International Standard

ISO 31657-2

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

Part 2: Characteristic values for calculation of multilobed journal bearings

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

Partie 2: Valeurs caractéristiques pour le calcul des paliers radiaux multilobés

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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 31657-2 cancels and replaces ISO/TS 31657-2:2020, which has been technically revised.

The main changes are as follows:

— the title has been modified;

— 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 2: Characteristic values for calculation of multilobed journal bearings

1 Scope

This document specifies the characteristic values for selected two-, three- and four-lobe bearings.

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 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 Characteristic values for calculation of multi-lobed journal bearings

4.1 General

The characteristics values plotted and listed in this clause are required for the operationally safe design of hydrodynamic multi-lobed 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 in this document shall be in accordance with ISO 31657-1:2025, Table 1; calculation examples are also given ISO 31657-1:2025, Annex A.

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 two-, three- and four-lobe bearings with relative lubrication pocket widths of $b_P^* = 0{,}8$ are given in 4.2 to 4.4. The characteristic values were calculated for the geometrical parameters summarised in Figure 1 (angular spans of segment sliding surface, Ω, angular coordinates of lubricant pocket centrelines, $\varphi_{P,1}$, gap ratios, $h_{0,max}^*$, bearing width ratios B^*) in the operating range $0{,}02 \leq h_{min}^* \leq 1$.

The profile factors, K_P, associated with the indicated gap ratios, $h^*_{0,max}$, can be calculated for these bearing types as shown in Formulae (1) to (3):

for $Z = 2$

$$K_P = h^*_{0,max} \tag{1}$$

for $Z = 3$

$$K_P = 2 \cdot h^*_{0,max} \tag{2}$$

for $Z = 4$

$$K_P = \frac{h^*_{0,max} - \frac{1}{\sqrt{2}}}{1 - \frac{1}{\sqrt{2}}} \tag{3}$$

The following (dimensionless) characteristic values are indicated in Tables 1 to 43.

a) Static characteristic values

The Sommerfeld number is given as Formula (4):

$$So = \frac{F \cdot \psi^2_{eff}}{B \cdot D \cdot \eta_{eff} \cdot \omega} \tag{4}$$

The relative eccentricity is given as Formula (5):

$$\varepsilon = \frac{e}{C_{R,eff}} \tag{5}$$

Attitude angle, β, in °.

For the product of maximum lubricant film pressure parameter and Sommerfeld number, see Formula (6):

$$p^*_{max} \cdot So = \frac{p_{max} \cdot \psi^2_{eff}}{\eta_{eff} \cdot \omega} \tag{6}$$

For the minimum relative lubricant film thickness, see Formula (7):

$$h^*_{min} = \frac{h_{min}}{C_{R,eff}} \tag{7}$$

For the friction force parameter, see Formula (8):

$$F^*_f = \frac{f}{\psi_{eff}} \cdot So \tag{8}$$

For the lubricant flow rate parameter due to hydrodynamic pressure build-up, see Formula (9):

$$Q^*_3 = \frac{Q_3}{Q_0} \tag{9}$$

For the lubricant flow rate parameter due to supply pressure, see Formula (10):

$$Q_{\mathrm{p}}^{*} = \frac{Q_{\mathrm{p}}}{P_{\mathrm{en}}^{*} \cdot Q_{0}} \tag{10}$$

For the lubricant flow rate parameter at the exit of the lubrication gap, see Formula (11):

$$Q_{2}^{*} = \frac{Q_{2}}{Q_{0}} \tag{11}$$

For non-dimensional difference between maximum lubricant temperature and lubricant temperature in the lubricant pockets, see Formula (12):

$$\Delta T_{\max}^{*} = \frac{\rho \cdot c_{\mathrm{p}} \cdot \Psi_{\mathrm{eff}}}{\bar{p} \cdot f} \cdot \Delta T_{\max} \tag{12}$$

b) Dynamic characteristic values

For non-dimensional lubricant film stiffness coefficients, see Formula (13):

$$c_{i,k}^{*} = \frac{\psi_{\mathrm{eff}}^{3}}{2 \cdot B \cdot \eta_{\mathrm{eff}} \cdot \omega} \cdot c_{i,k} \quad (i, k = 1, 2) \tag{13}$$

For non-dimensional lubricant film damping coefficients, see Formula (14):

$$d_{i,k}^{*} = \frac{\psi_{\mathrm{eff}}^{3}}{2 \cdot B \cdot \eta_{\mathrm{eff}} \cdot \omega} \cdot \omega \cdot d_{i,k} \quad (i, k = 1, 2) \tag{14}$$

For some selected four-lobe bearings ($\Omega = 70°$, $\varphi_{\mathrm{P},1} = 315°$), these characteristic values are shown graphically as a function of the Sommerfeld number *So*, the gap ratio $h_{0,\max}^{*}$ and the bearing width ratio B^{*} in Annex A, Figures A.1 to A.16.