BS ISO 12130-1:2021

BSI Standards Publication

Plain bearings — Hydrodynamic plain tilting pad thrust bearings under steady-state conditions

Part 1: Calculation of tilting pad thrust bearings

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National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Plain bearings — Hydrodynamic plain tilting pad thrust bearings under steady-state conditions —

Part 1: Calculation of tilting pad thrust bearings

Paliers lisses — Butées hydrodynamiques à patins oscillants fonctionnant en régime stationnaire —

Partie 1: Calcul des butées 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 second edition cancels and replaces the first edition (ISO 12130-1:2001), which has been technically revised.

The main changes compared to the previous edition are as follows:

— addition of Introduction;

— correction of numerical values in Table A.5;

— adjustment to ISO/IEC Directives, Part 2:2018;

— correction of typographical errors.

A list of all parts in the ISO 12130 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.

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Introduction

The aim of the ISO 12130 series is to achieve designs of plain bearings that are reliable in operation by the application of a calculation method for oil-lubricated hydrodynamic plain bearings with complete separation of the thrust collar and plain bearing surfaces by a film of lubricant.

The calculation method described in this document can be used for other gap shapes, e.g. parabolic lubrication clearance gaps, as well as for other types of sliding blocks, e.g. circular sliding blocks, when for these types the numerical solutions of Reynolds equation are present. ISO 12130-2 gives only the characteristic values for the plane wedge-shaped gap; the values are therefore not applicable to tilting pads with axial support.

The calculation method serves for designing and optimizing plain thrust bearings e.g. for fans, gear units, pumps, turbines, electric machines, compressors and machine tools. It is limited to steady-state conditions, i.e. load and angular speed of all rotating parts are constant under continuous operating conditions.

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Plain bearings — Hydrodynamic plain tilting pad thrust bearings under steady-state conditions —

Part 1: Calculation of tilting pad thrust bearings

1 Scope

This document specifies a calculation method for oil-lubricated hydrodynamic plain bearings with complete separation of the thrust collar and tilting pad thrust bearing surfaces by a film of lubricant.

This document applies to plain thrust bearings with tilting-type sliding blocks (tilting pads), where a wedge-shaped lubrication clearance gap is automatically formed during operation. The ratio of width to length of one pad can be varied in the range B/L = 0,5 to 2.

This document is not applicable to heavily loaded tilting pad thrust bearings.

NOTE Equivalent calculation procedures exist that enable operating conditions to be estimated and checked against acceptable conditions. The use of them is equally admissible.

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 12130-2, *Plain bearings — Hydrodynamic plain tilting pad thrust bearings under steady-state conditions — Part 2: Functions for calculation of tilting pad thrust bearings*

ISO 12130-3, *Plain bearings — Hydrodynamic plain tilting pad thrust bearings under steady-state conditions — Part 3: Guide values for the calculation of tilting pad thrust 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 Symbols, terms and units

Symbols, terms and units are shown in Table 1 and Figure 1.

Table 1 — Symbols, terms and units

Symbol	Term	Unit
a_F	distance between supporting point and inlet of the clearance gap in the direction of motion (circumferential direction)	m

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Table 1 *(continued)*

Symbol	Term	Unit
a_F^*	relative distance between supporting point and inlet of the clearance gap in the direction of motion (circumferential direction)	1
A	heat-emitting surface of the bearing housing	m^2
B	width of one pad	m
B_H	axial housing width	m
Cp	specific heat capacity of the lubricant (p = constant)	J/(kg·K)
C_{wed}	wedge depth	m
D	mean sliding diameter	m
D_H	housing outside diameter	m
D_i	inside diameter over tilting pads	m
D_o	outside diameter over tilting pads	m
f^*	characteristic value of friction	1
F	bearing force (load) at nominal rotational frequency	N
F^*	characteristic value of load carrying capacity	1
F_{st}	bearing force (load) at standstill	N
h	local lubricant film thickness (clearance gap height)	m
h_{lim}	minimum permissible lubricant film thickness during operation	m
$h_{lim,tr}$	minimum permissible lubricant film thickness on transition into mixed lubrication	m
h_{min}	minimum lubricant film thickness (minimum clearance gap height)	m
k	heat transfer coefficient related to the product $B \cdot L \cdot Z$	$W/(m^2 \cdot K)$
k_A	external heat transfer coefficient (reference surface A)	$W/(m^2 \cdot K)$
L	length of one pad in circumferential direction	m
M	mixing factor	1
N	rotational frequency (speed) of thrust collar	s^{-1}
p	local lubricant film pressure	Pa
$\bar{p}$	specific bearing load $\bar{p}=F/(B \cdot L \cdot Z)$	Pa
$\bar{p}_{lim}$	maximum permissible specific bearing load	Pa
P_f	frictional power in the bearing or power generated heat flow rate	W
$P_{th,amb}$	heat flow rate to the environment	W
$P_{th,f}$	heat flow rate arising from the friction power	W
$P_{th,L}$	heat flow rate in the lubricant	W
Q	lubricant flow rate	m^3/s
Q^*	characteristic value of lubricant flow rate	1
Q_0	relative lubricant flow rate $Q_0 = B \cdot h_{min} \cdot U \cdot Z$	m^3/s
Q_1	lubricant flow rate at the inlet of the clearance gap (circumferential direction)	m^3/s
Q_1^*	characteristic value of lubricant flow rate at the inlet of the clearance gap	1
Q_2	lubricant flow rate at the outlet of the clearance gap (circumferential direction)	m^3/s
Q_2^*	characteristic value of lubricant flow rate $Q_1^* - Q_3^*$ at the outlet of the clearance gap	1
Q_3	lubricant flow rate at the sides (perpendicular to circumferential direction)	m^3/s
Q_3^*	characteristic value of lubricant flow rate at the sides	1
Re	Reynolds' number	1

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Table 1 *(continued)*

Symbol	Term	Unit
Re_{cr}	Critical Reynolds' number	1
T_{amb}	ambient temperature	°C
T_B	bearing temperature	°C
$T_{B,0}$	initial bearing temperature	°C
T_{eff}	effective lubricant film temperature	°C
T_{en}	lubricant temperature at the inlet of the bearing	°C
T_{ex}	lubricant temperature at the outlet of the bearing	°C
T_{lim}	maximum permissible bearing temperature	°C
T_1	lubricant temperature at the inlet of the clearance gap	°C
T_2	lubricant temperature at the outlet of the clearance gap	°C
U	sliding velocity relative to mean diameter of bearing ring	m/s
w_{amb}	velocity of air surrounding the bearing housing	m/s
x	coordinate in direction of motion (circumferential direction)	m
y	coordinate in direction of lubrication clearance gap (axial)	m
z	coordinate perpendicular to the direction of motion (radial)	m
Z	number of tilting-pads	1
η	dynamic viscosity of the lubricant	Pa·s
η_{eff}	effective dynamic viscosity of the lubricant	Pa·s
ρ	density of the lubricant	kg/m^3

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