International Standard 4308/1

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Cranes and lifting appliances — Selection of wire ropes — Part 1 : General

Grues et appareils de levage — Choix des câbles — Partie 1 : Généralités

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4308/1 was prepared by Technical Committee ISO/TC 96, *Cranes, lifting appliances and related equipment.*

This second edition cancels and replaces the first edition (ISO 4308-1981), of which it constitutes a minor revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Cranes and lifting appliances — Selection of wire ropes — Part 1 : General

0 Introduction

This part of ISO 4308 is one of a series covering selection of wire ropes for cranes and lifting appliances. The series will consist of the following parts :

Part 1 : General.

Part 2 : Mobile cranes.

Part 3 : Tower cranes.

Part 4 : Portal and pedestal cranes.

Part 5 : Overhead travelling and portal bridge cranes.

1 Scope and field of application

This part of ISO 4308 specifies two methods for the selection of wire rope to be used on the types of lifting appliances designated in ISO 4306/1, and which are listed in annex A.

This part of ISO 4308 establishes the minimum requirements for these wire ropes to have acceptable strength and performance levels with respect to design, application and maintenance of the appliance.

It allows the wire rope to be selected by one of two methods, one based on the value of the rope selection factor C, and the other based on the value of the coefficient of utilization Z_p, as given in table 1.

For the specific application to a type of apparatus (mobile cranes, travelling bridge cranes, etc.), a choice in the classification groups shall be made in accordance with ISO 4301/1. Only the C or Z_p values of the selected group (or their calculated equivalent) shall be used for the choice of rope.

2 References

ISO 2408, *Steel wire ropes for general purposes — Characteristics.*

ISO 4301/1, *Cranes and lifting appliances — Classification — Part 1 : General.*

ISO 4306/1, *Lifting appliances — Vocabulary — Part 1 : General.*

ISO 4309, *Wire rope for lifting appliances — Code of practice for examination and discard.*

3 Type of rope

Where possible, the wire rope used shall be in accordance with ISO 2408.

However, the use of wire rope not specified by ISO 2408 is permitted, but in such cases the supplier of the wire rope shall show to the user that the product fulfils the minimum requirements detailed in this part of ISO 4308.

4 Duty conditions

The mechanisms of lifting appliances shall be classified according to the duty conditions laid down in ISO 4301/1.

5 Selection procedure

5.1 Calculation of C values

The value of C is a function of Z_p and is given by the equation

$$C = \sqrt{\frac{Z_p}{K' \times R_o}} \qquad \ldots(1)$$

where

C is the rope selection factor (minimum);

K' is the empirical factor of minimum breaking load of a given rope construction (see table 4 of ISO 2408);

R_o is the minimum tensile strength of the wire used in the rope, in newtons per square millimetre[1];

Z_p is the minimum practical coefficient of utilization.

5.2 Z_p values

Table 1 gives the values of Z_p which shall be used for each classification group of mechanism in order to achieve the

1) 1 N/mm^2 = 10^6 N/m^2 = 1 MPa

minimum requirements of this part of ISO 4308. It also gives the calculated values of C corresponding, for example, to a rope with R_o = 1 570 N/mm² and with an empirical factor K' = 0,294 8.

Table 1 — Z_p values and C values (for R_o = 1 570 N/mm² and K' = 0,294 8)

Classification of mechanism	Z_p value	C value $\frac{mm}{\sqrt{N}}$
M1	3,15	0,085
M2	3,35	0,087
M3	3,55	0,090
M4	4,0	0,095
M5	4,5	0,100
M6	5,6	0,112
M7	7,1	0,125
M8	9,0	0,140

NOTE — Whilst equation (1) shows the exact relationship between C and Z_p, the values shown in table 1 have been corrected to follow numbers extracted from the Renard Series.

For ropes having a tensile strength R_o and an empirical factor K' different from those shown above, different values of C may be calculated using equation (1) and substituted in equation (2) indicated in 5.3.

5.3 Calculation of minimum rope diameter

The minimum diameter of the rope, d, in millimetres, is given by the equation

$$d = C\sqrt{S} \qquad ...(2)$$

where

C is the rope selection factor;

S is the maximum rope tension, in newtons, which is obtained by taking account of the following factors :

a) rated working load of the appliance;

b) weight of the pulley block and/or other lifting attachments;

c) mechanical advantage of reeving;

d) efficiency of the rope reeving;

e) the weight of the suspended length of the hoist rope shall be included when the load handled is more than 5 m below the slewing mechanism of the lifting appliance.

5.4 Calculation of minimum breaking load

The minimum breaking load, F_o, in newtons, of the particular rope intended for use is given by the equation

$$F_o = S \times Z_p \qquad ...(3)$$

where

S is the maximum rope tension, in newtons, as defined in 5.3;

Z_p is the minimum practical coefficient of utilization.

Examples of rope selection are given in annex B.

6 Diameter of rope drums and pulleys

The minimum pitch diameter of the rope drums, rope pulleys and compensating pulleys shall be calculated using the minimum rope diameter established in 5.3 and by applying the respective values of h_1, h_2, and h_3, as applicable, and which relate to the classification of the mechanism, as shown in table 2, in the following equations :

$$D_1 \geqslant h_1 d \qquad ...(4)$$

or $$D_2 \geqslant h_2 d \qquad ...(5)$$

or $$D_3 \geqslant h_3 d \qquad ...(6)$$

where

D_1 is the pitch diameter of the drum;

D_2 is the pitch diameter of the pulley;

D_3 is the pitch diameter of the compensating pulley;

d is the minimum diameter of the rope, as defined in 5.3;

h_1 is the selection factor for the drum (ratio of the pitch diameter of the drum to the calculated diameter of the rope);

h_2 is the selection factor for the pulley (ratio of the pitch diameter of the pulley to the calculated diameter of the rope);

h_3 is the selection factor for the compensating pulley (ratio of the pitch diameter of the compensating pulley to the calculated diameter of the rope).

Table 2 — Selection factors h_1, h_2 and h_3

Classification of mechanism	Drums h_1	Pulleys h_2	Compensating pulleys h_3
M1	11,2	12,5	11,2
M2	12,5	14,0	12,5
M3	14,0	16,0	12,5
M4	16,0	18,0	14,0
M5	18,0	20,0	14,0
M6	20,0	22,4	16,0
M7	22,4	25,0	16,0
M8	25,0	28,0	18,0

However, it is recommended that for particular applications of lifting appliances, for example mobile cranes, a single set of h values be selected independent of the classification of the mechanism.

7 Stationary ropes

Stationary ropes are fixed at both rope ends and are not subject to winding on a drum. Their selection is made in accordance with 5.4 with Z_p values modified as in table 3, where the

maximum rope tension, S, shall be established by the manufacturer of the mechanism who must take account of both the static forces and those forces resulting from maximum wind and impact conditions.

Table 3 — Z_p values for stationary ropes

Classification of mechanism	Z_p value
M1	2,5
M2	2,5
M3	3,0
M4	3,5
M5	4,0
M6	4,5
M7	5,0
M8	5,0

8 Dangerous conditions

For dangerous conditions, for example the handling of molten metal,

a) no classification group lower than M5 may be used;

b) the Z_p value shall be increased by 25 % up to a maximum of 9,0 or, alternatively, the C value for the next higher classification group shall be adopted, when selecting the rope.

9 Examination, maintenance and discard of wire ropes

The examination, maintenance and discard criteria for wire ropes are specified in ISO 4309; the requirements laid down therein should be adopted.

Annex A

Lifting appliances to which this International Standard relates

This International Standard relates to the following cranes and lifting appliances, which are extracted from ISO 4306/1. (This list is not comprehensive.)

- Overhead travelling cranes
- Portal or semi-portal cranes
- Portal or semi-portal bridge cranes
- Cable and portal cable cranes
- Mobile cranes
- Tower cranes
- Railway cranes
- Floating cranes
- Deck cranes
- Derrick and guy derrick cranes
- Derrick cranes with rigid bracing
- Cantilever cranes (pillar, jib, wall or walking)

The cranes may be used for hook, grabbing, magnet, ladle, bucket or stacking duties and may be operated manually, electrically or hydraulically.

Annex B

Examples of wire rope selection

B.1 Example 1

A lifting appliance is to operate under duty conditions defined in the classification of mechanisms as M4.

The maximum rope tension has been established as 79 kN.

The construction and tensile strength of the rope to be selected has a K' value of 0,294 8 and R_o value of 1 570 N/mm².

$$d \text{ min.} = 0{,}095\sqrt{79\,000}$$
$$= 26{,}7 \text{ mm}$$

For practical purposes, the minimum diameter of the rope selected shall be not less than 27 mm.

From 5.4 using equation (3) :

$$\text{Minimum breaking load } F_o = 79 \times 4$$
$$= 316 \text{ kN}$$

For practical purposes, the minimum breaking load of the rope selected shall not be less than 316 kN.

B.2 Example 2

Exactly similar parameters are required as indicated in example 1, but on this occasion the constructor of the appliance wishes to employ a smaller rope size to reduce equipment weight and therefore selects a rope construction and tensile strength having a K' value of 0,329 9 and R_o value of 1 770 N/mm².

From 5.1 using equation (1) :

$$C = \sqrt{\frac{4}{0{,}329\,9 \times 1\,770}}$$
$$= 0{,}082\,7 \text{ min.}$$

corrected to 0,085 (Renard number from R 40 series).

From 5.3 using equation (2) :

$$d \text{ min.} = 0{,}085\sqrt{79\,000}$$
$$= 23{,}9 \text{ mm}$$

For practical purposes, the nominal diameter of the rope selected shall be not less than 24 mm.

From 5.4 using equation (3) as in example 1 :

$$\text{Minimum breaking load } F_o = 79 \times 4$$
$$= 316 \text{ kN}$$

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