



**International
Standard**

ISO 31657-1

**Plain bearings — Hydrodynamic
plain journal bearings under
steady-state conditions —**

**Part 1:
Calculation of multi-lobed and
tilting pad journal bearings**

*Paliers lisses — Paliers lisses hydrodynamiques radiaux
fonctionnant en régime stabilisé —*

*Partie 1: Calcul pour les paliers radiaux multilobés et 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).

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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 8, *Calculation methods for plain bearings and their applications*.

This first edition of ISO 31657-1 cancels and replaces ISO/TS 31657-1:2020, which has been technically revised.

The main changes are as follows:

- Clause 7 has been deleted;
- correction of typographical errors.

A list of all parts in the ISO 31657 series can be found on the ISO website.

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

The aim of this document is the operationally-safe design of plain journal bearings for medium or high journal circumferential velocities, U_j , up to approximately 90 m/s by applying a calculation method for oil-lubricated hydrodynamic plain bearings with complete separation of journal and bearing sliding surfaces by a lubricating film.

For low circumferential velocities up to approximately 30 m/s, circular cylindrical bearings are normally applied. For these bearings, a similar calculation method is given in ISO 7902-1, ISO 7902-2 and ISO 7902-3.

Based on practical experience, the calculation procedure is usable for application cases where specific bearing load times circumferential speed, $\bar{p} \cdot U_j$, does not exceed approximately 200 MPa·m/s.

This document discusses multi-lobed journal bearings with two, three and four equal, symmetrical sliding surfaces, which are separated by laterally-closed lubrication pockets, and symmetrically-loaded tilting-pad journal bearings with four and five pads. Here, the curvature radii, R_B , of the sliding surfaces are usually chosen larger than half the bearing diameter, D , so that an increased bearing clearance results at the pad ends.

The calculation method described here can also be used for other gap forms, for example asymmetrical multi-lobed journal bearings like offset-halves bearings, pressure-dam bearings or other tilting-pad journal bearing designs, if the numerical solutions of the basic formulae are available for these designs.

For a reliable evaluation of the results of this calculation method, it is indispensable to consider the physical implications of these assumptions as well as practical experiences for instance from temperature measurements carried out on real machinery under typical operating conditions. Applied in this sense, this document presents a simple way to predict the approximate performance of plain journal bearings for those unable to access more complex and accurate calculation techniques.

Unsteady operating states are not recorded. The stiffness and damping coefficients of the plain journal bearings required for the linear vibration and stability investigations are indicated in ISO 31657-2 and ISO 31657-3.

NOTE Equivalent calculation procedures exist that enable operating conditions to be estimated and checked against acceptable conditions. Another calculation procedure is equally admissible.

Plain bearings — Hydrodynamic plain journal bearings under steady-state conditions —

Part 1:

Calculation of multi-lobed and tilting pad journal bearings

1 Scope

This document specifies the general principles, assumptions and preconditions for the calculation of multi-lobed and tilting-pad journal bearings by means of an easy-to-use calculation procedure based on numerous simplifying assumptions.

The calculation method applies to the design and optimisation of plain bearings, for example in turbines, compressors, generators, electric motors, gears and pumps. It is restricted to steady-state operation, i.e. in continuous operating states the load according to size and direction and the angular velocity of the rotor are constant.

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 31657-2, *Plain bearings — Hydrodynamic plain journal bearings under steady-state conditions — Part 2: Characteristic values for calculation of multi-lobed journal bearings*

ISO 31657-3, *Plain bearings — Hydrodynamic plain journal bearings under steady-state conditions — Part 3: Characteristic values for calculation of tilting pad journal bearings*

ISO 31657-4, *Plain bearings — Hydrodynamic plain journal bearings under steady-state conditions — Part 4: Permissible operational parameters for calculation of multi-lobed and tilting pad journal bearings*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology 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 Symbols and units

[Table 1](#) contains the symbols used in the ISO 31657 series.