
**Plain bearings — Pad materials for
tilting pad bearings**

Paliers lisses — Matériaux des patins pour paliers à patins oscillants

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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.

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 second edition cancels and replaces the first edition (ISO 14287:2012), which has been technically revised. The main changes compared to the previous edition are as follows:

- The content of the Scope has been changed to a concise expression.
- Descriptions on processing and sheet dimensions have been deleted.
- [Table 1](#), [Figure A.1](#) and [Figure A.2](#) have been reviewed.

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.

Introduction

Tilting pad bearings are divided in circumferential direction and are pivoted at the supporting points on their back surfaces. This configuration allows the pads to tilt freely, enabling an optimum position and oil film to be realized for the applied duty condition (i.e. speed, pressure and oil viscosity), and improves load-carrying capabilities.

Such bearings are normally used as thrust and journal bearings for rotating machineries; tilting pad bearings are classified to the category of static load conditions with lubricating oil applied. They have been used for many years and have a long history. As a result of developments in high-speed, high-performance rotating machineries, many various types of pad materials have been put into practical use.

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Plain bearings — Pad materials for tilting pad bearings

1 Scope

This document specifies requirements for tilting pad bearing lining materials (metals and polymers), backing metals and pivots.

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 4381, *Plain bearings — Tin casting alloys for multilayer plain bearings*

ISO 4383, *Plain bearings — Multilayer materials for thin-walled plain 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 <http://www.electropedia.org/>

4 Requirements

4.1 General

The sliding surface of a pad may be a metal or a polymer, which is typically bonded to a backing metal, depending on the operating conditions of the bearing. Alloys shall be in accordance with ISO 4381; materials shall be in accordance with ISO 4383. Guidance for the selection of pad surface layer materials is given in [Annex A](#).

4.2 Metallic materials

4.2.1 Typical materials

The chemical composition of some typical materials based on metal is given in [Table 1](#).

4.2.2 Tin-based white metals

Tin-based white metals are used as general-purpose metallic lining materials. They are generally provided with linings by casting.

White metals are characterized by good castability. However, attention should be paid to quality problems, such as bonding strength with the back metal, segregation and blow holes.

To ensure appropriate strength/softness of a white metal alloy, the combination of Sb and Cu described in [Table 1](#) is used in many applications.

Lead-based white metals are rarely used due to their generally inferior performance and concerns over their impact on the environment.

4.2.3 Aluminium bearing alloys

Aluminium-based bearing alloys are used for high-speed operation under high-load and high-temperature conditions. Al-Sn alloys, i.e. alloys which are made by adding tin to aluminium, are the most commonly used aluminium bearing alloys. To improve sliding characteristics at high speed, 40 % Sn-Al alloy is typically used.

The pad of a bearing manufactured from such an alloy is formed from a bimetal strip consisting of an aluminium alloy, which is roll-bonded to carbon steel.

4.2.4 Lead-bronze bearing alloys

Lead-bronze bearing alloys are used under operating conditions equivalent to those for aluminium-bearing alloys or under higher load and higher temperature conditions. However, lead-bronze bearing alloys have limited uses. Lead-bronze bearing alloys are high in hardness; they normally require surface hardening (quench hardening, etc.) on the sliding surfaces of mating parts.

The pad of a bearing manufactured from such an alloy, as in the case of an aluminium bearing alloy, is typically formed from a bimetal strip. It can take the form of a copper alloy with a steel backing, although it is a rare case.

Table 1 – Chemical composition of meta materials

Chemical element	Chemical composition (mass fraction, %)			
	Tin-based white metals		Aluminium bearing alloys	Lead-bronze bearing alloys
	SnSb8Cu4	SnSb12Cu6Zn		
Sn	Remainder	Remainder	35 to 42	8 to 12
Al	0,01	0,01	Remainder	—
Cu	3 to 5	5,5 to 6,5	0,7 to 1,3	Remainder
Sb	8 to 10	11 to 13	—	0,5
Pb	0,5	0,06	—	7 to 13
Zn	0,01	0,3 to 0,7	—	0,75
Ni	—	0,06	0,15	0,5
Si	—	—	0,3	—
Fe	0,08	0,03	0,7	0,35
Bi	0,08	0,06	—	—
As	0,01	—	—	—
Ag	—	0,05 to 0,15	—	—

4.3 Polymer materials

Bearings with pads having polymer layers on their sliding surfaces, which are characterized by polymer-specific tribological characteristics, are in use.

Polyether-etherketone (PEEK) and polytetrafluoro-ethylene (PTFE) polymer materials are available. Bearings composed of such materials are provided with special measures to allow for bonding to the back metal. A porous metal layer is used as the bonding interface layer and its voids are impregnated with a polymer layer material to form a sliding surface layer. Thus, the metal interface layer is joined with the back metal. PEEK polymer materials contain some PTFE in order to improve sliding characteristics.

The chemical composition of some typical polymer materials is given in [Table 2](#).

Two types of electrical conductivities are provided: conductive and non-conductive, which are determined depending on the elements added. Non-conductive polymer materials have the advantage of preventing electro-erosion without an additional insulator.

Table 2 — Chemical composition of polymer materials

Chemical element	Chemical composition (mass fraction, %)		
	PEEK material		PTFE material
PEEK	Remainder	Remainder	—
PTFE	1 to 3	8 to 12	Remainder
CF	27 to 33	—	10 to 20
MoS ₂	—	—	4 to 6
Key			
CF: carbon fibre			
MoS ₂ : molybdenum disulfide			

4.4 Back metal materials

Low-carbon steels containing approximately 0,10 % to 0,35 % mass fraction carbon are often used as back metal materials. The carbon content of a back metal material is typically determined using a combination of a surface layer bearing material and a bonding process.

In the case of bearings operating under high-speed and high-temperature conditions, a copper alloy may be used as a back metal, although it is a rare case. Back metals of the copper alloy are usually Cu-Cr (copper chromium) alloys, which are expected to decrease pad temperature by approximately 10 °C to 20 °C because of their excellent thermal conductivity.

4.5 Pivot materials

Pivots are subjected to concentrated loads and can be integral to the pad. Pivot materials are very hard and are fixed to pads. A typical example of a pivot surface is a flat, cylindrical and spherical one. It is press-fitted on to the back surface of a pad and is then secured by caulking. High-carbon chromium bearing steels containing approximately 0,95 % to 1,10 % mass fraction carbon are commonly used for tilt pad pivots and in general heat-treated.

The shape of a pivot is designed to have different curvatures with respect to the circumferential and lateral directions to allow the pad to tilt freely in the circumferential and lateral directions.

Pivots may be fastened to the bearing casing instead of to the back of the pads.