INTERNATIONAL STANDARD

ISO 19360

First edition
2016-11-15

Ships and marine technology — Marine cranes — Technical requirements for rigging applications

Navires et technologie maritime — Grues marines — Exigences techniques pour les applications de gréement

Reference number
ISO 19360:2016(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee SC 4, *Outfitting and deck machinery*.

Ships and marine technology — Marine cranes — Technical requirements for rigging applications

1 Scope

Rigging used for marine cranes is mainly wire rope rigging. This document specifies the technical requirements of the selection and application of running rigging and standing rigging used for wire rope rigging of marine cranes.

This document specifies the minimum requirements of the allowable strength and performance level for wire ropes of marine cranes according to the design, application and maintenance requirements of cranes.

This document specifies the implementation criteria of installation, maintenance, inspection and discards for running rigging and standing rigging of marine cranes.

This document is applicable to the following types of marine crane:

— deck cranes mounted on ships for handling cargo or containers in harbour or sheltered water conditions;

— floating cranes or grab cranes mounted on barges or pontoons for operating in harbour conditions or sheltered water conditions;

— engine room cranes and provision cranes, etc. mounted on ships (including floating docks) for handling equipment and stores in harbour conditions.

This document does not apply to the following:

— loads from accidents or collisions;

— lifting operations below sea level;

— cranes which are supposed to be included in the class of the vessel and where the vessel receives a crane class notation; the contents of this document may be used however, as recommendation or guidance;

— other items where there is the danger that they might be considered in-scope are excluded from this document, such as

  — loose gear items, such as the hook block, and

  — ropes and fittings;

— cranes which are to be included in class by the class society;

— minimum ambient operating temperatures no less than −20 °C;

— maximum ambient operating temperatures above +45 °C;

— transport, assembly, dismantling and decommissioning of cranes;

— lifting accessories, i.e. any item between the crane and the load;

— lifting operations involving more than one crane;

— hand powered cranes;

— emergency rescue operations;

— shore-side cargo handling cranes;

— portable cranes on board;

— lifting appliances for lifeboats, liferafts accommodation ladders and pilot ladders;

— launching appliances for survival craft and rescue boats;

— gangways, accommodation and pilot ladders and their handling appliances.

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 4309:2010, *Cranes — Wire ropes — Care and maintenance, inspection and discard*

ISO 2408, *Steel wire ropes for general purposes — Minimum requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3828, ISO 4306-1, ISO 17893 and the following apply.

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

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

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

3.1
stable status of wire rope
status when the elongation measurement of the wire rope stays stable during repeated loading and unloading of wire rope within two ranges of the specified force value

3.2
standing rigging
supporting and non-operating wire rope that maintains a constant distance between the points of attachment to the two components connected by the wire rope

3.3
running rigging
operating wire rope used to change the distance between the points of attachment to the two components connected by the wire rope under outside force

3.4
rigging termination
rigging end for being connected with wedge socket

4 Form of rigging

The running rigging and standing rigging chosen for marine cranes shall comply with the requirements in ISO 2408; the wire rope, running rigging and standing rigging not specified in ISO 2408 can also be chosen, but the manufacturer shall provide the customer with technical documents of rigging strength and performance level related to mechanism design, equipment operation and maintenance. Running rigging which functions as hoisting of the marine crane shall give preference to the rotation-resistant wire rope type in ISO 2408. Three strand form of rigging shall not be used.

5 Selection method for wire ropes

5.1 Safety factor for running rigging

5.1.1 For crane with the safe working load SWL ≤ 100 kN, safety factor $n = 5$.

5.1.2 For crane with the safe working load SWL > 100 kN, safety factor of wire ropes shall be calculated according to Formula (1), in which the minimum shall be not less than 3:

$$n = \frac{10^4}{0{,}9\text{SWL} + 1\ 910} \quad (1)$$

where

SWL is the safe working load of crane, in kN.

5.2 Safety factor for standing rigging

Standing rigging shall not be wound on a drum or sheave, but fixed at both ends. Safety factor for standing rigging shall be determined according to design and inspection rules for the crane used in operational environment. If rules correspond, the safety factor for standing rigging should be the same as the one for running rigging.

5.3 Minimum breaking strength of wire rope

The minimum breaking strength, Q, of the marine crane rigging is calculated from Formula (2), in N:

$$Q = nW \quad (2)$$

where

n is the safe factor required for running or standing rigging;

W is the static load of the single wire rope, including friction effects of the wire rope running over sheaves (as applicable), in N.

See Annex A for examples of selection of wire ropes.

5.4 Rigging technical requirement

Select the nominal breaking strength, F_0, of the wire rope and the corresponding nominal diameter (d) according to the minimum breaking strength, Q, which is calculated from Formula (2). The following factors shall be taken into account when selecting the nominal breaking strength, F_0, of the wire rope.

a) Structure of the wire rope (see the related information from ISO 2408 or the data provided by the manufacturer of wire rope).

b) Nominal tensile strength of the wire rope (see the related information from ISO 2408 or the data provided by the manufacturer of wire rope).

c) Anticorrosion coating protection requirement for the wire rope should be taken into account.

d) Sockets of rigging, together with the wire rope shall be selected and installed as a whole by rigging manufacturer.

6 Extension of rigging

6.1 General

When the rigging is subject to tension, its length will be increased because of the rope structure and material of the rigging. When selecting the wire rope rigging, the influence of the rigging length change (length changes due to two stages: construction stretch and elastic stretch) on the operation of the crane shall be considered. Other factors of rigging extension, such as temperature, free rotation of one end of the wire rope, friction, are not taken into account unless customer particularly mentions these factors.

6.2 Original extension

Original extension of the rigging is not elastic and cannot be obtained precisely through calculation, and can only be determined by pretensioning force. Necessity of pretension and pretensioning force shall be decided appropriately between the manufacturers of rigging and marine cranes.

6.3 Elastic extension

When the rigging is at stable status under the tension, wire rope realizes elastic extension generally complying with Hooke's law. Elastic extension, L_0, shall be calculated according to Formula (3), in mm:

$$L_0 = \frac{WL}{1\,000EA} \tag{3}$$

where

W is the static load of the single wire rope, including friction effects of the wire rope running over sheaves (as applicable), in N;

L is the wire rope rigging length, in mm;

E is the ultimate elastic modulus of wire rope, in GPa;

A is the nominal metal cross section of wire rope, in mm^2.

Different form of wire rope has different elastic modulus, E, the elastic modulus, E, shall be provided according to section cross form of rigging by the rigging manufacturer.

7 Torsion of the rigging

Wire rope rigging, when loaded, will cause torsional force due to its self-rotation feature of the wire rope. The torque is related to load through "torque coefficient" due to wire rope rigging load. In the hoisting reeving system of marine crane, hook sheave produces angular displacement under the influence of torque caused by load, and the angular displacement increases with the hoisting height goes up. Running rigging of marine crane hoisting reeving system ensure that the angular displacement of rigging stay in a safe range when marine crane reaches the upper limit of hoisting height. Since there are different marine crane hoisting reeving systems, the upper limit of hoisting height of wire rope rigging and angular displacement also differ. Annex B provides an example for torsion of the rigging.

It is recommended that angular displacement should be calculated approximatively according to Formula (4):

$$S^2 = \frac{4\ 000 \times L \times k \times d}{\sin\theta} \quad (4)$$

where

- L is the upper limit of hoisting height of hoisting wire rope rigging, in m, (see Figure 1);
- S is the distance between hoisting wire rope rigging centers, in mm (see Figure 1);
- θ is the angular displacement for the upper limit of hoisting height of wire rope rigging, in degrees (°);
- k is the torque coefficient of 20 % wire rope breaking strength, the coefficient is provided by the rigging manufacturer;
- d is the nominal diameter of wire rope, in mm.

NOTE 1 Torque value = $k \times d$.

NOTE 2 Formula (4) is based on the assumption that wire rope rigging is in a state of free torsion and with no load. The torque from reeving system will generate during or after wire rope rigging installation. It can influence calculation result reversely.

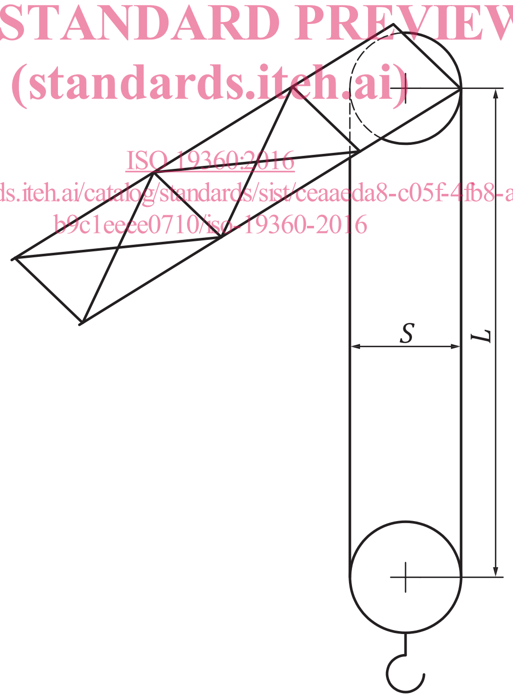

Figure 1 — Distance between rigging hoisting height and rigging center

When the angular displacement is beyond 90° (that is, sinθ = 1), instability situation is appeared and the wire rope can intertwine each other in reeving system. Judge condition for instability of reeving system is as given in Formula (5):

$$S > \sqrt{4\ 000 \times L \times k \times d} \quad (5)$$

Formula (5) is for single two falls of reeving system.

