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**Hydrodynamic plain journal bearings  
under steady-state conditions —  
Circular cylindrical bearings —**

**Part 3:  
Permissible operational parameters**

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*Paliers lisses hydrodynamiques radiaux fonctionnant en régime  
stabilisé — Paliers circulaires cylindriques —  
Partie 3: Paramètres opérationnels admissibles*

ISO 7902-3:2020

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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](http://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](http://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](http://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 second edition cancels and replaces the first edition (ISO 7902-3:1998), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

- adjustment to ISO/IEC Directives, Part 2:2018;
- correction of typographical errors.

A list of all parts in the ISO 7902 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](http://www.iso.org/members.html).

## Introduction

In order to attain sufficient operational reliability of circular cylindrical plain journal bearings when calculated in accordance with ISO 7902-1, it is essential that the calculated operational parameters  $h_{\min}$ ,  $T_B$  or  $T_{\text{ex}}$  and  $\bar{p}$  do not lie above or below the permissible operational parameters  $h_{\text{lim}}$ ,  $T_{\text{lim}}$  and  $\bar{p}_{\text{lim}}$ . The permissible parameters represent geometrically and technologically dependent operational limits within the plain bearing tribological system. They are empirical values which still enable sufficient operational reliability even for minor influences (see ISO 7902-1).

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# Hydrodynamic plain journal bearings under steady-state conditions — Circular cylindrical bearings —

## Part 3: Permissible operational parameters

### 1 Scope

This document specifies empirical permissible values for  $h_{lim}$ ,  $T_{lim}$  and  $\bar{p}_{lim}$ .

The empirical values stated can be modified for certain applications, for example if information supplied by the manufacturer is to be taken into account. The descriptions of the symbols and calculation examples are given in ISO 7902-1.

### 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 7902-1, *Hydrodynamic plain journal bearings under steady-state conditions Circular cylindrical bearings — Part 1: Calculation procedure*

ISO 7902-3:2020

### 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 Symbols and units

Symbols and units are defined in [Table 1](#). ISO 7902-1:2020, Table 1 shall be referenced to identify the meaning of symbols not listed in [Table 1](#).

**Table 1 — Symbols and their designations**

$B$	Nominal bearing width	m
$C$	Nominal bearing clearance	m
$D$	Nominal bearing diameter (inside diameter)	m
$E$	Dimensionless modulus of elasticity	1
$G$	Dimensionless shear modulus	1
$h_{wav}$	Waviness of sliding surface (from <a href="#">Figure 3</a> )	m
$h_{wav,eff}$	Effective waviness of sliding surface	m
$h_{wav,eff,lim}$	Maximum permissible effective waviness	m
$h_{wav,lim}$	Maximum permissible waviness	m

**Table 1** (continued)

$i$	Number of waviness	1
$l_G$	Length of lubrication groove	m
$l_P$	Length of lubricant pocket	m
$L_H$	Length of bearing housing	m
$N_F$	Rotational frequency of the bearing force	s <sup>-1</sup>
$Q_1$	Lubricant flow rate at the inlet to clearance gap	m <sup>3</sup> /s
$Q_2$	Lubricant flow rate at the outlet to clearance gap	m <sup>3</sup> /s
$Rz_B$	Average peak-to-valley height of bearing sliding surface	m
$Rz_J$	Average peak-to-valley height of shaft mating surface	m
$y$	Amount of deflection	m
$\gamma$	Angle of misalignment of the shaft	rad
$\phi_{wav}$	Period of waviness	°

## 5 Operational parameters to avoid wear

### 5.1 Minimum permissible lubrication film thickness

The aim of keeping above the minimum permissible lubrication film thickness  $h_{lim}$  is to retain complete lubrication of the plain bearing in order to attain the least possible wear and low susceptibility to faults. The lubricant should be free of contaminating particles, otherwise increased wear, scoring and local overheating can result, thus impairing correct functioning of the plain bearing. If necessary, appropriate filtering of the lubricant should be provided for.

The minimum permissible lubrication film thickness  $h_{lim}$ , as a characteristic parameter for the transition to mixed friction (see ISO 7902-1:2020, 7.6), can be determined from the following formula as shown in [Figure 1](#).

$$h_{lim} = Rz_B + Rz_J + \frac{1}{2} B \cdot y + \frac{1}{2} y + h_{wav, eff} \tag{1}$$

[Formula \(1\)](#) takes into account

- the sum of the mean peak-to-valley heights of bearing and shaft at the ideal location (line X-X) [ $Rz_B + Rz_J$ ],
- the misalignment (line Y-Y) within the bearing length [ $1/2 B \cdot y$ ], and
- the mean deflection (line Z-Z) [ $1/2 y$ ].

### 5.2 Effective waviness and maximum permissible effective waviness

If wavy geometrical deviations occur in the sliding surfaces (bearing or shaft) in the circumferential direction, they are taken into account during the determination of  $h_{lim}$  by the effective waviness  $h_{wav, eff}$  for the most unfavourable shaft position. In this case,  $h_{wav, eff}$  is the effective waviness of the bearing under static loading or the effective waviness of the shaft under rotating loading, respectively.

The effective waviness  $h_{wav, eff}$  and the maximum permissible effective waviness  $h_{wav, eff, lim}$  at a given operating point ( $\varepsilon$  or  $h_{lim}$ ) can be determined using [Figure 2](#) if roughnesses, deformations and tilt positions are known.



In accordance with [Formula \(1\)](#), the following applies:

$$h_{\text{lim}} = m + h_{\text{wav, eff}}$$

where

$$m = Rz_B + Rz_J + \frac{1}{2} B \cdot y + \frac{1}{2} y$$

$$h_{\text{wav, eff}} = \frac{E}{G} a$$

With  $a$  given minimum lubricant film thickness  $h_{\text{min}}$  the maximum permissible effective waviness amplitude is determined from

$$h_{\text{wav, eff, lim}} = h_{\text{min}} - m$$

The maximum permissible absolute waviness,  $h_{\text{wav, eff, lim}}$ , is determined from

$$h_{\text{wav, lim}} = \frac{G}{E} h_{\text{wav, eff, lim}}$$

An example of the determination of  $h_{\text{wav, eff}}$ ,  $h_{\text{lim}}$ ,  $h_{\text{wav, eff, lim}}$  and  $h_{\text{wav, lim}}$  (from [Figure 2](#)) is as follows.

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Given quantities:

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$$B/D = 0,5$$

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$$C/2 = 85 \times 10^{-6} \text{ m}$$

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$$m = 6 \times 10^{-6} \text{ m}$$

$$h_{\text{wav}} = 5 \times 10^{-6} \text{ m}$$

$$i = 6$$

$$h_{\text{min}} = 8,5 \times 10^{-6} \text{ m}$$

$$\varepsilon = 1 - \frac{h_{\text{min}}}{\frac{C}{2}} = 0,9$$

With  $B/D = 0,5$ , [Figure 2](#) gives  $E = 0,86$ .

With  $i = 6$  and  $\varepsilon = 0,9$ , [Figure 2](#) gives  $G = 1,85$ .