



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS B 1519 : 2023

(JBIA)

Rolling bearings — Static load ratings

ICS 21.100.20

Reference number : JIS B 1519 : 2023 (E)

PROTECTED BY COPYRIGHT

B 1519 : 2023

Date of Establishment: 1965-03-01

Date of Revision: 2023-01-20

Date of Public Notice in Official Gazette: 2023-01-20

Investigated by: Japanese Industrial Standards Committee
Standards Board for ISO area
Technical Committee on Machine Elements

JIS B 1519 : 2023, First English edition published in 2023-05

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2023

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED BY COPYRIGHT

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	2
3 Terms and definitions	2
4 Symbols	4
5 Radial ball bearings	5
5.1 Basic static radial load rating	5
5.2 Static equivalent radial load	8
6 Thrust ball bearings	9
6.1 Basic static axial load rating	9
6.2 Static equivalent axial load	9
7 Radial roller bearings	10
7.1 Basic static radial load rating	10
7.2 Static equivalent radial load	10
8 Thrust roller bearings	11
8.1 Basic static axial load rating	11
8.2 Static equivalent axial load	12
9 Static safety factor	12
9.1 General	12
9.2 Ball bearings	13
9.3 Roller bearings	14
Annex A (informative) Discontinuities in the calculation of basic static load ratings of angular contact ball bearings	15
Annex B (informative) Calculation of the Hertzian parameters for point contact	19
Annex C (informative) Graphical presentation of f_0 and Y_0	20
Annex JA (informative) Comparison table between JIS and corresponding International Standard	22

Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Bearing Industry Association (JBIA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS B 1519** : 2009), which has been technically revised.

This **JIS** document is protected by the Copyright Act.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, published patent application or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, published patent application or utility model rights.

Rolling bearings — Static load ratings

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 76** : 2006, Edition 3, and its Amendment 1 : 2017 with some modifications of the technical contents to reflect the local conditions in Japan. The amendment to the said International Standard has been incorporated into this Standard.

The dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the methods for calculating the basic static load rating and the static equivalent load for rolling bearings.

- This Standard is designed by the relevant standards specified in **JIS B 1511** and applied to bearings manufactured from high quality hardened bearing steel specified in **JIS G 4805** or **ISO 683-17** or alloy steel with equivalent quality.
- This Standard is not applicable in the case where there is a considerable truncation of the area of contact between the rolling elements and the ring raceways and where special surface treatment or coatings are used. The same limitation applies where application conditions cause deviations from a normal load distribution in the bearing, for example misalignment. Where there is reason to assume that such conditions prevail, the user should consult the bearing manufacturer for recommendations and the evaluation of the static equivalent load.
- Double-row radial bearings and double-direction thrust bearings are, when referred to in this Standard, presumed to be symmetrical.
- This Standard is not applicable to designs where the rolling elements operate directly on outer surface of the shaft or the inner surface of the housing, unless that surface is equivalent in all respects to the bearing surface it replaces
- Guidelines are given in Clause 9 for static safety factors to be applied in heavy loaded applications.

NOTE The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 76 : 2006 *Rolling bearings — Static load ratings* + Amendment 1 : 2017 (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

Part or all of the provisions of the following standards, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0104 *Rolling bearings — Vocabulary*

NOTE Normative reference in the corresponding International Standard : ISO 5593 : 1997 *Rolling bearings — Vocabulary*

JIS B 0124 *Rolling bearings — Symbols for quantities*

NOTE Normative reference in the corresponding International Standard : ISO 15241 *Rolling bearings — Symbols for physical quantities*

JIS B 1511 *Rolling bearings — General code*

JIS G 4805 *High carbon chromium bearing steels*

ISO 683-17 *Heat-treated steels, alloy steels and free-cutting steels — Part 17 : Ball and roller bearing steels*

ISO/TR 10657 *Explanatory notes on ISO 76*

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions, and those given in **JIS B 0104** apply.

3.1

static load

load acting on a bearing when the speed of rotation of its rings or washers in relation to each other is zero

3.2

basic static radial load rating

radial load which corresponds to a calculated contact stress at the centre of the most heavily loaded rolling element/raceway contact of

- 4.6 GPa for self-aligning ball bearings,
- 4.2 GPa for all other radial ball bearings types, and
- 4.0 GPa for all radial roller bearings

Note 1 to entry In the case of a single-row angular contact bearing and a single-row tapered roller bearing, the radial load rating refers to the radial component of that load which causes a purely radial displacement of the bearing rings in relation to each other.

Note 2 to entry For these contact stresses, under static load, a total permanent deformation of rolling element and raceway occurs which is approximately 0.000 1 of the rolling element diameter.

3.3

basic static axial load rating

static centric axial load which corresponds to a calculated contact stress at the centre of the most heavily loaded rolling element/raceway contact of

- 4.2 GPa for thrust ball bearings, and
- 4.0 GPa for all thrust roller bearings

Note 1 to entry For these contact stresses, under static load, a total permanent deformation of rolling element and raceway occurs which is approximately 0.000 1 of the rolling element diameter.

3.4

static equivalent radial load

static radial load which would cause the same contact stress at the centre of the most heavily loaded rolling element/raceway contact as that which occurs under the actual load conditions

3.5

static equivalent axial load

static centric axial load which would cause the same contact stress at the centre of the most heavily loaded rolling element/raceway contact as that which occurs under the actual load conditions

3.6

static safety factor

ratio between the basic static load rating and the static equivalent load, giving a margin of safety against inadmissible permanent deformation on rolling elements and raceways

3.7

roller diameter

theoretical diameter used for the calculation of load ratings

Note 1 to entry For a symmetrical roller, the diameter exists in a radial plane through the middle of the roller length.

Note 2 to entry For a tapered roller, the applicable diameter is equal to the mean value of the diameters at the imaginary sharp corners at the large end and at the small end of the roller.

Note 3 to entry For an asymmetrical convex roller, the applicable diameter is an approximation of the diameter at the point of contact between the roller and the ribless raceway at zero load.

3.8

effective roller length

theoretical maximum length of contact between a roller and that raceway where the contact is shortest, used for calculation of load ratings

Note 1 to entry This is normally taken to be either the distance between the theoretically sharp corners of the roller minus the roller chamfers, or the raceway width excluding the grinding undercuts, whichever is the smaller.

3.9

nominal contact angle

angle between a plane perpendicular to a bearing axis (a radial plane) and the nominal line of action of the resultant of the forces transmitted by a bearing ring or washer to a rolling element

Note 1 to entry For bearings with asymmetrical rollers, the nominal contact angle is determined by the contact with the ribless raceway (normally of the outer ring).

3.10

pitch diameter of ball set

diameter of the circle containing the centres of the balls in one row in a bearing

3.11

pitch diameter of roller set

diameter of the circle intersecting the roller axes at the middle of the rollers in one row in a bearing

4 Symbols

For the purpose of this Standard, the following symbols and definitions, and those given in **JIS B 0124** apply.

C_{0a}	: basic static axial load rating (N)
C_{0r}	: basic static radial load rating (N)
D_{pw}	: pitch diameter of ball or roller set (mm)
D_w	: nominal ball diameter (mm)
D_{we}	: roller diameter applicable in the calculation of load ratings (mm)
$E(\kappa)$	: complete elliptic integral of the second kind
F_a	: bearing axial load (axial component of actual bearing load) (N)
F_r	: bearing radial load (radial component of actual bearing load) (N)
$F(\rho)$	: auxiliary parameter of a contact point
f_0	: factor for calculation of basic static load rating
i	: number of rows of rolling elements

$K(\kappa)$	: complete elliptic integral of the first kind
L_{we}	: effective roller length applicable in the calculation of load ratings (mm)
P_{0a}	: static equivalent axial load (N)
P_{0r}	: static equivalent radial load (N)
r_e	: cross-sectional raceway groove radius of outer ring (mm)
r_i	: cross-sectional raceway groove radius of inner ring (mm)
S_0	: static safety factor
X_0	: static radial load factor
Y_0	: static axial load factor
Z	: number of rolling elements in a single-row bearing; number of rolling elements per row of a multi-row bearing with the same number of rolling elements per row
α	: nominal contact angle (°)
γ	: auxiliary parameter, $\gamma = D_w \cos \alpha / D_{pw}$
κ	: ratio of semi major to semi minor axis of the contact ellipse (= major axis radius/minor axis radius) (Hertzian parameter)
$\Sigma \rho_e$	: curvature sum at the outer ring contact (mm ⁻¹)
$\Sigma \rho_i$	: curvature sum at the inner ring contact (mm ⁻¹)

5 Radial ball bearings

5.1 Basic static radial load rating

5.1.1 Basic static radial load rating for single bearings

The basic static radial load rating (C_{0r}) for radial ball bearings is given by Formula (1) :

$$C_{0r} = f_0 i Z D_w^2 \cos \alpha \dots\dots\dots (1)$$

where the values of f_0 are as given in Table 1.

Table 1 applies to bearings with a cross-sectional raceway groove radius not larger than $0.52D_w$ in deep groove and angular contact ball bearing inner rings, and $0.53D_w$ in deep groove and angular contact ball bearing outer rings and self-aligning ball bearing inner rings.

The load-carrying ability of a bearing is not necessarily increased by the use of a smaller groove radius, but is reduced by the use of a groove radius larger than those indicated in the previous paragraph. In the latter case, a correspondingly reduced value of f_0 shall be used. Calculation of this reduced value of f_0 may be carried out by means of the following formula :

For deep groove and angular contact ball bearings

$$f_0 = \min(f_{0,i}, f_{0,e})$$

where,

$$f_{0,i} = 2.399\,05 \times \kappa_i \times \left[\frac{E(\kappa_i)}{2 + \frac{\gamma}{1-\gamma} - \frac{D_w}{2 \times r_i}} \right]^2 \dots\dots\dots (2)$$

$$f_{0,e} = 2.399\,05 \times \kappa_e \times \left[\frac{E(\kappa_e)}{2 - \frac{\gamma}{1+\gamma} - \frac{D_w}{2 \times r_e}} \right]^2 \dots\dots\dots (3)$$

where, i : the inner ring, e : the outer ring.

The calculation of the Hertzian parameters, κ and $E(\kappa)$, is described in Annex B.

For self-aligning ball bearings

$$f_0 = 3.151\,84 \times \left[\frac{\pi}{4} \times (1 + \gamma) \right]^2 \dots\dots\dots (4)$$

NOTE There is a discontinuity in the calculated basic static axial load rating when an angular contact ball bearing with the nominal contact angle $\alpha = 45^\circ$ is first regarded as a radial bearing and then as a thrust bearing. Annex A contains a detailed description of this phenomenon.

Figure C.1 gives a graphical representation of the value f_0 in the function of γ .

5.1.2 Basic static radial load rating for bearing combinations

5.1.2.1 Two single-row radial contact ball bearings operation as a unit

The basic static radial load rating for two similar single-row radial contact ball bearings mounted side by side on the same shaft, such that they operate as a unit (paired mounting), is twice the basic static radial load rating of one single-row bearing.

5.1.2.2 Back-to-back and face-to-face arrangements of single-row angular contact ball bearings

The basic static radial load rating for two similar single-row angular contact ball bearings mounted side by side on the same shaft, such that they operate as a unit (paired mounting) in a back-to-back or face-to-face arrangement, is twice the basic static radial load rating of one single-row bearing.

5.1.2.3 Tandem arrangement

The basic static radial load rating for two or more similar single-row radial contact ball bearings or two or more similar single-row angular contact ball bearings mounted side by side on the same shaft, such that they operate as a unit (paired or stack mounting) in a tandem arrangement, is the number of bearings multiplied by the basic static radial load rating of one single-row bearing. The bearings need to be properly manufactured and mounted for equal distribution of the load between them.