INTERNATIONAL STANDARD

ISO 23848-1

First edition
2009-11-15

Machine tools — Ball splines —

Part 1: General characteristics and requirements

Machines-outils — Guidages cannelés à billes —

Partie 1: Exigences et caractéristiques générales

Reference number
ISO 23848-1:2009(E)

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
Web www.iso.org

Published in Switzerland

Contents

Page

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 23848-1 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*

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 following characteristics of ball splines:

— the shapes and dimensions;

— the test methods;

— the inspection;

— the designation;

— the marking.

ISO 23848-2 specifies and standardizes the following properties of ball splines:

— the basic static and dynamic load ratings;

— the basic static and dynamic torque ratings;

— the rating life.

Machine tools — Ball splines —

Part 1:
General characteristics and requirements

1 Scope

This part of ISO 23848 specifies and standardizes the following characteristics for ball splines:

— the shapes and dimensions;

— the test methods;

— the inspection;

— the designation;

— the marking.

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 554, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6507-2, *Metallic materials — Vickers hardness test — Part 2: Verification and calibration of testing machines*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE See Figure 1.

3.1
ball spline
machine element consisting of the spline shaft, spline outer race, balls and recirculation devices and seals, for providing smooth relative axial motion between the shaft and the outer race, while preventing their relative rotation for the purpose of transmitting torque

3.2
effective spline length
actual available length of axial travel for the spline outer race on the spline shaft

3.3
groove twist of the ball spline
value of rotational deviation of the spline outer race over the effective travel length

3.4
nominal diameter of the spline shaft
outer diameter of the spline shaft representing the size of the ball spline without tolerance, sometimes expressed as the pitch circle diameter without tolerance

NOTE The pitch circle diameter, D_p, refers to the diameter specifying the location of the rolling ball centres in the ball spline assembly with their theoretical contacts on the groove surfaces of both the spline shaft and the spline outer race.

3.5
spline groove
groove ground or rolled along the axial direction on the shaft periphery or the inner surface of the spline outer race to facilitate the smooth rolling of balls inside the assembly

3.6
spline outer race
assembly comprising the body with internal spline grooves, balls, recirculation devices and/or additional embodiments

3.7
spline shaft
shaft consisting of axial spline grooves, which are matched with the grooves of a compatible spline outer race and can accommodate recirculating balls

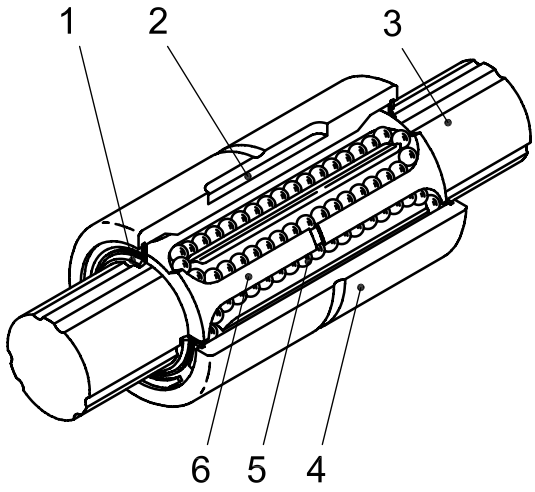
4 Classification and grade

Ball splines shall be classified as type A (angular) or type R (radial), as shown in Figure 1 and Table 1. Each ball spline type shall be divided into three grades, C1, C3 and C5, according to the quality and precision and may be represented by symbols such as:

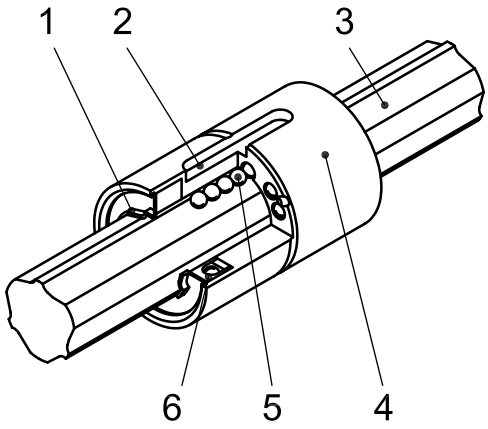
— P for C1;

— H for C3;

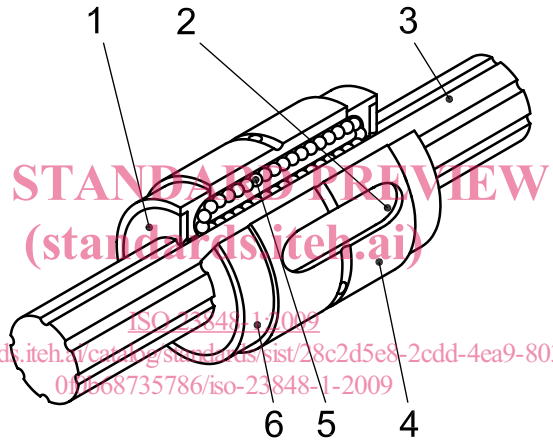
— no symbol for C5.



a) Type AI



b) Type AII



c) Type R

Key

1 seal
2 keyway
3 spline shaft
4 spline outer race
5 balls
6 retainer and/or end cap

NOTE These drawings are examples of a construction.

Figure 1 — Names of the parts of typical ball splines

Table 1 — Type and symbol of ball splines

Name	Type	Flange on the spline outer race	Seal	
Ball spline	AI AII R	without	without	
			with	one side (U)[a]
				both sides (UU)[a]
		with (F)[a]	without	
			with	one side (U)[a]
				both sides (UU)[a]

[a] Letters in parentheses in this table are indication symbols, the application of which is given in Clause 9.

5 Characteristics

5.1 Groove twist of the spline shaft

The tolerance on the groove twist of a ball spline, when measured by the method given in 7.2, shall meet the requirement of Table 2 with respect to 100 mm taken at random within the effective spline length.

In cases where it is impossible to take 100 mm or more relative travel distance between the spline shaft and spline outer race, apply a converted value of Table 2 in proportion to the travel distance.

Table 2 — Groove twist of the ball spline

Dimensions in micrometres

Grade	C1	C3	C5
Twist tolerance (max.)	6	13	33
NOTE See Figure 3.			

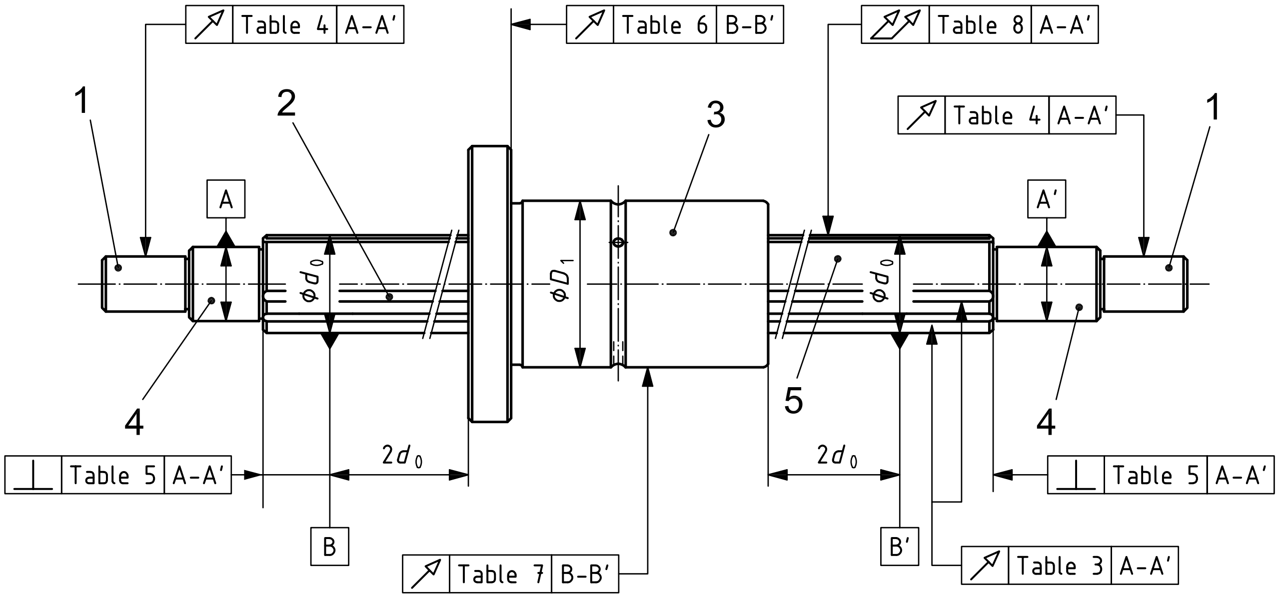
5.2 Spline shaft accuracy

The radial runout of the spline grooves, part mounting journals and the axial runout of the end face of the spline shaft in relation to the axis of support journals of the spline shaft, when measured by the methods given in 7.3.1 to 7.3.3, shall meet the specifications in Tables 3 to 5, respectively (see Figures 2, 4, 5 and 6).

5.3 Spline outer race mounting accuracy

The axial runout of the spline outer race reference face or the flange mounting face of the flange, and the radial runout of the spline outer race in relation to the axis of the spline shaft, when measured using the methods given in 7.4.1 and 7.4.2, shall meet the specifications in Tables 6 and 7, respectively (see Figures 2, 7 and 8).

NOTE Figures 2 to 9 typically show type AI, as an example.



Key

1 part mounting journal

2 spline groove

3 spline outer race

4 support journal

5 spline shaft

NOTE 1 The support journals refer to the portions, where bearings will support the spline shaft.

NOTE 2 The part mounting journals refer to the portions intended for mounting a gear wheel or other machine elements.

NOTE 3 Not applicable to those without support journals and/or part mounting journal.

Figure 2 — Accuracy of the ball spline

5.4 Total radial runout of the spline shaft in relation to the axis of the support journals

The tolerance on the total radial runout of the spline shaft in relation to the axis of the support journals, when measured using the method given in 7.5, shall meet the specifications in Table 8 (see Figures 2 and 9).

5.5 Hardness

The hardness of spline groove surfaces, when determined according to the method given in 7.6, shall be at least ⩾ 653 HV (⩾ 58 HRC).

Table 3 — Radial runout of the spline grooves in relation to the axis of the support journals

Nominal diameter, d_0 mm		Runout tolerance μm max.[a]		
		Grade		
Over	Up to and including	C1	C3	C5
—	8	8	14	33
8	12	10	17	41
12	20	12	19	46
20	32	13	22	53
32	50	15	25	62
50	80	17	29	73
80	125	20	34	86

NOTE See Figure 4.

[a] As the influence of the runouts of the axis of the spline shaft is included in this value, a correction is needed. For the correction, obtain the correction value from Table 8 for the total runout tolerance on the shaft support journals corresponding to the ratio of the total shaft length to the measured distance between the points of support and add it to the tolerance in Table 3 to apply.

Table 4 — Radial runout of the part mounting journals in relation to the axis of the support journals

Nominal diameter, d_0 mm		Runout tolerance μm max.		
		Grade		
Over	Up to and including	C1	C3	C5
—	8	8	14	33
8	12	10	17	41
12	20	12	19	46
—	—	—	—	—
20	32	13	22	53
32	50	15	25	62
50	80	17	29	73
80	125	20	34	86

NOTE See Figure 5.