—	<0,1	—	<0,2
Si	<0,7[a]	<0,7[a]	—	—	—
Fe	<0,7[a]	<0,7[a]	<0,3	<0,7[a]	<0,6
Mn	<0,7[a]	<0,7 [a]	<0,1	—	<0,3
Ti	<0,2	<0,2	<0,1	—	<0,2
Total others	0,5	0,5	0,3	1,0	0,4

[a] Total Si+Fe+Mn content shall not exceed 1,0 %.

Table 4 — Sintered bronze with polymer running surface

Chemical element	Chemical composition, mass fraction, %				
	CuSn10			CuPb10Sn10	
Component					
Cu	Remainder			Remainder	
Pb	—			9 to 12	
Sn	9 to 12			9 to 12	
Impurity					
P	<0,3			< 0,3	
Pb	<0,1			—	
Total others	0,5			0,5	
Running surface and impregnated polymer with fillers against friction and wear (specified in ISO 6691)	PTFE	POM	PVDF	PTFE	PVDF
Porous sintered bronze	Porosity 20 % to 45 %, vol. fraction, %				

Table 5 — Electroplated overlays

Chemical element	Chemical composition mass fraction, %		
	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

Table 6 — Sputtered overlays

Chemical element	Chemical composition mass fraction, %
	AlSn20Cu
AL	Remainder
Sn	18,5 – 22,5
Cu	1 to 3
Total others	0,5

Annex A
(informative)

Guidance on properties and selection of materials

See Tables A.1 and A.2.

Table A.1 — Bearing metal hardness in strip form

Bearing alloy	As cast	Sintered	Rolled and annealed	Special treatment
SnSb8Cu4	> 22	—	—	—
CuPb10Sn10	70 HBW to 130 HBW	60 HBW to 90 HBW	—	60 HBW to 140 HBW
CuPb17Sn5	60 HBW to 95 HBW	—	—	—
CuPb24Sn4	60 HBW to 90 HBW	45 HBW to 70 HBW	—	45 HBW to 120 HBW
CuPb24Sn	55 HBW to 80 HBW	40 HBW to 60 HBW	—	40 HBW to 110 HBW
CuPb30	—	30 HBW to 45 HBW	—	—
AlSn20Cu	—	—	30 HBW to 40 HBW	45 HBW to 60 HBW
AlSn6Cu	—	—	35 HBW to 45 HBW	—
AlSn12SiCu	—	—	45 HV to 65 HV	—
AlSi11Cu	—	—	45 HBW to 60 HBW	—
AlZn5Si1,5Cu1Pb1Mg	—	—	45 HBW to 70 HBW	70 HBW to 100 HBW
NOTE Hardness values may be increased by skin-rolling; tests should be carried out according to ISO 4384-1.				

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

Bearing alloy (overlays)	Characteristics and principal uses in high-speed engines	Minimum hardness of the shaft[a]
SnSb8Cu4	Soft; good corrosion resistance; good performance 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 HBW
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
[a] The tabulated hardness values for the shaft material are guide values of minimum hardness and are valid for use in high-speed machines. The working conditions, in particular the lubrication conditions, may have a considerable influence so that a larger difference in hardness may be necessary between the bearing material and shaft material.		