



**SLOVENSKI STANDARD**  
**oSIST prEN 12927:2013**  
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**Varnostne zahteve za žičniške naprave za prevoz oseb - Vrvi**

Safety requirements for cableway installations designed to carry persons - Ropes

Sicherheitsanforderungen an Seilbahnen für den Personenverkehr - Seile

Prescriptions de sécurité pour les installations à câbles destinées au transport des personnes - Câbles

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45.100

Oprema za žičnice

Cableway equipment

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English Version

## Safety requirements for cableway installations designed to carry persons - Ropes

Prescriptions de sécurité pour les installations à câbles  
destinées au transport des personnes - Câbles

Sicherheitsanforderungen an Seilbahnen für den  
Personenverkehr - Seile

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 242.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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## Contents

Page

|  |    |
|--|----|
| Foreword .....   | 4  |
| 1 Scope .....  | 5  |
| 2 Normative references .....   | 5  |
| 3 Terms and definitions .....  | 7  |
| 4 Requirements .....   | 9  |
| 5 Symbols and abbreviations .....  | 9  |
| 6 Safety principle.....  | 10 |
| 6.1 General .....  | 10 |
| 6.2 Hazard scenarios.....  | 10 |
| 6.3 Safety measures.....   | 12 |
| 6.3.1 Selection criteria for ropes and their end fixings.....  | 12 |
| 6.3.2 Safety factors .....   | 12 |
| 6.3.3 Discard Criteria.....  | 12 |
| 6.3.4 Long splicing of 6 strand hauling, carrying hauling and towing ropes .....                             | 12 |
| 6.3.5 End fixings.....   | 12 |
| 6.3.6 Inspection, repair and maintenance .....   | 12 |
| 7 Safety requirements .....  | 13 |
| 7.1 Selection criteria for ropes and their end fixing .....  | 13 |
| 7.1.1 Steel ropes.....   | 13 |
| 7.1.2 Fiber ropes.....   | 15 |
| 7.1.3 Rope re-use .....  | 16 |
| 7.1.4 End fixings.....   | 16 |
| 7.2 Safety factors .....   | 16 |
| 7.2.1 General .....  | 16 |
| 7.2.2 Factors .....  | 17 |
| 7.3 Discard criteria .....   | 20 |
| 7.3.1 Main body of rope (and long splice).....   | 20 |
| 7.3.2 Tension ropes.....   | 21 |
| 7.3.3 Local deterioration .....  | 21 |
| 7.3.4 Rope at end fixing .....   | 22 |
| 7.4 Storage,handling and transportation,installation ( including tensioning,connecting and/or splicing)..... | 23 |
| 7.4.1 Storage .....  | 23 |
| 7.4.2 Handling and transportation.....   | 23 |
| 7.4.3 Installation (including tensioning,connecting and/or splicing).....                                    | 24 |
| 7.4.4 Measurements,adjustments,tests and records.....  | 25 |
| 7.5 Long splicing of 6 strand hauling, carrying hauling and towing steel ropes .....                         | 25 |
| 7.5.1 Splice geometry.....   | 25 |
| 7.5.2 Splice dimensions .....  | 26 |
| 7.5.3 Operational documentation .....  | 26 |
| 7.6 End fixings.....   | 26 |
| 7.6.1 End fixing design .....  | 27 |
| 7.6.2 End fixing execution and conformity .....  | 27 |
| 7.6.3 Filled sockets .....   | 27 |
| 7.6.4 Clamp sockets.....   | 29 |
| 7.6.5 Drum ( fixing drum and anchor drum).....   | 31 |
| 7.6.6 Bolted clamp.....  | 32 |
| 7.6.7 Wedge socket .....   | 33 |
| 7.6.8 Spliced eye .....  | 33 |

|          |   |    |
|----------|---|----|
| 7.6.9    | Gripped eye .....   | 33 |
| 7.6.10   | Ferrule secured eye.....  | 33 |
| 7.6.11   | Lever winch .....   | 33 |
| 7.7      | Maintenance, inspection, and repair .....   | 34 |
| 7.7.1    | Maintenance .....   | 40 |
| 7.7.2    | Inspection .....  | 41 |
| 7.7.3    | Repair.....   | 45 |
| 7.8      | Magnetic rope testing.....  | 46 |
| 7.8.1    | Instrumentation Principles of operation of magnetic flux leakage instruments .....  | 46 |
| 7.8.2    | Personnel.....  | 48 |
| 7.8.3    | Magnetic Rope Testing Procedure .....   | 49 |
| 7.8.4    | Instrument verification .....   | 51 |
| Annex A  | (informative) Guidelines for executing Visual Inspection type "A" .....   | 53 |
| Annex B  | (informative) Magnetic Flux Density .....   | 54 |
| Annex ZA | (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2000/9/EC relating to Cableway Installations designed to Carry Persons ..... | 55 |

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## Foreword

This document (prEN 12927:2013) has been prepared by Technical Committee CEN/TC 242 “Safety requirements for passenger transportation by rope”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12927-1:2004, EN 12927-2:2004, EN 12927-3:2004, EN 12927-4:2004, EN 12927-5:2004, EN 12927-6:2004, EN 12927-7:2004, EN 12927-8:2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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## 1 Scope

This European Standard specifies the safety requirements applicable to:

- selection criteria for ropes and their end fixings,
- safety factors (excluding brake ropes and ropes for installations used for the transportation of goods, nor to inclined lifts),
- discard criteria,
- storage, handling, transportation and installation (including tensioning, connecting and/or splicing),
- long splicing of 6 strand hauling, carrying hauling and towing ropes,
- end fixings,
- inspection, repair and maintenance,

and the minimum requirements applicable to:

- MRT and radiographic equipments and procedures for the examination of steel wire ropes.

This standard is not applicable to installations for the transportation of goods nor to inclined lifts.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 444, *Non-destructive testing - General principles for radiographic examination of metallic materials by X- and gamma-rays*

EN 1559-2, *Founding - Technical conditions of delivery - Part 2: Additional requirements for steel castings*

EN 1709, *Safety requirements for cableway installations designed to carry persons - Precommissioning inspection, maintenance, operational inspection and checks*

EN 1908, *Safety requirements of cableway installations designed to carry persons - Tensioning devices*

EN 1909, *Safety requirements for cableway installations designed to carry persons – Recovery and evacuation*

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

EN 12385-2, *Steel wire ropes - Safety - Part 2: Definitions, designation and classification*

EN 12385-4, *Steel wire ropes - Safety - Part 4: Stranded ropes for general lifting applications*

EN 12385-8, *Steel wire ropes - Safety - Part 8: Stranded hauling and carrying-hauling ropes for cableway installations designed to carry persons*

**prEN 12927:2013 (E)**

EN 12385-9, *Steel wire ropes - Safety - Part 9: Locked coil carrying ropes for cableway installations designed to carry persons*

EN 12397, *Safety requirements for cableway installations designed to carry persons - Operation*

EN 12408, *Safety requirements for cableway installations designed to carry persons - Quality assurance*

EN 12929-1, *Safety requirements for cableway installations designed to carry persons - General requirements - Part 1: Requirements for all installations*

EN 12929-2, *Safety requirements for cableway installations designed to carry persons - General requirements - Part 2: Additional requirements for reversible bicable aerial ropeways without carrier truck brakes*

EN 12930, *Safety requirements for cableway installations designed to carry persons - Calculations*

EN 13107, *Safety requirements for cableway installations designed to carry persons - Civil engineering works*

EN 13223, *Safety requirements for cableway installations designed to carry persons - Drive systems and other mechanical equipment*

EN 13243, *Safety requirements for cableway installations designed to carry persons - Electrical equipment other than for drive systems*

EN 13411-2, *Terminations for steel wire ropes - Safety - Part 2: Splicing of eyes for wire rope slings*

EN 13411-3, *Terminations for steel wire ropes - Safety - Part 3: Ferrules and ferrule-securing*

EN 13411-4, *Terminations for steel wire ropes - Safety - Part 4: Metal and resin socketing*

EN 13411-5, *Terminations for steel wire ropes - Safety - Part 5: U-bolt wire rope grips*

EN 13411-6, *Terminations for steel wire ropes - Safety - Part 6: Asymmetric wedge socket*

EN 13411-7, *Terminations for steel wire ropes - Safety - Part 7: Symmetric wedge socket*

EN 13796-1, *Safety requirements for cableway installations designed to carry persons - Carriers - Part 1: Grips, carrier trucks, on-board brakes, cabins, chairs, carriages, maintenance carriers, tow-hangers*

EN 13796-2, *Safety requirements for cableway installations designed to carry persons - Carriers - Part 2: Slipping resistance test for grips*

EN 13796-3, *Safety requirements for cableway installations designed to carry persons - Carriers - Part 3: Fatigue tests*

EN ISO 9554, *Fibre ropes - General specifications (ISO 9554)*

EN ISO 9934-1, *Non-destructive testing - Magnetic particle testing - Part 1: General principles (ISO 9934-1)*

EN ISO 10547, *Polyester fibre ropes - Double braid construction (ISO 10547)*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*



### 3 Terms and definitions

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

#### 3.1

##### **additional tensioning device**

additional device intended to hold the tension in a rope in case of failure of the main tensioning device

#### 3.2

##### **bending ratio (rope)**

ratio between either:

the pitch diameter of the sheave (D) and the nominal rope diameter (d)

the pitch radius of the shoe, saddle or roller chain (R) and the nominal rope diameter (d)

#### 3.3

##### **bolted clamp**

accessory end fixing consisting of two grooved plates bolted together between which the entire rope is pressed and secured by means of bolts

#### 3.4

##### **clamp socket**

type of end fixing incorporating a socket basket wherein the entire strands of the rope are separated from each other and secured between the socket basket and a conical shaped wedge, usually incorporating grooves to match them

#### 3.5

##### **discard criteria**

level of deterioration at which the rope or the end fixing is declared unfit for further service

#### 3.6

##### **drum**

end fixing consisting of a number of dead turns of rope permanently wound around a winch support, the end of the rope being secured by means of a bolted clamp

#### 3.7

##### **dynamic bending**

rope bending which varies significantly during operations

#### 3.8

##### **efficiency**

ratio between the breaking force of the combination of rope and end fixing, and the minimum breaking force of the rope. It determines the load bearing capacity of the combination in respect to those of the wire rope

#### 3.9

##### **filled socket**

socket end fixing where a into the brushed rope end is secured using molten metal a poured suitable mean

#### 3.10

##### **indicators**

devices inserted into the rope with the scope to identify and mark particular rope areas

#### 3.11

##### **installer**

person or organisation responsible for the whole rope installation, the splicing and the end connecting, the tensioning and the adjustment, or a part of it

## prEN 12927:2013 (E)

**3.12****lever winch**

end fixing accessory comprising a mechanism actuated by a lever and acting on two sets of jaws alternately gripping the rope and moving it longitudinally

**3.13****local discontinuity**

localised fault or defect such as a broken or damaged wire or a corrosion pit on a wire

**3.14****loss of metallic area**

reduction in area expressed as a percentage of the nominal metallic cross-sectional area of the new rope, taking into account the effects of broken wires and the effect of corrosion and wear

**3.15****lubrification agent**

any product applied to the rope in service in order to protect it against internal wear, corrosion or both

**3.16****magnetic rope testing**

method of testing based on the detection of the magnetic flux leakage of a magnetized rope

**3.17****main body of the rope**

all the length of rope excluding any sections in end fixing or long splice

**3.18****nominal diameter (d)**

dimension by which the rope is designed

**3.19****optical rope inspection devices**

instrumentation designed to acquire and record images of ropes surface.

**3.20****radiographic examination**

method of testing based on the impress of a film by X or gamma rays passing through a wire rope

**3.21****reference bendings**

total number of bends over sheaves in one complete revolution (unidirectional ropeways) or one complete ride forward and backward ( reversible ropeways)

**3.22****reference length**

the length of rope over which the value of a specified characteristic is measured or assessed e.g. 6xd (6 x nominal diameter of the rope)

**3.23****rope signature**

the signals on the test recording display as the rope travels through the test head on the first occasion that it is tested. The signature is taken as the datum upon which in-service deterioration effects are referred. The signature reflects the construction of the rope and changes in magnetic characteristics of the rope among its length, e.g. magnetic permeability differences

**3.24****single function instrument**

instrument which detects either local discontinuities

**3.25**

**slipping force**

maximum longitudinal tension force, which can be applied at a clamped to a rope held by friction before its initial slippage

**3.26****socket basket**

part of the socket containing the metal or resin cone

**3.27****static bending**

rope bending which does not vary significantly during operations

**3.28****tensile safety factor**

ratio between the Minimum Breaking Force of the rope and the calculated tension force in the rope (see EN 12930)

**3.29****test head**

device on that part of the test instrument positioned around the rope during testing which generates the magnetising field and contains the detecting or sensing elements

**3.30****transverse force factor**

ratio between the tension force in the rope and the force normal to the rope axis

**3.31****visual inspection**

method of inspection based on the visual detection of wire rope damages

**3.32****wire break indication**

indication from the local discontinuity (LD) channel of the test instrument specifically identified as an internal or external wire break type

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**4 Requirements**

The requirements of this document apply to all installations along with those of EN 1709, EN 1908, EN 1909, EN 12397, EN 12408, EN 12929-1, EN 12929-2, EN 12930, EN 13107, EN 13223, EN 13243, EN 13796-1, EN 13796-2 and EN 13796-3.

**5 Symbols and abbreviations**

|       |  |
|-------|--|
| sf    | slipping force   |
| $D/d$ | the pitch diameter of the sheave (D) and the nominal rope diameter (d)                     |
| $R/d$ | the pitch radius of the shoe, saddle or roller chain (R) and the nominal rope diameter (d) |
| LD    | local discontinuity  |
| MRT   | magnetic rope testing  |
| RT    | radiographic examination   |
| VI    | visual inspection  |

**prEN 12927:2013 (E)**

OID            optical rope inspection devices

**6 Safety principle****6.1 General**

The safety principles set out in EN 12929-1 apply.

If ropes of different productions are required to be spliced together, they shall have the same basic design

characteristics in terms of nominal rope diameter, strand construction, minimum breaking force, direction and type of lay, wire grades, measured rope diameter and measured lay length.

Rope repairs using ropes or strands of different production batches are allowed.

Irrespective of whether the rope is inspected by MRT or visual means, the same wire broken in several places over the stated reference length shall be regarded as a single broken wire.

Loose wires and wires repaired by welding, brazing or gluing shall be regarded as broken wires.

Ropes shall be discarded if their condition cannot, or can no longer, be assessed with the current methods of inspection.

**6.2 Hazard scenarios**

The following events may lead to hazardous situations which may be avoided or limited by the requirements of this document.

Selection criteria for ropes and their end fixing:

- a) The breakage of a rope or the failure of an end fixing may lead to the following hazardous situations:
  - 1) Falling down of rope with the risk of carrier crash and the risk of impact to persons;
  - 2) Release of the elastic potential energy of a tensioned / extended rope;
- b) Deterioration/damages of the structure of the rope can lead to the following hazardous situations:
  - 1) Derailment of rope (deropement);
  - 2) Derailment of carrier truck.
- c) The rotation of the rope around its axis in the low rope tow systems can create dangerous situation to the user.
- d) Vibrations may lead to premature failures of the installation components.

Safety factors:

- e) Excessive working stress in the steel wires may lead to premature fatigue breaks and rope-failure within the stated inspection intervals.

Discard criteria:

- f) excessive decrease of the metallic cross sectional area may lead to the breakage of the rope;

- g) fatigue breaks, loose wires, corrosion and wear may lead to a failure of end fixing and of ropes;
- h) deterioration/damaging of the structure of the rope can lead to deropement or to insufficient
- i) attachment of the grip:
  - 1) Storage, handling, transportation and installation (including tensioning, connecting and/or splicing)
- j) elevated temperature and inefficient rope protection during storage may lead to corrosion which may
- k) lead to rope failure within an inspection period;
- l) failure of properly supporting the reels may allow it to roll out;
- m) failure of the rope connection with an auxiliary rope or with the brake controlled reel may lead to loss of control of the rope uncoiling process.

Long splicing of 6 strand hauling, carrying hauling and towing ropes:

- n) slipping apart of the two rope ends connected by a long splice may lead to a failure of the long splice;
- o) variations of the diameter in the splice area may lead to slippage or malfunction of the grips;
- p) reduction of the diameter in the splice area may lead to an increase of stresses in the rope.

End fixings:

- q) failure of the end fixing may lead to the release of the rope end from the end fixing or from the installation anchor point;
- r) slipping of the rope end in the end fixing may lead to hazardous disturbances in the function with other components
- s) the risk of lack of brush cleaning, due to environmental operating conditions during socketing, may reduce the safety level of the end fixing

Inspection, repair and maintenance:

- t) rope dirt surface may lead to a malfunction of components (carrying rope brakes, detachable grips etc.) interacting to the rope.

Magnetic rope testing:

- u) poor MRT instrument design can impair the execution of the inspections;
- v) poor MRT instrument sensitivity prevents proper damage evaluation
- w) not detectable malfunction of the MRT instrument during the inspection prevents proper damage evaluation;
- x) inability of personnel to properly carry out the inspection prevents proper damage evaluation;
- y) absence of, or inaccuracy in, the inspection report.

### 6.3 Safety measures

#### 6.3.1 Selection criteria for ropes and their end fixings

To select ropes and end fixings in accordance with this standard.

#### 6.3.2 Safety factors

The risk of a rope failure within stated inspection intervals shall be limited by:

- a) incorporating a tensile safety factor in accordance with this standard into the rope design calculation according to EN 12930;
- b) incorporating a bending ratio in accordance with this standard into the design of sheaves, drums, saddles or any support of ropes where the curvature of the rope is determined only by the curvature of the support; and by
- c) avoiding a bending stress in the steel wires exerted by transverse forces exceeding the allowable bending stress limited by the bending ratio given in this standard.

#### 6.3.3 Discard Criteria

- a) The decrease of the metallic cross sectional area shall be limited by repair according to this standard or by discarding the rope according to this standard;
- b) the risk of a failure of end fixing and of ropes may be reduced by discarding by timeout (hours or years) according to this standard;
- c) deterioration/damaging of the structure of the rope shall be limited by repair according to this standard or by discarding the rope according to this standard;
- d) the risk of slipping apart spliced rope ends may be reduced by repair according to this standard or by discarding the long splice according to this standard.

#### 6.3.4 Long splicing of 6 strand hauling, carrying hauling and towing ropes

The risk of slipping apart of the spliced rope ends may be reduced by a correct correlation of geometrical characteristics of the two ropes connected by the splice, by selecting the splice geometry in accordance with this standard and by selecting the correct auxiliary (wrapping) material.

The risk of an insufficient grip attachment may be reduced by applying the diameters overall to the splice in accordance with this standard.

#### 6.3.5 End fixings

The risk of release of the rope end may be reduced by design, executing and discarding the end fixing in accordance with this standard;

The risk of hazardous disturbances in the function with other components may be reduced by performing and inspecting the end fixing in accordance with this standard.

#### 6.3.6 Inspection, repair and maintenance

- a) the risk of malfunction of components may be reduced by cleaning the rope surface;
- b) the risk of corrosion and excessive internal friction may be reduced by lubrication the rope in accordance with this standard;

- c) the risk of stress concentration shall be limited by discarding the rope or by relocation in accordance with this standard;
- d) the effect of the working stress on the steel wires shall be controlled by assessing the current condition of rope and end fixing by inspections at intervals in accordance with this standard.

## 7 Safety requirements

### 7.1 Selection criteria for ropes and their end fixing

#### 7.1.1 Steel ropes

The type of ropes shall be selected in accordance with Table 1 and Table 2.

**Table 1 — Ropes selection criteria- Aerial ropeway**

| Type of cableway for passenger transport |           | Aerial ropeway  |  |
|--|-----------|---|--|
|  |           | Monocable or double   | Bicable  |
| Ordinary designation of cableway         |           | Chairlift, bucketlift or cabin  | Cabin<br>Reversible aerial ropeway                                   |
| Carrying rope                            |           |   | Full locked coil rope  |
| Carrying-hauling rope                    |           | Single layer stranded rope<br>(fibre or solid polymer core)   |  |
| Haulage rope                             | Spliced   |   | Single layer stranded rope (fibre, solid polymer core or steel rope) |
|  | End fixed |   | Single layer stranded rope   |
| Tension rope (incl. dual ropes)          |           | Full locked coil rope or single layer stranded rope (fibre, solid polymer or steel core) or rotation resistant rope |  |
| Recovery rope                            | Winch     | Single layer stranded rope or rotation resistant rope   |  |
|  | Rope loop | Single layer stranded rope (fibre or solid polymer core)  |  |
| Evacuation rope                          |           | Stranded rope or fibre rope or rotation resistant rope  |  |
| Guy rope                                 |           | Spiral strand or full locked coil or single layer stranded rope (fibre, solid polymer or steel core)                |  |
| Signal cable                             |           | Performed spiral strand, locked coil or single layer stranded rope or rotation resistant rope                       |  |
| Brake rope                               |           |   | Single layer stranded rope (fibre core)                              |