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**Rolling bearings — Explanatory notes on  
ISO 281 —**

Part 2:

**Modified rating life calculation, based on  
a systems approach to fatigue stresses**

*Roulements — Notes explicatives sur l'ISO 281 —*

*Partie 2: Calcul modifié de la durée nominale de base fondé sur une  
approche système du travail de fatigue*



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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 exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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/TR 1281-2 was prepared by Technical Committee ISO/TC 4, *Rolling bearings*, Subcommittee SC 8, *Load ratings and life*.

This first edition of ISO/TR 1281-2, together with the first edition of ISO/TR 1281-1, cancels and replaces the first edition of ISO/TR 8646:1985, which has been technically revised.

ISO/TR 1281 consists of the following parts, under the general title *Rolling bearings — Explanatory notes on ISO 281*:

- *Part 1: Basic dynamic load rating and basic rating life*
- *Part 2: Modified rating life calculation, based on a systems approach of fatigue stresses*

## Introduction

Since the publication of ISO 281:1990 [25], more knowledge has been gained regarding the influence on bearing life of contamination, lubrication, fatigue load limit of the material, internal stresses from mounting, stresses from hardening, etc. It is therefore now possible to take into consideration factors influencing the fatigue load in a more complete way.

Practical implementation of this was first presented in ISO 281:1990/Amd.2:2000, which specified how new additional knowledge could be put into practice in a consistent way in the life equation. The disadvantage was, however, that the influence of contamination and lubrication was presented only in a general fashion. ISO 281:2007 incorporates this amendment, and specifies a practical method of considering the influence on bearing life of lubrication condition, contaminated lubricant and fatigue load of bearing material.

In this part of ISO/TR 1281, background information used in the preparation of ISO 281:2007 is assembled for the information of its users, and to ensure its availability when ISO 281 is revised.

For many years the use of basic rating life,  $L_{10}$ , as a criterion of bearing performance has proved satisfactory. This life is associated with 90 % reliability, with commonly used high quality material, good manufacturing quality, and with conventional operating conditions.

However, for many applications, it has become desirable to calculate the life for a different level of reliability and/or for a more accurate life calculation under specified lubrication and contamination conditions. With modern high quality bearing steel, it has been found that, under favourable operating conditions and below a certain Hertzian rolling element contact stress, very long bearing lives, compared with the  $L_{10}$  life, can be obtained if the fatigue limit of the bearing steel is not exceeded. On the other hand, bearing lives shorter than the  $L_{10}$  life can be obtained under unfavourable operating conditions.

A systems approach to fatigue life calculation has been used in ISO 281:2007. With such a method, the influence on the life of the system due to variation and interaction of interdependent factors is considered by referring all influences to the additional stress they give rise to in the rolling element contacts and under the contact regions.

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## Rolling bearings — Explanatory notes on ISO 281 —

Part 2:

### Modified rating life calculation, based on a systems approach to fatigue stresses

#### 1 Scope

ISO 281:2007 introduced a life modification factor,  $a_{\text{ISO}}$ , based on a systems approach to life calculation, in addition to the life modification factor for reliability,  $a_1$ . These factors are applied in the modified rating life equation

$$L_{\text{rm}} = a_1 a_{\text{ISO}} L_{10} \quad (1)$$

For a range of reliability values,  $a_1$  is given in ISO 281:2007 as well as the method for evaluating the modification factor for systems approach,  $a_{\text{ISO}}$ .  $L_{10}$  is the basic rating life.

This part of ISO/TR 1281 gives supplementary background information regarding the derivation of  $a_1$  and  $a_{\text{ISO}}$ .

NOTE The derivation of  $a_{\text{ISO}}$  is primarily based on theory presented in Reference [5], which also deals with the fairly complicated theoretical background of the contamination factor,  $e_C$ , and other factors considered when calculating  $a_{\text{ISO}}$ .

#### 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 11171, *Hydraulic fluid power — Calibration of automatic particle counters for liquids*

#### 3 Symbols

Certain other symbols are defined on an *ad hoc* basis in the clause or subclause in which they are used.

$A$	scaling constant in the derivation of the life equation
$a_{\text{ISO}}$	life modification factor, based on a systems approach to life calculation
$a_{\text{SLF}}$	stress-life factor in Reference [5], based on a systems approach to life calculation (same as the life modification factor $a_{\text{ISO}}$ in ISO 281)
$a_1$	life modification factor for reliability
$C$	basic dynamic load rating, in newtons
$C_u$	fatigue load limit, in newtons