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ISO 16123

Ships and marine technology — Marine cranes — Slewing bearings

Navires et technologie maritime — Grues marines — Supports d'orientation

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Foreword

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This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 4, *Outfitting and deck machinery*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Ships and marine technology — Marine cranes — Slewing bearings

1 Scope

This document provides requirements on the classification, designation, inspection, testing method, marking, packaging, transportation, storage, installation and maintenance of slewing bearings for marine cranes.

This document is applicable to the design, manufacture and acceptance of slewing bearings for marine cranes at an ambient temperature not lower than −40 °C.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 54, *Cylindrical gears for general engineering and for heavy engineering — Modules*

ISO 683-2, *Heat-treatable steels, alloy steels and free-cutting steels — Part 2: Alloy steels for quenching and tempering*

ISO 683-17, *Heat-treatable steels, alloy steels and free-cutting steels — Part 17: Ball and roller bearing steels*

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*

ISO 898-2, *Fasteners — Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes*

ISO 1122-1, *Vocabulary of gear terms — Part 1: Definitions related to geometry*

ISO 1132-1, *Rolling bearings — Tolerances — Part 1: Terms and definitions*

ISO 1328-1, *Cylindrical gears — ISO system of flank tolerance classification — Part 1: Definitions and allowable values of deviations relevant to flanks of gear teeth*

ISO 1328-2, *Cylindrical gears — ISO system of flank tolerance classification — Part 2: Definitions and allowable values of double flank radial composite deviations*

ISO 3290-1, *Rolling bearings — Balls — Part 1: Steel balls*

ISO 3452-2, *Non-destructive testing — Penetrant testing — Part 2: Testing of penetrant materials*

ISO 5593, *Rolling bearings — Vocabulary*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO 9934 (all parts), *Non-destructive testing — Magnetic particle testing*

ISO/TR 10064-2:1996, *Code of inspection practice — Part 2: Inspection related to radial composite deviations, runout, tooth thickness and backlash*

ISO 14556, *Metallic materials — Charpy V-notch pendulum impact test — Instrumented test method*

ISO 15241, *Rolling bearings — Symbols for physical quantities*

ISO 16396-1, *Plastics — Polyamide (PA) moulding and extrusion materials — Part 1: Designation system and basis for specifications*

ISO 16396-2:2022, *Plastics — Polyamide (PA) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

ISO 16859-1, *Metallic materials — Leeb hardness test — Part 1: Test method*

ISO 18203, *Steel — Determination of the thickness of surface-hardened layers*

EN 10228-1, *Non-destructive testing of steel forgings — Part 1: Magnetic particle inspection*

EN 10228-2, *Non-destructive testing of steel forgings — Part 2: Penetrant testing*

EN 10228-3:2016, *Non-destructive testing of steel forgings — Part 3: Ultrasonic testing of testing of ferritic or martensitic steel forgings*

ISO 10474:2013, *Steel and steel products — Inspection documents*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 1132-1, ISO 5593 and ISO 15241 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
crane slewing bearing
structure connecting the crane and the base, provided with mounting holes inside and outside, which is a large rolling bearing capable of bearing combined loads (axial and radial loads and tilting moments) and transmitting large torques

4 Classification and designation

4.1 Composition and structure

A slewing bearing consists of bearing rings (inner rings, outer rings), a rolling element, a cage/separator, a sealing ring and an oil cup. There are three types of slewing bearings according to their structural forms:

a) Single-row four-point contact ball slewing bearing (see Figure 1)

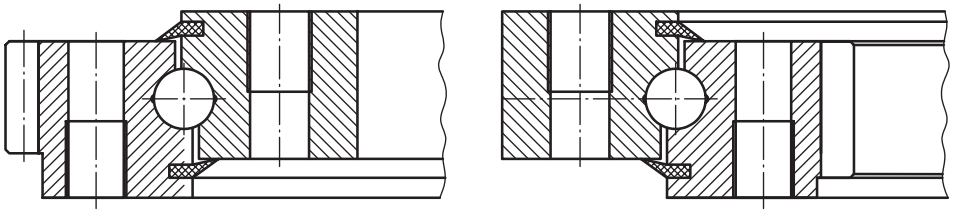

Figure 1 — Single-row four-point contact ball slewing bearing

b) Double-row reducing ball slewing bearing (see Figure 2)

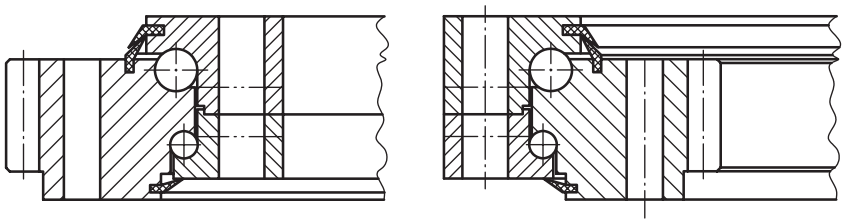

Figure 2 — Double-row reducing ball slewing bearing

c) Three-row cross-roller slewing bearing (see Figure 3)

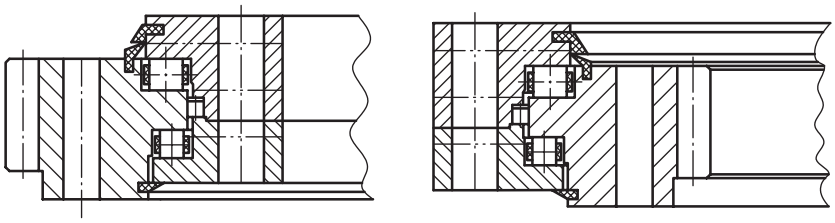

Figure 3 — Three -row cross-roller slewing bearing

4.2 Designation

The model representation of slewing bearings is shown in Figure 4. If other codes such as change in material, gear surface requirements, heat treatment mode of the raceway, tolerance grade and sealing structure are required, they shall be marked after the diameter of the raceway centre circle, separated by a space.

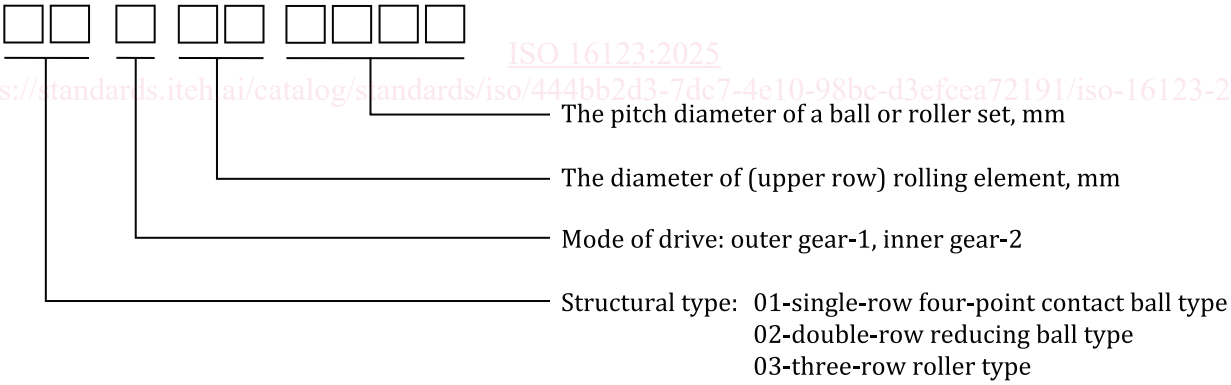

Figure 4 — Model representation of slewing bearings

EXAMPLE The marine internal gear type three-row roller slewing bearing with the diameter of the upper row rolling element of 40 mm and the diameter of the raceway centre circle of 2 500 mm:

Crane slewing bearing-ISO 16123-03-1-40–2500

5 Technical requirements

5.1 Load ratings

The static and dynamic load ratings of the slew bearings can be calculated based on ISO 76 and ISO 16281, respectively.

5.2 Rolling element

5.2.1 Materials shall conform to the requirements on 100CrMnsi6 and 100Cr for bearing steel in ISO 683-17. Other materials that meet the performance may also be used.

5.2.2 Steel balls shall conform to ISO 3290-1 and their tolerance grades shall be in accordance with Table 1.

Table 1 — Tolerance grade of steel ball

Diameter D_w mm	**Tolerance grade of steel ball**
$D_w \leq 30$	G40
$30 < D_w \leq 50$	G60
$D_w > 50$	G100

5.2.3 Tolerances of the cylindrical roller shall be in accordance with Table 2.

Table 2 — Tolerances of cylindrical roller

Diameter D_w mm	**Diameter variation** V_{DWL} µm	**Outer diameter surface roundness error** Δ_{Rw} µm	**Length face runout** S_{DW} µm	**Rolling surface roughness**	**Face roughness**	**Chamfer roughness**
				$R_{a,max}$ µm		
$D_w \leq 18$	4	1,0	10			
$18 < D_w \leq 30$	4	1,5	10	0,25	0,32	2,5
$D_w > 30$	5	2,5	10			
NOTE The definitions of outer diameter surface roundness error and length face runout are according to ISO 286-2.						

5.2.4 The residual magnetism limit of the rolling element shall be in accordance with Table 3.

Table 3 — Residual magnetism limit of rolling element

Rolling element type	**Nominal diameter** $D_{rolling}$ mm	**Maximum value of residual magnetism** m_T
Steel ball	$5 < D_{rolling} \leq 50$	0,25
	$D_{rolling} > 50$	0,3
Cylindrical roller	$10 < D_{rolling} \leq 18$	0,2
	$18 < D_{rolling} \leq 30$	0,25
	$30 < D_{rolling} \leq 50$	0,3
	$D_{rolling} > 50$	0,4

5.3 Bearing rings

5.3.1 Bearing rings shall be manufactured with 42CrMo4 quenched and tempered steel in accordance with ISO 683-2, quenched and tempered to 260HBW-320HBW. Other materials with the same performance may be used. An "Inspection Certificate 3.2" shall be obtained in accordance with ISO 10474:2013, 5.2.

NOTE 1 42CrMo4 refers to a brand of steel. HBW refers to Hardness Brinell Wolffran-carbide.

NOTE 2 Inspection Certificate 3.2 refers to a document validated by the manufacture's authorized inspection representative and either the purchaser's authorized representative or an inspector designed by a third party, declaring that the products supplied comply with the requirements of the order and which test results are supplied from a specific inspection.

5.3.2 The average value of the Charpy V-notch pendulum impact absorption energy of the ring material shall be not less than 25 J, and the single specimen value not less than 20 J, at –10 °C or the design temperature, whichever is lower. The average value shall be not less than 42 J, and the single specimen value not less than 27 J, at –20 °C or the design temperature minus 10 °C, whichever is lower.

5.3.3 The non-destructive testing shall be carried out by testing personnel with at least Level II qualification, in accordance with ISO 9712, on the blank or finished surface of the bearing ring forging.

5.3.4 The NDT method shall meet the following requirements:

a) magnetic particle testing in accordance with the ISO 9934 series and EN 10228-1;

b) dye penetrant testing in accordance with ISO 3452-2 and EN 10228-2;

c) ultrasonic testing in accordance with EN 10228-3:2016, Clause 14, quality class Level 3.

5.3.5 When the diameter of bearing ring raceway is more than 2 500 mm or the mass of the forging is greater than 3 000 kg (3 tons), the forging shall be sampled at the positions shown in Figure 5, for mechanical properties, hardness and impact value, etc. after heat treatment, other than the positions where mechanical properties does not correspond to the actual stress.

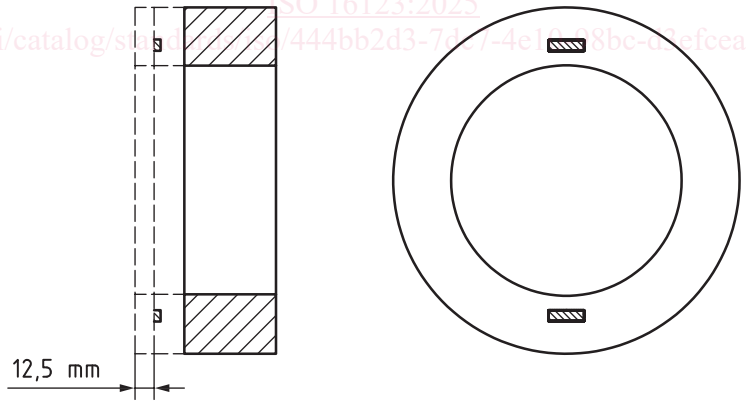

Figure 5 — Bearing ring

5.3.6 The ring raceway shall be quenched to achieve surface hardness of 55 HRC to 63 HRC. The effective depth of hardening (i.e. the depth of the raceway surface with hardness no less than 48 HRC), D_S, shall meet the requirements in Table 4. The effective depth of hardening shall be tested in accordance with ISO 18203.

NOTE HRC refers to Rockwell hardness C scale.

Table 4 — Effective depth of hardening of bearing ring raceway

Dimensions in millimetres

Diameter D_w	$D_w \leq 30$	$30 < D_w \leq 40$	$40 < D_w \leq 50$	$D_w > 50$
Effective depth of hardening D_S	≥ 3,0	≥ 3,5	≥ 4,0	≥ 5,0

5.3.7 A soft zone is allowed in the raceway after quenching, with the following requirements:

a) Width: For a bearing ring without a blockage hole, the soft zone width shall not be greater than two times of D_w (for $D_w \leq 25$ mm) or shall be equal to 50 mm (for $D_w > 25$ mm). For a bearing ring with a blockage hole, the soft zone width shall be no greater than the blockage hole diameter plus 35 mm.

b) Marking: Except bearing rings with a blockage hole for which a soft zone shall be located in the blocked raceway position without need of marking, all other bearing rings shall be marked with a permanent "S" mark on the soft zone at a position not for fitting. For a double-half bearing ring, in addition to the marking, the soft zones of the double-half bearing ring shall overlap into one during mating boring and assembly.

5.3.8 There shall be no cracks on the surface of the raceway.

5.3.9 The bearing ring shall be free from white spots or cracks.

5.3.10 The bearing ring shall not be subject to repair welding.

5.4 Cage/separator

The cage/separator shall be made of PA1010 as specified in ISO 16396-1 and ISO 16396-2:2022, Clause 6. Heavy slewing bearings shall be generally made of steel. Other materials that meet the performance requirements may also be used.

NOTE PA1010 refers to polyamide 1010, where 10 represents the number of carbon atoms.

5.5 Sealing ring

The material of the sealing tape shall be selected from oil-resistant, aging-resistant, seawater corrosion-resistant and heat-resistant materials, such as BLD7453 nitrile rubber or other materials that meet the performance requirements.

5.6 Oil cup

If an oil cup is used, it shall be resistant to corrosion by seawater.

5.7 Gears of the bearing ring

5.7.1 The gear shall be an involute cylindrical spur gear and the radial modification coefficient x of inner/outer gear shall be +0,5 in accordance with ISO 1122-1. The tip clearance coefficient k is taken as $k = 0,2$ for inner gear and $k = 0,1$ for outer gear. Other modification coefficients and tip clearance coefficients can also be used according to the user's requirements.

5.7.2 The gear modulus shall be in accordance with ISO 54.

5.7.3 The accuracy of gears shall be Grade 10 as specified in ISO 1328-1 and ISO 1328-2. The deviation of the gear's tooth thickness can be determined by the manufacturer and the user through consultation.