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

Part 3: Characteristic values for calculation of tilting pad journal bearings

FDIS stage

Contents

Foreword

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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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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 31657-3 cancels and replaces ISO/TS 31657-3:2020, which has been technically revised.

The main changes are as follows:

— ~~— Title~~the title has been modified~~.~~;

— ~~Figure 1~~Figure 1 has been updated.

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.

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

Part 3: Characteristic values for calculation of tilting pad journal bearings

1 Scope

This document specifies the characteristic values for selected tilting-pad journal bearings with four or five centrally or eccentrically supported tilting pads, and with angular spans of pad sliding surfaces of Ω = 80°, 60° and 45°.

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 31657-1:2025, *Plain bearings — Hydrodynamic plain journal bearings under steady-state conditions — Part 1: 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 terminological databases for use in standardization at the following addresses:

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

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

4 Characteristic values for calculation of multi-lobed journal bearings

4.1 General

The characteristic values plotted and listed in this clause are required for the operationally safe design of hydrodynamic tilting-pad journal bearings in accordance with ISO 31657-1. They are based on the presumptions and boundary conditions indicated there and only apply to stationary operating states. The symbols used are explainedshall be in accordance with ISO 31657-1:2025, Table 1; calculation examples are also given in ISO 31657-1:2025, Annex A.

The calculation method described in ISO 31657-1 can also be used for other tilting-pad journal bearing designs, if the numerical solutions of the basic equations are available in the same manner for these designs.

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

The characteristic values for symmetrically loaded tilting-pad journal bearings with four and five centrally (relative angular distance between leading edge and pivot position of pad Ω_F^* Ω_F^* = 0,5) or eccentrically (Ω_F^* (Ω_F^* = 0,6) supported tilting pads are indicated.

The characteristic values were calculated for the geometrical parameters summarised in Figure 1Error! Reference source not found. (angular spans of pad sliding surface Ω, angular coordinates of pivot position of pad $\varphi_{F,1}$, $\varphi_{F,1}$, profile factors K_P, K_P, bearing width ratios B^*) B^*) in the operating range 0,02 ≤ h_{min}^* h_{min}^* ≤ 1. The following (dimensionless) characteristic values are individually listed from table 1Error! Reference source not found. to 56:Error! Reference source not found.:

a) a) Static characteristic values

The Sommerfeld number: is given as Error! Reference source not found.:

$$So = \frac{F \cdot \psi_{eff}^2}{B \cdot D \cdot \eta_{eff} \cdot \omega}$$

Relative eccentricity:

$$\varepsilon = \frac{e}{C_{R,eff}}$$

$$So = \frac{F \cdot \psi_{eff}^2}{B \cdot D \cdot \eta_{eff} \cdot \omega} \qquad (1)$$

The relative eccentricity is given as Error! Reference source not found.:

$$\varepsilon = \frac{e}{C_{R,eff}} \qquad (2)$$

Attitude angle β in °C.°C.

ProductFor the product of maximum lubricant film pressure parameter and Sommerfeld number:, see Error! Reference source not found.:

$$p_{max}^* \cdot So = \frac{p_{max} \cdot \psi_{eff}^2}{\eta_{eff} \cdot \omega}$$

Minimum $$p_{max}^* \cdot So = \frac{p_{max} \cdot \psi_{eff}^2}{\eta_{eff} \cdot \omega} \qquad (3)$$

For the minimum relative lubricant film thickness:, see Error! Reference source not found.:

$$h_{min}^* = \frac{h_{min}}{C_{R,eff}}$$

Friction force parameter:

$$F_f^* = \frac{f}{\psi_{eff}} \cdot So$$

Lubricant $$h_{min}^* = \frac{h_{min}}{C_{R,eff}} \qquad (4)$$

For the friction force parameter, see Error! Reference source not found.:

$$F_f^* = \frac{f}{\psi_{eff}} \cdot So \qquad (5)$$

For the lubricant flow rate parameter due to hydrodynamic pressure build-up~~:~~, see Error! Reference source not found.:

~~$Q_3^* = \frac{Q_3}{Q_0}$~~

~~Lubricant~~

$$Q_3^* = \frac{Q_3}{Q_0} \qquad (6)$$

For the lubricant flow rate parameter due to supply pressure~~:~~, see Error! Reference source not found.:

~~$Q_p^* = \frac{Q_p}{P_{en}^* \cdot Q_0}$~~

~~Lubricant~~

$$Q_p^* = \frac{Q_p}{P_{en}^* \cdot Q_0} \qquad (7)$$

For the lubricant flow rate parameter at the exit of the lubricant gap~~:~~, see Error! Reference source not found.:

~~$Q_2^* = \frac{Q_2}{Q_0}$~~

~~Non~~

$$Q_2^* = \frac{Q_2}{Q_0} \qquad (8)$$

For non-dimensional difference between maximum temperature of lubricant film and lubricant temperature in the lubricant pocket~~:~~, see Error! Reference source not found.:

~~$\Delta T_{max}^* = \frac{\rho \cdot c_p \cdot \psi_{eff}}{\bar{p} \cdot f} \cdot \Delta T_{max}$~~

~~b)~~

$$\Delta T_{max}^* = \frac{\rho \cdot c_p \cdot \psi_{eff}}{\bar{p} \cdot f} \cdot \Delta T_{max} \qquad (9)$$

b) Dynamic characteristic values

~~Non~~For non-dimensional lubricant film stiffness coefficients~~:~~, see Error! Reference source not found.:

~~$c_{i,k}^* = \frac{\psi_{eff}^3}{2 \cdot B \cdot \eta_{eff} \cdot \omega} \cdot c_{i,k}$~~

$$c_{i,k}^* = \frac{\psi_{eff}^3}{2 \cdot B \cdot \eta_{eff} \cdot \omega} \cdot c_{i,k} \; (i, k = 1, 2) \qquad (10)$$

~~Non~~For non-dimensional lubricant film damping coefficients~~:~~, see Error! Reference source not found.:

~~$d_{i,k}^* = \frac{\psi_{eff}^3}{2 \cdot B \cdot \eta_{eff} \cdot \omega} \cdot \omega \cdot d_{i,k}$~~

$$d_{i,k}^* = \frac{\psi_{eff}^3}{2 \cdot B \cdot \eta_{eff} \cdot \omega} \cdot \omega \cdot d_{i,k} \; (i, k = 1, 2) \qquad (11)$$