FINAL DRAFT

INTERNATIONAL STANDARD

ISO/FDIS 14287

ISO/TC **123**/SC **7**

Secretariat: JISC

Voting begins on:
2021-04-26

Voting terminates on:
2021-06-21

Plain bearings — Pad materials for tilting pad bearings

Paliers lisses — Matériaux des patins pour paliers à patins oscillants

Reference number
ISO/FDIS 14287:2021(E)

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Subcommittee SC 7, *Special types of plain bearings*.

This third edition cancels and replaces the second edition (ISO 14287:2018), which has been technically and editorially revised. The main changes compared to the previous edition are as follows:

— The scope has been changed to allow the use of other materials if they have been proven to be suitable for the operating requirements.

— The document has been rewritten so that the format is consistent with other standards related to materials for multilayer plain bearings.

— The composition of SnSb8Cu4 referenced in Table 1 has been corrected and alternative lining materials have been added to Tables 1, 2, 3 and 4.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Plain bearings — Pad materials for tilting pad bearings

1 Scope

This document specifies requirements for some commonly used pad lining materials utilized on tilting pad bearings. The requirements in this document are expressed by specifying the chemical composition of the lining materials. Other lining materials can be used if they have been proven to be equally suitable at the required operating conditions. Descriptive characteristics of the lining materials are given along with the appropriate selection of pad backing and pivot materials.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 6280, *Plain bearings — Requirements and guidance on backings for thick-walled multilayer bearings*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Requirements

4.1 Lining materials

4.1.1 Chemical composition

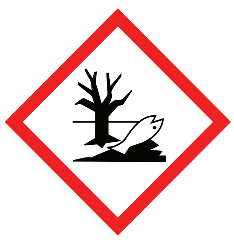
The chemical composition of alloy elements and compounds of the materials covered by this document shall be within the limits specified in Tables 1, 2, 3 and 4.

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 manufacturer and purchaser.

WARNING — Lead's (Pb) toxicity was recognized, and its use has since been phased out of many applications. However, many countries still allow the sale of products that expose humans to lead. Lead is a neurotoxin.

GHS 07

GHS 08



GHS 09

4.1.2 Mechanical properties

Mechanical properties of linings can be expected to vary in individual cases due to the range of possible elemental and compound compositions of a specified alloy, the marked influence exerted by the cooling conditions an alloy experiences and the influence of the backing material. Consequently, material properties for lining materials shall be the subject of agreement between the manufacturer and purchaser.

4.1.3 Selection of lining materials

Guidance on properties and selection materials is given in Annex A.

4.2 Backing materials

Requirements for suitable backing materials should be found in ISO 6280. Other backing materials can be used if they have been proven in service and an optimum bond, between the backing material and the lining material, is ensured by control of the manufacturing process.

4.3 Pivot materials

Pivot materials are usually selected in combination with the type of pivot design in order to minimize pivot wear and ensure pivot stresses remain within acceptable limits. In some cases, the requirements for the pivot material cannot be satisfied by the chosen pad backing material, leading to the use of a separate pivot, or 'insert'. Various factors determine the type of pivot to be used, including the magnitude of the load, requirements for self-aligning capability and the degree of pivot flexibility permitted for the application. Due to these factors, pivot materials cannot be specified in isolation of the design and, consequently, shall be the subject of agreement between the manufacturer and purchaser.

Table 1 — Tin-based white metals

Chemical element	Chemical composition (mass fraction, %)		
	SnSb8Cu4	**SnSb10Cu5**	**SnSb12Cu6Zn**
Sn	Remainder (ca. 89)	Remainder (ca. 87)	Remainder (ca. 81)
Sb	7 to 8	8,5 to 10	11 to 13
Cu	3 to 4	3,5 to 5	5,5 to 6,5
Zn	—	—	0,3 to 0,7
Ag	—	—	0,05 to 0,15
Impurities			
Pb	< 0,35	< 0,35	< 0,06
As	< 0,1	< 0,1	< 0,03
Bi	< 0,08	< 0,08	< 0,06
Fe	< 0,1	< 0,1	< 0,03
Al	< 0,01	< 0,005	< 0,01
Zn	< 0,01	< 0,005	—
Cd	< 0,05	< 0,05	< 0,03
Ni	—	—	< 0,06
Total others	0,2	0,2	0,2
NOTE Data valid for raw materials in the shape of ingots or welding wires.			

Table 2 — Aluminium-tin alloys

Chemical element	Chemical composition (mass fraction, %)	
	AlSn40Cu1	AlSn40
Al	Remainder	Remainder
Sn	35 to 42	37 to 42
Cu	0,7 to 1,3	0,35 to 0,70
Fe	< 0,7	< 0,3
Si	< 0,3	< 0,3
Ni	< 0,15	< 0,1
Mn	—	< 0,1
Ti	—	< 0,1
Total others	0,3	0,3

Table 3 — Copper alloys

Chemical element	Chemical composition (mass fraction, %)
	CuPb20Sn5
Cu	Remainder
Pb	18 to 23
Sn	4 to 6
Impurities	
Zn	< 1
P	< 0,1
Ni	< 2
Sb	< 0,5
Si	< 0,01
Total others	0,3

Table 4 — Polymer bearing materials

Chemical compound	Chemical composition (mass fraction, %)			
	PEEK material		PTFE material	
PEEK	Remainder	Remainder	—	—
PTFE	1 to 3	8 to 12	Remainder	Remainder
CF	27 to 33	—	10 to 20	10 to 20
Graphite	—	—	—	1 to 5
MoS_2	—	—	4 to 6	—

Key

PEEK: polyether-etherketone

PTFE: polytetrafluoro-ethylene

CF: carbon fibre

MoS_2: molybdenum disulphide

5 Designation

EXAMPLE A tilting pad bearing consisting of a metallic lining material with chemical composition SnSb8Cu4 is designated as follows:

Lining material ISO 14287 – SnSb8Cu4

Polymer lining materials will be subject to a more general designation, with the specific compounds agreed between the manufacturer and the purchaser, e.g.:

Lining material ISO 14287 – PEEK, **or**

Lining material ISO 14287 – PTFE

Annex A
(informative)

Guidance on properties and selection of materials

Table A.1 — Application notes for lining materials

Lining material	Characteristics and principal uses in tilting pad bearings	Minimum shaft hardness[a]
SnSb8Cu4	Good sliding properties, conformability and high toughness; good embeddability and seizure resistance; suitable for high sliding velocities in the hydrodynamic range and moderate loads; impact stress at low frequency; insensitive to reverse bending stress. The maximum permissible sliding surface temperature is approximately 120 °C to 130 °C. Used for high-speed turbomachinery, electric machines, gearboxes, pumps and propeller shafts.	160 HBW
SnSb10Cu5	Good sliding properties and conformability; good embeddability and seizure resistance; suitable for high sliding velocities in the hydrodynamic range and moderate loads; impact stress at low frequency. The maximum permissible sliding surface temperature is approximately 120 °C to 130 °C. Used for high-speed turbomachinery, electric machines, gearboxes, pumps, and propeller shafts.	160 HBW
SnSb12Cu6Zn	Good sliding properties, conformability and high temperature strength; least creep deformation; good embeddability; suitable for high sliding velocities in the hydrodynamic range at high load; high fatigue limit at high frequency. Used for high-speed turbomachinery, electric machines and gearboxes.	160 HBW
AlSn40 and AlSn40Cu1	Good sliding properties, conformability; embeddability and seizure resistance approaching that of tin-based white metals, but with a usefully higher fatigue strength at elevated temperatures; suitable for high sliding velocities in the hydrodynamic range and higher loads than tin-based white metals. The maximum permissible sliding surface temperature is approximately 25 °C to 30 °C higher than tin-based white metal lined bearings. Unhardened steel shafts can be used. Used for high-speed turbomachinery, electric machines, gearboxes and special applications where the levels of copper found in tin-based white metals and polymer lined pads with bronze interlayers are prohibited.	160 HBW

[a] In multilayer plain bearings, the difference between the hardness of the lining material and the shaft material should be such that welding under working conditions is safely avoided. The working conditions, in particular the lubrication conditions, have considerable influence on the selection of the shaft material. For this reason, the recommended hardness value for the shaft material is a minimum value. In general, the unquenched and untempered shaft materials are used in the case of lining materials based on tin.

[b] To be determined by the bearing manufacturer in line with their experience for the selected material and working conditions.

Table A.1 *(continued)*

Lining material	Characteristics and principal uses in tilting pad bearings	Minimum shaft hardness[a]
CuPb20Sn5	High strength and high temperature characteristics — the maximum permissible sliding surface temperature is approximately 30 °C to 40 °C higher than tin-based white metal lined bearings. Good compromise between strength and surface properties. Requires hardened shaft surface. Used for high-speed turbomachinery and gearboxes.	350 HBW
Polymers	PEEK and PTFE polymer materials: excellent sliding properties compared to metallic bearing alloys (low coefficient of friction and seizure resistance); good embeddability; superior corrosion resistance; low thermal conductivity — reduces pad thermal distortion leading to increased load-carrying capability. Experimental results for start-up friction coefficient under static load conditions are shown in Figures A.1 and A.2. In some cases, the use of jacking oil for large-size vertical thrust bearings can be eliminated by specifying PTFE or PEEK thrust pads. Non-conductive polymer materials have the advantage of preventing electro-erosion without an additional insulation. PEEK characteristics: excellent load-carrying capability; low wear/creep deformation under high surface pressure conditions; high fatigue strength; high temperature capability — the maximum permissible sliding surface temperature is approximately 75 °C higher than tin-based white metal lined bearings. Used for subsea pump and motor applications with low viscosity lubricants (including mineral and water-glycol), electric submersible pumps (ambient temperatures up to 200 °C), process lubricated pumps, water-filled motors, high-speed turbomachinery, electric machines, gearboxes. PTFE characteristics: excellent load-carrying capability; conformability under high surface pressure and misalignment conditions; very low coefficient of friction and smooth breakout under high surface pressures excellent capability under boundary lubrication conditions, low sliding speeds and oil film thicknesses. The maximum permissible sliding surface temperature is similar to that of tin-based white metal lined bearings. Used for vertical pumps, hydroelectric turbine-generators and marine propulsion applications	See footnote [b]

[a] In multilayer plain bearings, the difference between the hardness of the lining material and the shaft material should be such that welding under working conditions is safely avoided. The working conditions, in particular the lubrication conditions, have considerable influence on the selection of the shaft material. For this reason, the recommended hardness value for the shaft material is a minimum value. In general, the unquenched and untempered shaft materials are used in the case of lining materials based on tin.

[b] To be determined by the bearing manufacturer in line with their experience for the selected material and working conditions.

An overview of the operational range for the lining materials is available in Figure A.3.