

---

---

**Machine tools — Ball splines —**

**Part 2:  
Dynamic and static load ratings  
and rating life**

*Machines-outils — Guidages cannelés à billes —*

*Partie 2: Charges dynamiques et statiques de base et durée de vie  
de base*

**iTeh STANDARD PREVIEW  
(standards.iteh.ai)**

ISO 23848-2:2009

<https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009>



**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.

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO 23848-2:2009](https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009)

<https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2009

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
Introduction.....	v
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	1
4 Symbols.....	3
5 Type A1 and type A11 (angular type) .....	4
5.1 Basic dynamic load rating .....	4
5.2 Basic static load rating .....	5
5.3 Basic dynamic torque rating .....	5
5.4 Basic static torque rating .....	5
6 Type R (radial type) .....	5
6.1 Basic dynamic load rating .....	6
6.2 Basic static load rating .....	6
7 Rating life .....	7
Bibliography.....	8

<https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009>  
 iTeh STANDARD PREVIEW  
 (standards.iteh.ai)

## 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 23848-2 was prepared by Technical Committee ISO/TC 39, *Machine tools*.

ISO 23848 consists of the following parts, under the general title *Machine tools – Ball splines*:

- *Part 1: General characteristics and requirements*
- *Part 2: Dynamic and static load ratings and rating life*

<https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009>

## Introduction

The ball spline is a power transmission component based on recirculating balls, which is designed to translate axially while transmitting torque by an anti-friction means. The ball spline is selected for its smooth operation, high-speed capability, low friction and high radial and high torsional load capacity. This part of ISO 23848 specifies and standardizes the basic dynamic load rating and torque rating, the basic static load rating and torque rating and the 90 % rating life for ball splines of type AI, type AII and type R.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 23848-2:2009](https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009)

<https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009>

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO 23848-2:2009

<https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009>

# Machine tools — Ball splines —

## Part 2: Dynamic and static load ratings and rating life

### 1 Scope

This part of ISO 23848 specifies the calculation method of basic dynamic load rating, basic static load rating and basic rating life prediction for the design and use of ball splines of type AI, type AII and type R. It also establishes the basic static and dynamic torque ratings for these ball splines.

### 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 23848-1, *Machine tools — Ball splines — Part 1: Characteristics, shapes, and dimensions*

<https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009>

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23848-1 and the following apply.

#### 3.1

##### basic dynamic load rating

$C$

constant stationary radial load, having direction and magnitude which do not vary with time and which a ball spline assembly theoretically endures for a basic rating life of 50 km

#### 3.2

##### basic dynamic torque rating

$C_T$

constant torque, having direction and magnitude which do not vary with time and which a ball spline assembly theoretically endures for a basic rating life of 50 km

#### 3.3

##### basic rating life

$L_{10}$

fatigue life that of a group of ball splines have a 90 % probability of enduring

#### 3.4

##### basic static load rating

$C_0$

static radial load which corresponds to a calculated Hertzian contact stress at the centre of the contacting surfaces of the maximum ball load position

See Table 1.

**Table 1 — Maximum contact stress,  $\sigma_{max}$ , corresponds to basic static load rating**

$r_g/D_w$	$\leq 0,52$	0,53	0,54	0,55	0,56	0,57	0,58	0,59	$\geq 0,6$
$\sigma_{max}$ MPa	4 200	4 250	4 300	4 350	4 400	4 450	4 500	4 550	4 600

**3.5 basic static torque rating**

$C_{0T}$   
static torque which corresponds to a calculated Hertzian contact stress at the centre of the contacting surfaces of the maximum ball load position, as shown in Table 1

**3.6 dynamic equivalent load**

$P$   
constant radial load under the influence of which a ball spline has the same life as it attains under the actual applied load conditions

**3.7 dynamic equivalent torque**

$T$   
constant torque under which a ball spline has the same life as it attains under the actual applied torque conditions

**3.8 life**  
total running distance of a ball spline before the first evidence of rolling contact fatigue failure or flaking occurs at the raceways of either the spline outer race, the spline shaft or the re-circulating balls

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

**3.9 static equivalent load**

<https://standards.iteh.ai/catalog/standards/sist/5c4bfc4a-90c6-4266-b992-064292d452c5/iso-23848-2-2009>

$P_0$   
static radial load which causes the same constant stress at the centre of the contacting surfaces as occurs under the actual applied load conditions

**3.10 static equivalent torque**

$T_0$   
static torque which causes the same constant stress at the centre of the contacting surfaces as occurs under the actual applied torque conditions

**3.11 reliability**

$R$   
probability that the ball spline assembly will not fail by rolling contact fatigue under a specified load and/or torque

NOTE This term is the same as the probability of survival.



## 4 Symbols

Symbol	Description	Unit
$b_m$	Rating factor for contemporary used high quality hardened steel and product quality	—
$C$	Basic dynamic load rating	N
$C_T$	Basic dynamic torque rating	Nm
$C_0$	Basic static load rating	N
$C_{0T}$	Basic static torque rating	Nm
$D_{pw}$	Ball pitch circle diameter	mm
$D_w$	Ball diameter	mm
$f_c$	Factor determined by geometrical shape, working accuracy and material for each part of ball spline	—
$f_0$	Factor determined by geometrical shape and working stress for each part of ball spline	—
$i$	Number of spline grooves	—
$i_t$	Number of spline grooves applied to calculation of load rating	—
$k_i$	Ball row arrangement factor applied to calculation of dynamic load rating	—
$k_{0i}$	Ball row arrangement factor applied to calculation of static load rating	—
$L_{10}$	Basic rating life with 90 % reliability	50 km
$l_t$	Outer race spline groove length applied to calculation of load rating	mm
$P$	Dynamic equivalent load	N
$P_0$	Static equivalent load	N
$R$	Reliability	—
$r_g$	Spline groove radius	mm
$T$	Dynamic equivalent torque	Nm
$T_0$	Static equivalent torque	Nm
$Z_t$	Number of effective balls for one spline groove applied to calculation of load rating	—
$\alpha$	Contact angle for radial load	°
$\beta$	Contact angle for torque direction	°
$\lambda$	Adjustment factor for dynamic load rating and torque rating	—
$\sigma_{max}$	Maximum contact stress	MPa