INTERNATIONAL STANDARD

**ISO 4344**

Third edition
2022-12

# Steel wire ropes for lifts — Minimum requirements

*Câbles en acier pour ascenseur — Exigences minimales*



Reference number
ISO 4344:2022(E)

**COPYRIGHT PROTECTED DOCUMENT**



ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: 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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.



This document was prepared by Technical Committee ISO/TC 105, *Steel wire ropes*.

This third edition cancels and replaces the second edition (ISO 4344:2004), which has been technically revised.



The main changes are as follows:

— added more rope grades commonly used in lifts and deleted rope grades rarely used in lifts;

— added more rope constructions commonly used in lifts;

— revised the requirement of lubricant content for rope cores;

— added the requirement of lubricant content for strands;

— revised diameter tolerances of steel core ropes;

— added the requirement of tensile strength for wires after rope making;

— added the information for rope selection, installation and maintenance;

— revised rope discard criteria.

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.

# Introduction

This document was developed in response to a worldwide demand for a specification giving minimum requirements for ropes for use on lifts.

It is desirable in such cases that the equipment designer, rope manufacturer or other competent person be consulted prior to ordering a rope.

This document does not limit itself to those classes and constructions covered by the tables.

Other stranded rope constructions may also conform to the minimum requirements, and in such cases the manufacturer would specify the minimum breaking force and rope grade.

# Steel wire ropes for lifts — Minimum requirements

## 1 Scope

This document specifies the minimum requirements for the manufacture and testing of stranded carbon steel wire ropes for lifts, made from bright and galvanized wire finish in various constructions from 6 mm to 38 mm diameter.

It is applicable to ropes used for suspension duty on traction drive and roped hydraulic lifts, and for compensation and governor duties on passenger lifts, freight lifts, service lifts, and man lifts moving between guides.

It is not applicable to ropes for

— builder's hoists,

— temporary hoists not running between permanent guides,

— cable-ways,

— mine hoists.



## 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 2232, *Round non-alloy steel wires for general purpose wire ropes, large diameter wire ropes and mine hoisting wire ropes —Specifications*

ISO 3108, *Steel wire ropes — Test method — Determination of measured breaking force*

ISO 4101, *Drawn steel wire for elevator ropes — Specifications*

ISO 4345:1988, *Steel wire ropes — Fibre main cores — Specification*

ISO 4346, *Steel wire ropes for general purposes — Lubricants — Basic requirements*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 17893, *Steel wire ropes — Vocabulary, designation and classification*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17893 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**
**composite steel core**
**CSC**
wire rope core which is made of steel wires plus a fibre or polymer core

# 4 Requirements

## 4.1 Material

### 4.1.1 Wire

#### 4.1.1.1 Wire properties and grades

Before rope making, wire properties shall be in accordance with ISO 4101 or ISO 2232.

Wire grades shall meet the following tensile strength grades given in Table 1.

**Table 1 — Wire properties and grades**

| Position of wires in the rope | 1320[a] | 1370 | 1570 and 1620[b] | 1770 | 1960 |
|---|---|---|---|---|---|
| Outer wires of outer strands | ISO 4101 | ISO 4101 | ISO 4101 | ISO 4101 | ISO 2232 |
| Inner, centre and core | — | — | ISO 2232 | ISO 2232 | ISO 2232 |
| Filler wires | ISO 4101 | ISO 4101 | ISO 2232 | ISO 2232 | ISO 2232 |
| [a] Torsion properties are performed at 1370 MPa wire tensile strength grade. | | | | | |
| [b] Torsion properties are performed at 1770 MPa wire tensile strength grade. | | | | | |

Wire grades not given in Table 1, shall be subject to agreement between the purchaser and the manufacturer.



#### 4.1.1.2 Wire finish

Unless otherwise specified by the purchaser, the rope shall be made from bright wires.

Galvanized wire ropes shall be subject to agreement between the purchaser and the manufacturer, the level of coating shall be Class B.



### 4.1.2 Core

#### 4.1.2.1 General

The core shall be one of the following types:

a) fibre core;

b) steel core;

c) steel-based composite core, i.e. steel plus fibre or steel plus polymer;

d) non-metallic core, other than fibre-only.

Because of the large variety of existing designs, such as those prescribed by d), these core types should be the subject of negotiation between purchaser and manufacturer.

#### 4.1.2.2 Fibre core

Fibre cores (FC) including natural fibre cores (NFC), synthetic fibre cores (SFC) and solid polymer cores (SPC), shall conform to ISO 4345. Natural fibre cores and synthetic fibre cores shall be doubly closed (i.e. from yarn into strand and from strand into rope) and solid polymer cores can be one layer

or multiple layers. Unless otherwise specified by the purchaser, all the fibre cores shall conform to the following requirements.

a) Natural fibre cores shall be manufactured from new sisal or manila vegetable fibre and, when measured after rope closing in accordance with Annex A or ISO 4345:1988, Annex C, shall have a lubricant content of 8 % to16 % by weight of the dry fibre material.

b) Synthetic fibre cores and solid polymer cores shall be manufactured from one or more than one of the following materials: polypropylene, polyethylene, polyester or polyamide.

   When measured after rope closing in accordance with Annex A or ISO 4345:1988, Annex C, synthetic fibre cores for suspension ropes shall have a lubricant content of 6 % to 15 % by weight of the dry material; synthetic fibre cores for governor ropes and compensating ropes shall have a lubricant content of 3 % to 10 % by weight of the dry material.

c) The lubricant used in the manufacture of the fibre core shall not affect the lubricant used in rope making.

d) Consideration of environmental humidity and temperature shall be given to potential rope abnormal elongation and shrinkage when using natural fibre core ropes for governor and compensating duties.

e) Fibre cores can include a core colour tracer for purposes of identifying the rope manufacturer, and manufacturers can add their own information on the colour tracer, might include the manufacturer's name, brand, telephone number, etc.



#### 4.1.2.3 Steel core

Steel cores (WC) include independent wire rope cores (IWRC), parallel closed wire rope cores (PWRC) and wire strand cores (WSC).

Steel cores for ropes larger than 7 mm diameter shall not be a wire strand core.



#### 4.1.2.4 Steel-based composite core

Typical steel-based composite cores (SCC) include composite steel cores (CSC) and polymer coated steel cores (EPIWRC).

The fibres or polymers in steel-based composite cores shall be made from one or more than one of the following materials: polypropylene, polyethylene, polyester or polyamide.

### 4.1.3 Lubricant

The lubricant shall be in accordance with ISO 4346.

## 4.2 Rope manufacture

### 4.2.1 General

All the wires in a strand shall have the same direction of lay and in the same layer shall be of the same tensile strength grade.

In a new rope under tension on the closing machine, there shall be clearance between the outer strands. The completed rope shall be evenly laid and free from unlaying, loose wires, distorted strands and other irregularities. Indentations caused by forming toolings, e.g. dies, preformers and postformers, are allowed.

When uncoiled, and under no load, the rope shall not be wavy.

For galvanized ropes, all the wires shall be galvanized, including those of a steel core where applicable.

#### 4.2.2 Wire joints

Wires over 0,4 mm diameter shall, where necessary, have their ends joined by butt welding. All welds shall be annealed.

Wires up to and including those of 0,4 mm diameter shall, where necessary, be joined by brazing or butt welding or simply by ends being inserted into their correct position in the strand's formation.

The spacing between any two adjacent joints shall not be less than 18 times of the rope nominal diameter.

#### 4.2.3 Fibre core joints

Joints in fibre cores shall be made by splicing.

#### 4.2.4 Lubrication

All of the strands of suspension, governor and compensating ropes shall be lubricated during the stranding process. Unless otherwise specified by the purchaser, no lubricant shall be applied during the final closing of the rope.

Unless otherwise specified by the purchaser, the rope shall meet the following requirements.

— For suspension and compensating ropes, when measured after rope closing in accordance with Annex A, the outer strands shall have a lubricant content of 0,6 % to 1,8 % by weight of wires.

— For governor ropes, when measured after rope closing in accordance with Annex A, the outer strands shall have a lubricant content of 0,5 % to 1,25 % by weight of wires.



#### 4.2.5 Preformation and postformation



Unless otherwise specified by the purchaser, the ropes shall be preformed and/or postformed.

#### 4.2.6 Prestretching load limit

Where rope is supplied in the pre-stretched condition, in order to avoid rope damage, the maximum load to which the rope shall be subjected during the pre-stretching process shall not exceed 55 % of the minimum breaking force of the rope. The loading may be through static or dynamic means.

#### 4.2.7 Rope ends

The rope ends shall be secured such that they are prevented from unlaying.

#### 4.2.8 Rope construction

The rope construction or class shall be agreed between the purchaser and the manufacturer and shall be:

a) one of the more common rope constructions or classes covered by Tables B.1 to B.11 in Annex B, where

   Tables B.1 to B.8 apply to suspension ropes,

   Tables B.1 to B.9 apply to governor ropes,

   Tables B.1 to B.11 apply to compensating ropes, or

b) another single layer or parallel closed construction not covered by the tables but having no less than six or not more than nine outer strands, or

c) another stranded rope construction specified by the purchaser other than those covered by a) and b).

Where only the class is specified by the purchaser, the construction shall be decided by the manufacturer.

NOTE Each class of rope consists of a number of strand constructions, e.g. 8 × 19 class comprises 8×19W (1-6-6+6), 8x19S (1-9-9), 8x21F (1-5-5F-10) and 8x25F (1-6-6F-12).

#### 4.2.9 Rope grade

##### 4.2.9.1 General

The rope grade shall reflect the tensile strength grades of the outer and inner wires respectively, and shall be one of the following grades. Other rope grades shall be subject to the agreement between the purchaser and the manufacturer.

##### 4.2.9.2 Suspension ropes

Suspension ropes shall be of the following grades.

a) For traction drive lifts (see Tables B.1 to B.8):

— rope with fibre core: 1320/1620, 1370/1770, 1570/1770, 1620/1770, 1570, 1620, 1770, 1960;

— rope with steel core and parallel closed ropes: 1370/1770, 1570/1770, 1570, 1770, 1960.

b) For roped hydraulic lifts (see Tables B.1 and B.4):

— rope with fibre core: 1320/1770, 1370/1770, 1620/1770, 1570 and 1620, 1770;

— rope with steel core and parallel closed ropes: 1370/1770, 1570/1770, 1570, 1770, 1960.



##### 4.2.9.3 Governor ropes

Governor ropes shall be of the following grades: 1320/1620, 1370/1770, 1620/1770, 1570, 1620, 1770, 1960. (See Tables B.1 to B.9.)

##### 4.2.9.4 Compensating ropes

Compensating ropes shall have rope grades in accordance with 4.2.9.2. (See Tables B.1 to B.11.)

#### 4.2.10 Type and direction of lay

The direction and type of rope lay shall be one of the following:

a) right ordinary lay (sZ);

NOTE 1 Formerly referred to as right hand ordinary (designated RHO) and right regular lay (designated RRL).

b) left ordinary lay (zS);

NOTE 2 Formerly referred to as left hand ordinary (designated LHO) and left regular lay (designated LRL).

c) right lang lay (zZ);

NOTE 3 Formerly referred to as right hand langs (designated RHL) or right lang lay (designated RLL).

d) left lang lay (sS).

NOTE 4 Formerly referred to as left hand langs (designated LHL) or left lang lay (designated LLL).

The direction and type of rope lay should be right ordinary lay (sZ), if not be specified by the purchaser.

#### 4.2.11 Lay length

Unless otherwise specified by the purchaser, the lay length of the completed rope shall not exceed 6,75 times the nominal rope diameter.

### 4.3 Designation and classification

Rope classification and designation shall conform to the system requirements of ISO 17893.

### 4.4 Dimensions

#### 4.4.1 Diameter

##### 4.4.1.1 General

The nominal diameter shall be the dimension by which the rope is designated.

##### 4.4.1.2 Tolerances

Unless otherwise specified by the purchaser, when measured in accordance with 5.2, the measured diameter of the rope shall not exceed the tolerances given in Tables 2 to 4.

Considering the different requirements in lift designs, two grade of diameter tolerances are given in Table 3 for suspension ropes of traction drive lifts and governor ropes with steel or steel-based composite cores (including parallel closed ropes). Purchasers can choose the diameter tolerance according to their needs.



**Table 2 — Tolerances on diameter for suspension ropes for traction drive lifts and governor ropes with cores of fibre or other non-metallic materials**

| Nominal rope diameter $d$ [mm] | Tolerance on nominal rope diameter [%] | | |
|---|---|---|---|
| | Max. at no load | Min. at 5 % of $F_{min}$ | Min. at 10 % of $F_{min}$ |
| ≤10 | +6 | +1 | 0 |
| > 10 | +5 | +1 | 0 |

**Table 3 — Tolerances on diameter for suspension ropes of traction drive lifts and governor ropes with steel or steel-based composite cores (including parallel closed ropes)**

| Tolerance | Nominal rope diameter $d$ [mm] | Tolerance on nominal rope diameter [%] | | |
|---|---|---|---|---|
| | | Max. at no load | Min. at 5 % of $F_{min}$ | Min. at 10 % of $F_{min}$ |
| Grade A | ≤10 | +3 | 0 | -1 |
| | >10 | +2 | 0 | -1 |
| Grade B | ≤10 | +4 | +1 | 0 |
| | >10 | +3 | +1 | 0 |

**Table 4 — Tolerances on diameter for suspension ropes of roped hydraulic lifts and compensating ropes**

| Nominal rope diameter<br>$d$<br>[mm] | Tolerance on nominal rope diameter<br>[%] |
|---|---|
| $6 \leq d < 8$ | +6<br>0 |
| ≥8 | +5<br>0 |

#### 4.4.1.3 Permissible differences in diameter

The difference between any two of the four measurements when measured in accordance with 5.2 at a load equivalent to 5 % or 10 % of the minimum breaking force shall not exceed the values given in Table 5 for ovality.

The difference between the average of the two measurements taken at each of the two positions when measured in accordance with 5.2 at a load equivalent to 5 % or 10 % of the minimum breaking force shall not exceed the values given in Table 5 for average diameter variation.

**Table 5 — Permissible differences in diameter**

| Nominal rope diameter<br>$d$<br>[mm] | Ovality<br>% of $d$ | Average diameter variation<br>% of $d$ |
|---|---|---|
| <8 | 4 | 3 |
| ≥8 | 3 | 2 |



### 4.4.2 Length

The actual length of rope under no load shall be the specified length subject to the following tolerances:

a) ≤400 m: 0~+5 %

b) >400 m and ≤ 1 000 m: 0~+20 m

c) >1 000 m: 0~+2 %

## 4.5 Minimum breaking force

The minimum breaking force, $F_{min}$, for a given diameter, construction or class and rope grade shall be either

a) as given in Tables B.1 to B.11, or

b) as stated by the manufacturer.

For those rope classes covered by Tables B.1 to B.11, the minimum breaking forces of intermediate rope diameters shall be calculated using the formula given in Annex C, with the respective minimum breaking force factors given in Tables B.1 to B.11.

When tested in accordance with 5.3, the measured breaking force $F_m$ shall be greater than or equal to the minimum breaking force $F_{min}$.

Approximate rope length mass, nominal metallic cross-sectional area and approximate outer wire size are also given in Table B.1 to B.11 by calculation using the formulae in Annex D for information only.