International Standard 4382/1

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

Plain bearings — Copper alloys — Part 1 : Cast copper alloys for solid and multilayer plain bearings

Paliers lisses — Alliages de cuivre — Partie 1 : Alliages de cuivre moulés pour paliers lisses massifs et multicouches

First edition — 1982-01-01

UDC 669.35.018.24-14 **Ref. No. ISO 4382/1-1982 (E)**

Descriptors : bearing alloys, copper alloys, designation, chemical composition, mechanical properties, physical properties.

Price based on 5 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 4382/1 was developed by Technical Committee ISO/TC 123, *Plain bearings*, and was circulated to the member bodies in September 1978.

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.

This International Standard has been drawn up in close cooperation with ISO/TC 26, *Copper and copper alloys*, which agreed to the symbols for the different types of castings.

Printed in Switzerland

Plain bearings — Copper alloys — Part 1 : Cast copper alloys for solid and multilayer plain bearings

1 Scope and field of application

This part of ISO 4382 specifies requirements for cast copper alloys for use in solid and multilayer plain bearings. This is a limited selection of those currently available for general purposes.

2 References

ISO/R 400, *Tensile testing of copper and copper alloys.*

ISO/R 401, *Tensile testing of copper and copper alloy tubes of circular section.*

ISO 1338, *Cast copper alloys — Composition and mechanical properties.*

ISO 4379, *Plain bearings — Solid copper alloy bushes — Dimensions and tolerances.*

ISO 4383, *Plain bearings — Metallic multilayer materials for thin-walled plain bearings.*

ISO 4384, *Plain bearings — Hardness testing on bearing metals*

— *Part 1 : Compound materials.* [1]

— *Part 2 : Solid materials.* [1]

3 Requirements

The alloys shown in tables 1 and 2 are extracted from ISO 1338.

If the purchaser's requirements necessitate limits for any element not specified, or limits different from those already specified, these should be agreed upon between supplier and purchaser.

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 compositions exactly correspond to those included in ISO 1338.

3.2 Analysis

Methods of analysis for alloying elements, permissible additions, or impurities shall either be as specified in relevant International Standards or as mutually agreed between supplier, purchaser and any mutually acceptable arbitrator.

4 Material properties

The values of R_m, A and $R_{p0,2}$ (see tables 1 and 2) exactly correspond to those included in ISO 1338.

4.1 General

The minimum tensile strength and elongation values quoted in tables 1 and 2 are extracted from ISO 1338 and are included as properties which may assist designers. Brinell hardness is the mandatory quality control check. If tensile strength and elongation tests are required this should be stated by the purchaser at the time of ordering.

For finished bearings Brinell hardness will normally be checked.

4.2 Methods of tests

4.2.1 Hardness test

Hardness testing shall be carried out according to ISO 4384. If specimen size does not permit this, the method of test may be agreed between supplier and purchaser. Acceptable minimum values shall then be as agreed.

4.2.2 Tensile test

The tensile test shall be carried out according to ISO/R 400 or ISO/R 401. If specimen sizes do not permit the use of standard test pieces, then test methods and mandatory values shall be as agreed between supplier and purchaser.

For sampling of sand casting and chill casting, see ISO 1338. If tensile tests are required for centrifugal casting, samples may be separately chill cast.

1) At present at the stage of draft.

5 Designation and ordering information

Distinguished by the following types of casting :

GS — Sand

GM — Permanent mould

GZ — Centrifugal

GC — Continuous

The following tests may be requested by the purchaser :

R : Test of tensile strength

RA : Test of tensile strength and elongation

H : Test of Brinell hardness (on cast material or finished solid plain bearing).

Example : Designation of the bearing metal made of continuous casting (GC) having the symbol CuPb10Sn10, when the test for tensile strength and elongation (RA) is to be carried out on the test bar :

Bearing metal ISO 4382 — GC — CuPb10Sn10 — RA

For finished machined material, the dimensions may be selected, for example, from ISO 4379.

For unmachined material, the manufacturer's recommended allowances for machining should be added to the outside diameter and subtracted from the inside diameter.

The purchaser shall indicate whether a certificate of conformance is required.

Table 1 — Copper-lead-tin and copper-aluminium casting alloys for solid and multilayer plain bearings

Chemical elements and properties	Chemical composition, % (*m/m*)				
	CuPb9Sn5	CuPb10Sn10[4]	CuPb15Sn8	CuPb20Sn5	CuAl10Fe5Ni5
Cu	80,0 to 87,0[1]	78,0 to 82,0[1]	75,0 to 79,0[1]	70,0 to 78,0[1]	> 76,0
Sn	4,0 to 6,0	9,0 to 11,0	7,0 to 9,0	4,0 to 6,0	0,20
Pb	8,0 to 10,0	8,0 to 11,0	13,0 to 17,0	18,0 to 23,0	0,10
Zn	2,0	2,0	2,0	2,0	0,50
Fe	0,25	0,25	0,25	0,25	3,5 to 5,5
Ni	2,0	2,0	2,0	2,5	3,5 to 6,5
Sb	0,5	0,5	0,5	0,75	—
P	0,10[2]	0,05[2]	0,10[2]	0,10[2]	—
Al	0,01	0,01	0,01	0,01	8,0 to 11,0
Mn	0,2	0,2	0,2	0,2	3,0
Si	0,01	0,01	0,01	0,01	0,10
S	0,10	0,10	0,10	0,10	—
Cu + Fe + Ni + Al + Mn	—	—	—	—	> 99,2
Material properties of test bar					
Brinell hardness[3] HB 10/1000/10, min.					
GS — Sand	55	65	60	45	140
GM — Permanent mould	60	65	60	50	140
GZ — Centrifugal	60	70	65	50	140
GC — Continuous	60	70	65	50	140
Tensile strength R_m N/mm², min.					
GS — Sand	160	180	170	150	600
GM — Permanent mould	200	220	200	170	600
GZ — Centrifugal	220	220	220	180	680
GC — Continuous	230	220	220	180	680
Elongation A %, min.					
GS — Sand	7	7	5	5	10
GM — Permanent mould	5	3	3	5	12
GZ — Centrifugal	6	6	8	7	12
GC — Continuous	9	6	8	7	12
0,2 % Proof stress $R_{p0,2}$ N/mm², min.					
GS — Sand	60	80	80	60	250
GM — Permanent mould	80	140	100	80	250
GZ — Centrifugal	80	110	100	80	280
GC — Continuous	130	110	100	80	280
Elastic modulus E kN/mm² ≈	85	90	85	75	120
Thermal expansion α_l 10^{-6}/K ≈	18	18	18	19	16
Thermal conductivity λ at 15 °C W/(m·K) ≈	71	47	47	59	~~60~~ 27
Density ϱ kg/dm³ ≈	9,0	9,0	9,1	9,3	7,6

1) Including Ni.

2) For continuous casting, the phosphorus content may be increased to a maximum of 1,5 % by agreement.

3) For hardness testing see ISO 4384/2.

4) The chemical composition of this alloy differs from that of thin-walled multilayer plain bearings (see ISO 4383).

Table 2 — Copper-tin-zinc-casting alloys for solid plain bearings

Chemical elements and properties	Chemical composition, % (m/m)				
	CuSn8Pb2	CuSn10P	CuSn12Pb2	CuPb5Sn5Zn5	CuSn7Pb7Zn3
Cu	82,0 to 91,0[1]	89,5 to 97,0	84,0 to 87,5[1]	84,0 to 86,0[1]	81,0 to 85,0[1]
Sn	6,0 to 9,0	10,0 to 11,5	11,0 to 13,0	4,0 to 6,0	6,0 to 8,0
Pb	0,5 to 4,0	0,25	1,0 to 2,5	4,0 to 6,0	5,0 to 8,0
Zn	3,0	0,05	2,0	4,0 to 6,0	2,0 to 5,0
Fe	0,2	0,10	0,20	0,30	0,20
Ni	2,5	0,10	2,0	2,5	2,0
Sb	0,25	0,05	0,2	0,25	0,35
P	0,05[2]	0,50 to 1,0	0,05 to 0,40[2][4]	0,05[2]	0,10[2]
Al	0,01	0,01	0,01	0,01	0,01
Mn	—	0,5	0,2	—	—
Si	0,01	0,02	0,01	0,01	0,01
S	0,10	0,05	0,05	0,10	0,10
Material properties of test bar					
Brinell hardness[3] HB 10/1000/10, min.					
GS — Sand	60	70	80	60	65
GM — Permanent mould	85	95	—	60	65
GZ — Centrifugal	85	95	90	65	70
GC — Continuous	85	95	90	65	70
Tensile strength R_m N/mm², min.					
GS — Sand	250	220	240	200	210
GM — Permanent mould	220	310	—	200	210
GZ — Centrifugal	230	330	280	250	260
GC — Continuous	270	360	280	250	260
Elongation A %, min.					
GS — Sand	3	3	7	13	12
GM — Permanent mould	2	2	—	13	12
GZ — Centrifugal	4	4	5	13	12
GC — Continuous	5	6	7	13	12
0,2 % Proof stress $R_{p0,2}$ N/mm², min.					
GS — Sand	130	130	130	90	100
GM — Permanent mould	130	170	—	90	100
GZ — Centrifugal	130	170	150	100	120
GC — Continuous	130	170	150	100	120
Elastic modulus E kN/mm² ≈	75	95	95	90	85
Thermal expansion α_l 10^{-6}/K ≈	18	18	18	18	18
Thermal conductivity λ at 15 °C W/(m·K) ≈	47	50	54	71	59
Density ϱ kg/dm³ ≈	8,8	8,8	8,7	8,7	8,8

1) Including Ni.

2) For continuous casting, the phosphorus content may be increased to a maximum of 1,5 % by agreement.

3) For hardness testing see ISO 4384/2.

4) The phosphorus content shall be fixed by agreement.

Table 3 — Guide for uses of bearing metals

Bearing alloys	Characteristics and principle uses
CuPb9Sn5	Soft copper based bearing alloys suitable for moderate loads and moderate to high sliding velocities. Increasing the tin content increases the hardness and wear resistance, increasing the lead content improves the tolerance of poor alignment and intermittent lubrication.
CuPb10Sn10	
CuPb15Sn8	Soft copper based bearing alloys suitable for moderate loads and moderate to high sliding velocities. Increasing the tin content increases the hardness and wear resistance, increasing the lead content improves the tolerance of poor alignment and intermittent lubrication. Tolerant of water lubrication.
CuPb20Sn5	Soft copper based bearing alloys suitable for moderate loads and moderate to high sliding velocities. Increasing the tin content increases the hardness and wear resistance, increasing the lead content improves the tolerance of poor alignment and intermittent lubrication. Suitable for water lubrication.
CuAl10Fe5Ni5	Very hard alloy for structural components under sliding conditions. Suitable for marine environments. Hardened shafts essential. Relatively poor embeddability.
CuSn8Pb2	For non-critical applications with low to moderate loads; adequate lubrication.
CuSn7Pb7Zn3	
CuSn10P	For hardened shafts with a combination of high load, high sliding velocity, impact loading or pounding; when there is adequate lubrication and good alignment.
CuSn12Pb2	For hardened shafts with a combination of high load, high sliding velocity, impact loading or pounding; when there is adequate lubrication and good alignment.
CuPb5Sn5Zn5	For non-critical applications with low loads; adequate lubrication.