

---

---

**Ball screws —**

Part 5:

**Static and dynamic axial load ratings  
and operational life**

*Vis à billes —*

*Partie 5: Charges axiales statiques et dynamiques de base et durée  
de vie*



**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

This document is a preview generated by EVS

© ISO 2006

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 either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

|   |          |
|---|----------|
| Foreword.....   | iv       |
| <b>1 Scope .....</b>  | <b>1</b> |
| <b>2 Normative references .....</b>   | <b>1</b> |
| <b>3 Terms and definitions.....</b>   | <b>1</b> |
| <b>4 Symbols and subscripts .....</b>   | <b>2</b> |
| 4.1 Symbols .....   | 2        |
| 4.2 Subscripts .....  | 3        |
| <b>5 Basic axial load ratings .....</b>   | <b>4</b> |
| 5.1 Basic static axial load rating, $C_{0a}$ .....  | 4        |
| 5.2 Basic dynamic axial load rating, $C_a$ .....  | 4        |
| <b>6 Modified axial load ratings.....</b>   | <b>5</b> |
| 6.1 Modified static axial load rating, $C_{0am}$ .....  | 5        |
| 6.1.1 General equation.....   | 5        |
| 6.1.2 Correction for surface hardness, $f_{h0}$ .....   | 5        |
| 6.1.3 Correction for accuracy, $f_{ac}$ .....   | 6        |
| 6.2 Modified dynamic axial load rating, $C_{am}$ .....  | 6        |
| 6.2.1 General equation.....   | 6        |
| 6.2.2 Correction for surface hardness, $f_h$ .....  | 6        |
| 6.2.3 Correction for accuracy, $f_{ac}$ .....   | 6        |
| 6.2.4 Influence of material melting process, $f_m$ .....  | 6        |
| <b>7 Life.....</b>  | <b>7</b> |
| 7.1 Equivalent rotational speed and equivalent axial load .....                                     | 7        |
| 7.1.1 General.....  | 7        |
| 7.1.2 Ball screw with backlash between ball nut and screw shaft.....                                | 7        |
| 7.1.3 Ball screw with preloaded ball nuts on screw shaft .....                                      | 10       |
| 7.2 Nominal life, $L$ or $L_h$ .....  | 12       |
| 7.2.1 Ball screw with backlash between ball nut and screw shaft.....                                | 12       |
| 7.2.2 Ball screw with preloaded ball nuts on screw shaft .....                                      | 13       |
| 7.2.3 Resulting life, $L_r$ .....   | 13       |
| 7.2.4 Nominal life, $L_{ar}$ or $L_{har}$ , with reliability factor, $f_{ar}$ (see Table 3).....    | 13       |
| 7.3 Modified life, $L_m$ or $L_{hm}$ .....  | 14       |
| 7.3.1 Ball screw with backlash between ball nut and screw shaft.....                                | 14       |
| 7.3.2 Ball screw with preloaded ball nuts on screw shaft .....                                      | 14       |
| 7.3.3 Modified resulting life, $L_{mr}$ .....   | 14       |
| 7.3.4 Modified life, $L_{mar}$ or $L_{hmar}$ , with reliability factor, $f_{ar}$ (see Table 3)..... | 14       |

## 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.

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 3408-5 was prepared by Technical Committee ISO/TC 39, *Machine tools*.

ISO 3408 consists of the following parts, under the general title *Ball screws*:

- *Part 1: Vocabulary and designation*
- *Part 2: Nominal diameters and nominal leads — Metric series*
- *Part 3: Acceptance conditions and acceptance tests*
- *Part 4: Static axial rigidity*
- *Part 5: Static and dynamic axial load ratings and operational life*

## Ball screws —

### Part 5:

## Static and dynamic axial load ratings and operational life

### 1 Scope

This part of ISO 3408 specifies the calculation schemes for static and dynamic load ratings, and operational life, in order to obtain comparable values for the design and use of ball screws.

NOTE The calculations have been based primarily on publications by Prof. G. Lundberg and A. Palmgren *Acta Polytechnica, mech. Eng.* series Vol. I, No. 3, Stockholm, Sweden. Part 7, 1947.

This part of ISO 3408 is applicable under the following preconditions:

- elastic deformation of ball and balltrack;
- hardness of balltrack basically exceeds a minimum of HRC 58;
- conformity  $f_{rs}$  and  $f_{rn} > 0,5$ ;
- the quality of steel of which the ball screw is made is equivalent to that of ball bearing steel or similar steel alloys;
- optimum lubrication is always provided.

### 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)

ISO 3408-1, *Ball screws — Part 1: Vocabulary and designation*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3408-1 apply.