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**Spherical plain bearings — Method for
the calculation of static and dynamic
load ratings**

*Rotules lisses — Méthode de calcul des charges statiques et
dynamiques de base*

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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).

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: 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*.

Spherical plain bearings — Method for the calculation of static and dynamic load ratings

1 Scope

This document specifies methods of calculating the static load rating and the dynamic load rating for spherical plain bearings within the size ranges shown in ISO 12240-1, ISO 12240-2 and ISO 12240-3.

Rod ends according to ISO 12240-4 are excluded.

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 6811, *Spherical plain bearings — Vocabulary*

ISO 12240-1, *Spherical plain bearings — Part 1: Radial spherical plain bearings*

ISO 12240-2, *Spherical plain bearings — Part 2: Angular contact radial spherical plain bearings*

ISO 12240-3, *Spherical plain bearings — Part 3: Thrust spherical plain bearings*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12240-1, ISO 12240-2, ISO 12240-3 and ISO 6811 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 Static conditions

3.1.1

static load rating

<spherical plain bearings> maximum load that the spherical plain bearing can accommodate at room temperature without inadmissible deforming or damage of the sliding surfaces, when there is no relative movement between the sliding contact surfaces

3.1.2

static radial load rating

C_{0r}

static load rating (3.1.1) when a load is applied on the spherical plain bearing in pure radial direction

3.1.3

static axial load rating

C_{0a}

static load rating (3.1.1) when a load is applied on the spherical plain bearing in pure axial direction

3.2 Dynamic conditions

3.2.1

dynamic load rating

<spherical plain bearings> maximum load that the spherical plain bearing can accommodate at room temperature without inadmissible deforming or damage of the sliding surfaces, when there is relative movement between the sliding contact surfaces

3.2.2

dynamic radial load rating

C_r

dynamic load rating (3.2.1) when a load is applied on the spherical plain bearing in pure radial direction

3.2.3

dynamic axial load rating

C_a

dynamic load rating (3.2.1) when a load is applied on the spherical plain bearing in pure axial direction

4 Symbols and units

For the purposes of this document, the symbols given in ISO 12240-1, ISO 12240-2, ISO 12240-3 and the following apply (see [Figures 1, 3 and 5](#)).

B	inner ring width, in millimetre (mm)
C	outer ring width, in millimetre (mm)
C_a	dynamic axial load rating, in newton (N)
C_r	dynamic radial load rating, in newton (N)
C_{0a}	static axial load rating, in newton (N)
C_{0r}	static radial load rating, in newton (N)
D	outside diameter, in millimetre (mm)
d	bore diameter, in millimetre (mm)
d_k	sphere diameter, in millimetre (mm)
f_a	factor for the calculation of dynamic axial load ratings of the sliding contact area, which depends on design and material, in newton 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 newton 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 newton 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 newton per square millimetre (MPa)

For angular contact spherical plain bearings and thrust spherical plain bearings, the symbols given in ISO 12240-2, ISO 12240-3 and following symbols apply additionally (see [Figures 2 and 4](#)):

D_{S1} smallest diameter of sliding contact surface of the outer ring, in millimetre (mm)

D_{S2} largest diameter of sliding contact surface of the outer ring, in millimetre (mm)

5 Radial spherical plain bearings

5.1 Static radial load rating

For radial spherical plain bearings with dimensions and tolerances in accordance to ISO 12240-1 (see [Figure 1](#)), the static radial load rating is calculated by [Formula \(1\)](#):

$$C_{0r} = f_{0r} \cdot C \cdot d_k \quad (1)$$

The value of f_{0r} is not defined in this document, and should be requested from the manufacturer.

The information that is considered in f_{0r} is described in [Annex A](#). A calculation example of static load rating using f_{0r} is described in [Annex B](#).

5.2 Dynamic radial load rating

For radial spherical plain bearings with dimensions and tolerances in accordance to ISO 12240-1 (see [Figure 1](#)), the dynamic radial load rating is calculated by [Formula \(2\)](#):

$$C_r = f_r \cdot C \cdot d_k \quad (2)$$

The value of f_r is not defined in this document, and it should be requested from the manufacturer.

The information that is considered in f_r is described in [Annex A](#). A calculation example of dynamic load rating using f_r is described in [Annex B](#).

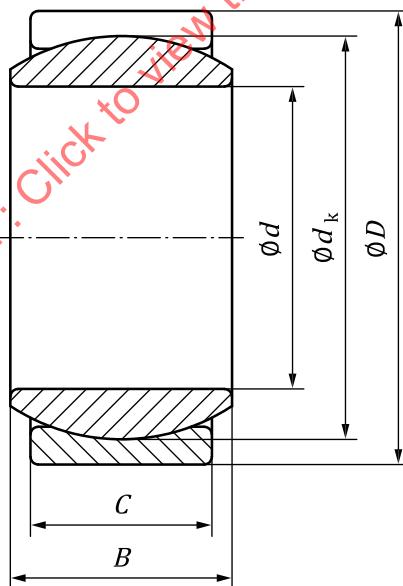


Figure 1 — Scheme of a radial spherical plain bearing

6 Angular contact radial spherical plain bearings

6.1 Static radial load rating

For angular contact radial spherical plain bearings with dimensions and tolerances in accordance to ISO 12240-2 (see [Figure 2](#) and [Figure 3](#)), the static radial load rating is calculated by [Formula \(3\)](#):

$$C_{0r} = f_{0r} \cdot C \cdot \frac{D_{s1} + D_{s2}}{2} \quad (3)$$

The value of f_{0r} is not defined in this document, and it should be requested from the manufacturer.

The information that is considered in f_{0r} is described in [Annex A](#).

6.2 Dynamic radial load rating

For angular contact radial spherical plain bearings with dimensions and tolerances in accordance to ISO 12240-2 (see [Figure 2](#) and [Figure 3](#)), the dynamic radial load rating is calculated by [Formula \(4\)](#):

$$C_r = f_r \cdot C \cdot \frac{D_{s1} + D_{s2}}{2} \quad (4)$$

The value of f_r is not defined in this document, and it should be requested from the manufacturer.

The information that is considered in f_r is described in [Annex A](#).

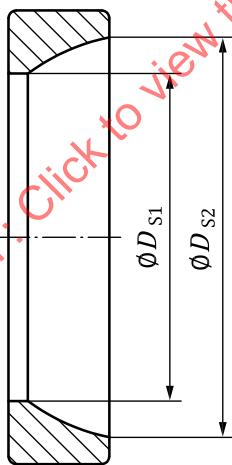


Figure 2 – Scheme of the outer ring of an angular contact spherical plain bearing

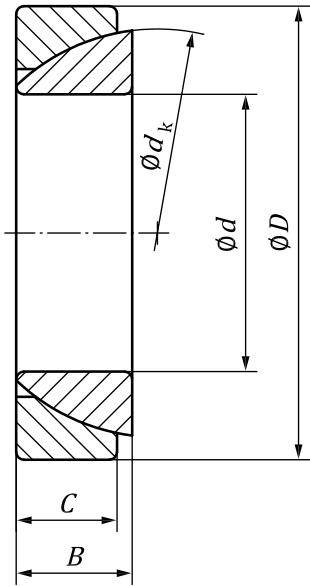


Figure 3 — Scheme of an angular contact spherical plain bearing

7 Thrust spherical plain bearings

7.1 Static axial load rating

For thrust spherical plain bearings with dimensions and tolerances in accordance to ISO 12240-3 (see [Figure 4](#) and [Figure 5](#)), the static axial load rating is calculated by [Formula \(5\)](#):

$$C_{0a} = f_{0a} \cdot (D_{s2}^2 - D_{s1}^2) \cdot \frac{\pi}{4} \quad (5)$$

The value of f_{0a} is not defined in this document, and it should be requested from the manufacturer.

The information that is considered in f_{0a} is described in [Annex A](#).

7.2 Dynamic axial load rating

For thrust spherical plain bearings with dimensions and tolerances in accordance to ISO 12240-3 (see [Figure 4](#) and [Figure 5](#)), the dynamic axial load rating is calculated by [Formula \(6\)](#):

$$C_a = f_a \cdot (D_{s2}^2 - D_{s1}^2) \cdot \frac{\pi}{4} \quad (6)$$

The value of f_a is not defined in this document, and it should be requested from the manufacturer.

The information that is considered in f_a is described in [Annex A](#).

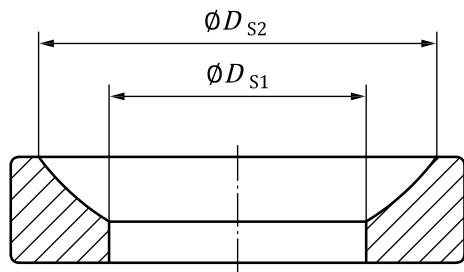


Figure 4 — Scheme of the housing washer of a thrust spherical plain bearing

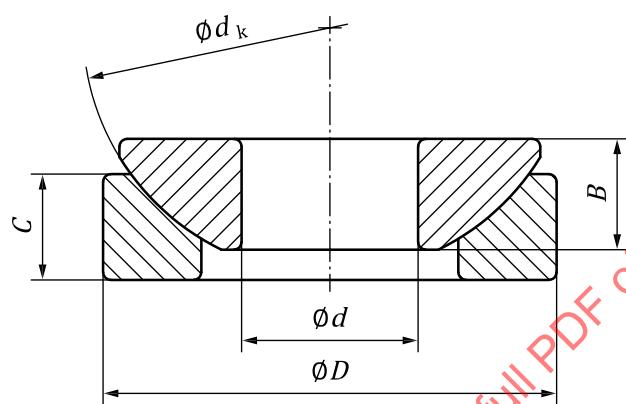


Figure 5 — Scheme of a thrust spherical plain bearing

Annex A (informative)

Explanations of factors for the calculation of load ratings

Features in this document that are not defined in ISO 12240-1, ISO 12240-2 and ISO 12240-3 should be requested from the manufacturer.

The meaning of the design and load factors f_a , f_r , f_{0a} and f_{0r} are given in [Clause 4](#). The values of these factors should be requested from the manufacturer.

The factors f_a , f_r , f_{0a} and f_{0r} are based on specific materials and design features, as follows.

- Material related:
 - sliding material (steel, PTFE fabric, composite, bronze, etc.);
 - contact surface treatment on inner ring and/or outer ring (e.g. coating);
 - heat treatment.
- Design related:
 - seal recess size;
 - lubrication grooves on inner ring and/or outer ring.