SLOVENSKI STANDARD
SIST-TS ISO/TS 16281:2008

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Kotalni leģaji - Metode za izraļ un modificirane dobe trajanja

Rolling bearings - Methods for calculating the modified reference rating life for universally loaded bearings

Wälzlager - Dynamische Tragzahlen und nominelle Lebensdauer - Berechnung der modifizierten nominellen Referenz-Lebensdauer für Wälzlager

Roulements - Méthodes de calcul de la durée nominale de référence corrigée pour les roulements chargés universellement

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Rolling bearings — Methods for calculating the modified reference rating life for universally loaded bearings

Roulements — Méthodes de calcul de la durée nominale de référence corrigée pour les roulements chargés universellement

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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.

ISO/TS 16281 was prepared by Technical Committee ISO/TC 4, *Rolling bearings*, Subcommittee SC 8, *Load ratings and life*.

Introduction

Since publication of ISO 281 in 1990, additional knowledge has been gained regarding the influence on bearing life of contamination, lubrication, internal stresses from mounting, stresses from hardening, fatigue load limit of the material etc. It is therefore now possible to consider factors that have influence on bearing life in a more complete way in the life calculation.

ISO 281:2007 provides a method to put into practice this new knowledge in a consistent way when the modified rating life of a bearing is calculated. However, the calculation method given in ISO 281:2007 cannot consider the influence on life of tilted or misaligned bearings and the influence on life of bearing clearance during operation. This Technical Specification describes an advanced calculation method, which also makes it possible to consider these influences, and by that in addition provide the most accurate support for estimating the influence of contamination and other factors.

Rolling bearings — Methods for calculating the modified reference rating life for universally loaded bearings

1 Scope

This Technical Specification contains recommendations for the calculation of the modified reference rating life taking into consideration lubrication, contamination and fatigue load limit of the bearing material, as well as tilting or misalignment, operating clearance of the bearing and internal load distribution on rolling elements. The calculation method provided in this Technical Specification covers influencing parameters additional to those described in ISO 281.

The directions and limitations given in ISO 281 apply to this Technical Specification. The calculation methods pertain to the fatigue life of the bearings. Other mechanisms of failure, like wear or microspalling (gray staining), lie outside the scope of this Technical Specification.

This Technical Specification applies to tilted single-row radial ball bearings, subjected to radial and axial load and with radial clearance and tilt taken into account. It also applies to tilted single-row roller bearings, subjected to pure radial load and with radial clearance, edge stress and tilt taken into account. References to methods for the analysis of the internal load distribution under general load are given.

The analysis of internal load distribution and modified reference rating life for multi-row bearings or bearings of a more complex geometry can be derived from the equations given in this Technical Specification. For these bearings, the load distribution for each individual row has to be considered.

This Technical Specification is primarily intended to be used for computer programs and together with ISO 281 covers the information needed for life calculations. For accurate life calculations under the operating conditions specified above, it is recommended that either this Technical Specification or advanced computer calculations provided by bearing manufacturers, for determining the dynamic equivalent reference load under different loading conditions, be used.

2 Normative references

The following referenced documents are indispensable for the application 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 281:2007, *Rolling bearings — Dynamic load ratings and rating life*

ISO 15241, *Rolling bearings — Symbols for quantities*

3 Symbols

For the purpose of this document, the symbols given in ISO 15241 and the following apply. See also the terms and definitions in ISO 281:2007, Clause 3 and other definitions in ISO 281.

A distance, in millimetres, between raceway groove curvature centres of ball bearing having no clearance and having an initial contact angle

a_{ISO} life modification factor, based on a systems approach of life calculation

a_1 life modification factor for reliability

C_a basic dynamic axial load rating, in newtons

C_r basic dynamic radial load rating, in newtons

C_u fatigue load limit, in newtons

c_L spring constant, in newtons per millimetre to the power of 10/9, of a rolling element with line contact

c_P spring constant, in newtons per millimetre to the power of 3/2, of a rolling element with point contact

c_s spring constant, in newtons per millimetre to the power of 8/9, of a roller lamina

D_{pw} pitch diameter, in millimetres, of ball or roller set

D_w nominal ball diameter, in millimetres

D_{we} roller diameter, in millimetres, applicable in the calculation of load ratings

E modulus of elasticity, in megapascals [1)]

$E(\chi)$ complete elliptic integral of the second kind

e subscript for outer ring or housing washer

e_C contamination factor

$F(\rho)$ relative curvature difference

F_a bearing axial load (axial component of actual bearing load), in newtons

F_r bearing radial load (radial component of actual bearing load), in newtons

$f[j,k]$ stress correction function for consideration of edge load

i subscript for inner ring or shaft washer

i number of rows of rolling elements

$K(\chi)$ complete elliptic integral of the first kind

L_{nmr} modified reference rating life, in million revolutions

L_{we} effective roller length, in millimetres, applicable in the calculation of load ratings

L_{10r} basic reference rating life, in million revolutions

M_z moment, in newton millimetres, acting on tilted bearing

1) 1 MPa = 1 N/mm^2

n_s number of laminae

$P_{ref,a}$ dynamic equivalent reference axial load, in newtons

$P_{ref,r}$ dynamic equivalent reference radial load, in newtons

$P(x)$ profile function, in millimetres

p_{He} contact stress, in megapascals, at the contact of outer ring and rolling element

p_{Hi} contact stress, in megapascals, at the contact of inner ring and rolling element

P_{ks} dynamic equivalent load, in newtons, of a bearing lamina k

Q rolling element load, in newtons

Q_{ce} rolling element load, in newtons, for the basic dynamic load rating of outer ring or housing washer

Q_{ci} rolling element load, in newtons, for the basic dynamic load rating of inner ring or shaft washer

Q_{ee} dynamic equivalent rolling element load, in newtons, on outer ring or housing washer

Q_{ei} dynamic equivalent rolling element load, in newtons, on inner ring or shaft washer

Q_j rolling element load, in newtons, of rolling element j

q_{ce} basic dynamic load rating, in newtons, of a bearing lamina at the outer ring or housing washer contact

q_{ci} basic dynamic load rating, in newtons, of a bearing lamina at the inner ring or shaft washer contact

q_{ee} dynamic equivalent load, in newtons, of a bearing lamina at the outer ring or housing washer contact

q_{ei} dynamic equivalent load, in newtons, of a bearing lamina at the inner ring or shaft washer contact

$q_{j,k}$ load, in newtons, on the lamina k of roller j

R_i distance, in millimetres, between the centre of curvature of the inner race groove and the axis of rotation

R_p crown radius, in millimetres, of spherical rollers

r_e cross-sectional raceway groove radius, in millimetres, of outer ring or housing washer

r_i cross-sectional raceway groove radius, in millimetres, of inner ring or shaft washer

s radial operating clearance, in millimetres, of bearing

x_k distance, in millimetres, between centre of lamina k and roller centre

Z number of rolling elements

α nominal contact angle, in degrees, of a bearing

α_j operating contact angle, in degrees, of the rolling element j

α_0 initial contact angle, in degrees

γ auxiliary parameter, $\gamma = D_w \cos\alpha / D_{pw}$

δ total elastic deflection, in millimetres, of both contacts of a rolling element

δ_j elastic deflection, in millimetres, of the rolling element j

$\delta_{j,k}$ elastic deflection, in millimetres, of the lamina k of the roller j