

Teknisk rapport

SIS-ISO/TR 20051:2020

Spherical plain bearings – Derivation of the load ratings factors



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Denna tekniska rapport är inte en svensk standard. Detta dokument innehåller den engelska språkversionen av ISO/TR 20051:2020, utgåva 1.

This Technical Report is not a Swedish Standard. This document contains the English language version of ISO/TR 20051:2020, edition 1.

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols	1
5 General	3
6 Radial spherical plain bearings	3
6.1 Bearing load distribution on the sliding contact area.....	3
6.2 Bearing load rating.....	5
6.3 Bearing load rating calculation for engineering.....	6
7 Angular contact thrust spherical plain bearings	6
7.1 Bearing load distribution on the sliding contact area.....	6
7.2 Bearing load rating.....	8
7.3 Bearing load rating calculation for engineering.....	8
8 Angular contact radial spherical plain bearings	9
8.1 Bearing load distribution on the sliding contact area.....	9
8.2 Bearing load rating.....	10
8.2.1 General.....	10
8.2.2 Radial load rating.....	10
8.2.3 Axial load rating.....	10
8.3 Bearing load rating calculation for engineering.....	11
8.3.1 General.....	11
8.3.2 Radial load rating.....	11
8.3.3 Axial load rating.....	11
Annex A (informative) Values of factors for spherical plain bearings with steel/steel contacting surfaces	12
Bibliography	13

SIS-ISO/TR 20051:2020 (E)

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 4, *Rolling bearings*, Subcommittee SC 8, *Load ratings and life*.

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

Different calculating methods for static and dynamic load ratings of spherical plain bearings have been used in different countries, thus making it difficult to compare different solutions. A unified method for the calculation of static and dynamic load ratings has been standardized in ISO 20015.

ISO 20015 leaves the load rating factors to the manufacturers to determine because they are dependent on design and material. Bearing manufacturers don't have unified methods to determine these factors themselves. This document gives the supplementary background information regarding the derivation of factors in ISO 20015.

Spherical plain bearings — Derivation of the load rating factors

1 Scope

This document gives supplementary background information regarding the derivation of factors given in ISO 20015.

2 Normative references

There are no normative references in this document.

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

A	contact area on bearing sliding surface, in square millimetres (mm ²)
B	inner ring width, in millimetres (mm)
C	outer ring width, in millimetres (mm)
\bar{C}	effective width of distribution of contact load, in millimetres (mm)
$\bar{C}(\theta)$	effective width of distribution of contact load function versus θ , in millimetres (mm)
C_a	dynamic axial load rating, in newtons (N)
C_r	dynamic radial load rating, in newtons (N)
C_{0a}	static axial load rating, in newtons (N)
C_{0r}	static radial load rating, in newtons (N)
D	outside diameter, in millimetres (mm)
D_{S1}	smallest diameter of sliding contact surface of the outer ring, in millimetres (mm)
D_{S2}	largest diameter of sliding contact surface of the outer ring, in millimetres (mm)
d	bore diameter, in millimetres (mm)
d_k	sphere diameter, in millimetres (mm)
F_a	axial load, in newtons (N)

SIS-ISO/TR 20051:2020 (E)

F_r	radial load, in newtons (N)
f_a	factor for the calculation of dynamic axial load ratings of the sliding contact area, which depends on design and material, in newtons per square millimetre (MPa)
$f_a(\tau)$	factor for the calculation of axial load ratings of the sliding contact area for angular contact radial spherical plain bearings and angular contact thrust spherical plain bearings, function versus τ , in newtons per square millimetre (MPa)
$f_{ar}(\theta_0, \tau)$	factor for the calculation of radial load ratings of the sliding contact area for angular contact radial spherical plain bearings, function versus θ_0 and τ , in newtons per square millimetre (MPa)
f_{0a}	factor for the calculation of static axial load ratings of the sliding contact area, which depends on design and material, in newtons per square millimetre (MPa)
f_r	factor for the calculation of dynamic radial load ratings of the sliding contact area, which depends on design and material, in newtons per square millimetre (MPa)
$f_r(\varepsilon)$	factor for the calculation of radial load ratings of the sliding contact area for radial spherical plain bearing, function versus ε , in newtons per square millimetre (MPa)
f_{0r}	factor for the calculation of static radial load ratings of the sliding contact area, which depends on design and material, in newtons per square millimetre (MPa)
$g_a(\beta)$	axial contact stress distribution dimensionless function versus β
$g_{ar}(\theta, \zeta)$	contact stress distribution dimensionless function versus θ and ζ for angular contact radial spherical plain bearing
$g_r(\theta)$	radial contact stress distribution dimensionless function versus θ
$I(\theta_0)$	surface integral of radial contact stress distribution dimensionless function versus θ_0
$J(\tau)$	surface integral of axial contact stress distribution dimensionless function versus τ
k	factor affecting the accuracy for manufacturing ($k \leq 1$)
$p(\theta)$	contact stress function versus θ , in newtons per square millimetre (MPa)
$p(\beta)$	contact stress function versus β , in newtons per square millimetre (MPa)
$p(\theta, \beta)$	contact stress function versus θ and β , in newtons per square millimetre (MPa)
$p(\theta, \varphi)$	contact stress function versus θ and φ , in newtons per square millimetre (MPa)
$p_a(\theta)$	axial contact stress function versus θ , in newtons per square millimetre (MPa)
$p_a(\beta)$	axial contact stress function versus β , in newtons per square millimetre (MPa)
$p_a(\theta, \beta)$	axial contact stress function versus θ and β , in newtons per square millimetre (MPa)
$p_r(\theta)$	radial contact stress function versus θ , in newtons per square millimetre (MPa)
$p_r(\beta)$	radial contact stress function versus β , in newtons per square millimetre (MPa)
$p_r(\theta, \beta)$	radial contact stress function versus θ and β , in newtons per square millimetre (MPa)
$p_r(\theta, \zeta)$	radial contact stress function versus θ and ζ , in newtons per square millimetre (MPa)
\bar{p}	allowable contact stress of bearing material, in newtons per square millimetre (MPa)

r	variable of integration of radius of contact area
S	width of contact area in spherical surface direction, in millimetres (mm)
s	variable of integration of width of contact area in spherical surface direction
T	bearing width, in millimetres (mm)
z	coordinate variable along z axis
α	variable angle in arising contact area, in radians (rad) (see Figure 3)
β	variable angle in arising contact area, in radians (rad) (see Figure 3)
ε	dimensionless parameter of radial internal clearance ratio versus sphere diameter
ζ	dimensionless variable ($\zeta = z/\bar{C}$)
$\zeta_0(\theta)$	boundary value of dimensionless variable ζ versus θ
θ	variable of integration of load distribution angle along the circumferential direction, in radians (rad)
θ_0	maximum angle of load distribution along the circumferential direction, in radians (rad)
μ	factor of effective contact width of outer ring of bearing
τ	bearing nominal contact angle, in radians (rad)
τ_{S1}	smallest contact angle to diameter of sliding contact surface, in radians (rad)
τ_{S2}	largest contact angle to diameter of sliding contact surface, in radians (rad)
φ	variable of integration of load distribution angle perpendicular to the circumferential direction, in radians (rad)
φ_{\max}	maximum angle of load distribution perpendicular to the circumferential direction, in radians (rad)

5 General

The calculation of the radial load rating and the axial load rating for radial spherical plain bearings, angular contact thrust spherical plain bearings and angular contact radial spherical plain bearings is explained in [Formulas \(1\) to \(42\)](#).

6 Radial spherical plain bearings

6.1 Bearing load distribution on the sliding contact area

When the bearing supports a radial load F_r , the radial load distribution on the bearing sliding contact area is shown in [Figures 1 and 2](#).