# SLOVENSKI STANDARD
# SIST ISO 15312:2020

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**Kotalni ležaji - Ocenitev hitrosti segrevanja - Preračun**

Rolling bearings - Thermal speed rating - Calculation

Roulements - Vitesse de référence thermique - Calculs



**Ta slovenski standard je istoveten z:** **ISO 15312:2018**

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**ICS:**

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2018-02

# Rolling bearings — Thermal speed rating — Calculation

*Roulements — Vitesse de référence thermique — Calculs*



Reference number
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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 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*.



This second edition cancels and replaces the first edition (ISO 15312:2003), of which it constitutes a minor revision with the following changes:

a) the term “coefficients” has been deleted from the title;

b) the normative references have been updated and modified;

c) Formula (11) has been corrected;

d) Clause 7 has been moved to a new informative Annex B;

e) content from Annex B has been moved to a new informative Annex C.

 

# Rolling bearings — Thermal speed rating — Calculation

## 1 Scope

This document defines the thermal speed rating for oil bath lubricated rolling bearings and defines calculation principles for the determination of this parameter. The parameter determined in accordance with this document applies to rolling bearings of the given series and sizes of standard design or of a design that, from a frictional point of view, can be related to a standard design bearing.

In most cases of standard assembly, the permissible temperature determines the maximum operating speed. Heating of the assembly is then generated by the bearing.

Thrust ball bearings are excluded from this document as kinematic effects do not allow the thermal speed rating defined in this document to be applied.

NOTE 1 In Annex A mean values for the coefficients $f_{0r}$ and $f_{1r}$ are given — $f_{0r}$ for calculating viscous losses of oil bath lubricated bearings and $f_{1r}$ for calculating frictional losses of bearings.

NOTE 2 Explanatory notes on the limiting criterion are given in Annex B.

NOTE 3 In Annex C the reference conditions for grease lubrication are defined. The reference conditions are chosen such that the thermal speed rating for grease lubrication is identical to that for oil bath lubrication.



## 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 76, *Rolling bearings — Static load ratings*

ISO 1132-1, *Rolling bearings — Tolerances — Part 1: Terms and definitions*

ISO 5593, *Rolling bearings — Vocabulary*

ISO 5753-1, *Rolling bearings — Internal clearance — Part 1: Radial internal clearance for radial bearings*

ISO 15241, *Rolling bearings — Symbols for physical quantities*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1132-1 and ISO 5593, and the following, apply.

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/

**3.1**
**thermal speed rating**
inner ring or shaft washer rotational speed at which equilibrium is reached between the heat generated by the friction in the bearing and the heat flow emitted through the bearing seating (shaft and housing) under the reference conditions

Note 1 to entry: The thermal speed rating is one among various criteria which permit comparison of the different rolling bearing types and sizes with regard to their suitability for operation at high speed.

Note 2 to entry: Mechanical and kinematic criteria which could lead to further speed limitations are not taken into account by the thermal speed rating.

**3.2**
**reference conditions**
conditions for the thermal speed rating related to

a) the mean temperature of the stationary outer ring or housing washer of the bearing, i.e. the reference temperature, and the mean environmental temperature, i.e. the reference ambient temperature;

b) the factors determining the friction losses in the bearing, such as:

   — the magnitude and direction of the bearing load;

   — the method of lubrication, type of lubricant, its kinematic viscosity and quantity;

   — other general reference conditions;



c) the heat flow emitted from the rolling bearing defined as the product of the "heat emitting reference surface area of the rolling bearing" and the "reference heat flow density specific to the rolling bearing".



Note 1 to entry: The heat emission under the reference conditions is based on empirical values and represents the heat emission of the real bearing arrangement. It is, however, independent of the real design of the bearing arrangement.

**3.3**
**heat emitting reference surface area**
sum of the contact areas, between inner ring (shaft washer) and shaft and between outer ring (housing washer) and housing, through which the heat flow is emitted

**3.4**
**reference load**
bearing load, determined by the reference conditions, which causes the load-dependent frictional moment

**3.5**
**reference heat flow**
heat flow, emitted by thermal conduction through the heat emitting reference surface, and caused by frictional resistance, when the bearing is operating under the reference conditions

**3.6**
**reference heat flow density**
reference heat flow divided by the heat emitting reference surface area

**3.7**
**reference ambient temperature**
mean environmental temperature of the bearing arrangement under the reference conditions

**3.8**
**reference temperature**
mean temperature of the stationary outer ring or housing washer of the bearing under the reference conditions

## 4 Symbols and units

For the purposes of this document, the symbols given in ISO 15241 and the following apply.

**Table 1 — Symbols and units**

| Symbol | Term | Unit |
|---|---|---|
| $A_r$ | Heat emitting reference surface area | $mm^2$ |
| $B$ | Width of rolling bearing | mm |
| $C_{0a}$ | Basic static axial load rating in accordance with ISO 76 | N |
| $C_{0r}$ | Basic static radial load rating in accordance with ISO 76 | N |
| $D$ | Bearing outside diameter | mm |
| $D_1$ | Inside diameter of the outer ring of thrust spherical roller bearing | mm |
| $d$ | Bearing bore diameter | mm |
| $d_m$ | Mean diameter of rolling bearing $d_m = 0{,}5 \times (D + d)$ | mm |
| $d_1$ | Outside diameter of the inner ring of thrust spherical roller bearing | mm |
| $f_{0r}$ | Coefficient for the load-independent frictional moment for the reference conditions | 1 |
| $f_{1r}$ | Coefficient for the load-dependent frictional moment for the reference conditions | 1 |
| $M_0$ | Load-independent frictional moment | N·mm |
| $M_{0r}$ | Load-independent frictional moment under the reference conditions at the thermal speed rating, $n_{\theta r}$ | N·mm |
| $M_1$ | Load-dependent frictional moment | N·mm |
| $M_{1r}$ | Load-dependent frictional moment under the reference conditions at the thermal speed rating, $n_{\theta r}$ | N·mm |
| $N_r$ | Bearing power loss under the reference conditions at the thermal speed rating, $n_{\theta r}$ | W |
| $n_{\theta r}$ | Thermal speed rating | $min^{-1}$ |
| $P_{1r}$ | Reference load | N |
| $q_r$ | Reference heat flow density | $W/mm^2$ |
| $T$ | Total width of tapered roller bearing | mm |
| $\nu_r$ | Kinematic viscosity of the lubricant under the reference conditions (at the reference temperature, $\theta_r$, of the rolling bearing) | $mm^2/s$ |
| $\alpha$ | Contact angle | ° |
| $\theta_{Ar}$ | Reference ambient temperature | °C |
| $\theta_r$ | Reference temperature | °C |
| $\Phi_r$ | Reference heat flow | W |



## 5 Reference conditions

### 5.1 General

The reference conditions in this document are mainly based on the operating conditions of the most frequently used bearing types and sizes.

### 5.2 Reference conditions determining the frictional heat generation

#### 5.2.1 Reference temperatures

Reference temperature of the bearing on the stationary outer ring or housing washer: $\theta_r = 70$ °C.

Reference temperature of the bearing environment: $\theta_{Ar} = 20$ °C.