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Varnostne zahteve za žičniške naprave za prevoz oseb - Pogonski sistemi in druga mehanska oprema

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

Sicherheitsanforderungen für Seilbahnen für den Personenverkehr - Antriebe und weitere mechanische Einrichtungen

Prescriptions de sécurité pour les installations à câbles transportant des personnes - Entraînements et autres dispositifs mécaniques

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

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Foreword

This document (prEN 13223:2013) has been prepared by Technical Committee CEN/TC 242 “Safety requirements for cableway installations designed to carry persons”, the secretariat of which is held by AFNOR.

This document is currently submitted for CEN enquiry.

This document replaces the EN 13223:2004.

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

For the relationship with EU Directives, see informative Annex ZA, which is an integral part of this document.

This document forms part of the standards programme approved by the CEN Technical Board on safety requirements for cableway installations designed to carry persons. This programme comprises the following standards:

- 1) Safety requirements for cableway installations designed to carry persons – Terminology
- 2) Safety requirements for cableway installations designed to carry persons – General requirements
- 3) Safety requirements for cableway installations designed to carry persons – Calculations
- 4) Safety requirements for cableway installations designed to carry persons – Ropes
- 5) Safety requirements for cableway installations designed to carry persons – Tensioning devices
- 6) Safety requirements for cableway installations designed to carry persons – Drive systems and other mechanical devices
- 7) Safety requirements for cableway installations designed to carry persons – Carriers
- 8) Safety requirements for cableway installations designed to carry persons – Electrical installations apart from drive systems
- 9) Safety requirements for cableway installations designed to carry persons – Civil engineering works.
- 10) Safety requirements for cableway installations designed to carry persons – Precommissioning inspection, maintenance and operational inspection and checks
- 11) Safety requirements for cableway installations designed to carry persons – Recovery and evacuation
- 12) Safety requirements for cableway installations designed to carry persons – Operation
- 13) Safety requirements for cableway installations designed to carry persons – Quality assurance

Together these form a series of standards applicable to the design, manufacture, erection, maintenance and operation of all cableway installations designed to carry persons.

In respect of ski-tows, the drafting of this document has been guided by the works of the International Organisation for Transportation by Rope (OITAF).

1 Scope

This document specifies safety requirements for the mechanical and electrical devices of the drive system and other mechanical devices for cableway installations designed to carry persons. This standard is applicable to the various types of installations and takes into account their environment.

This document applies to the design, erection, manufacture, maintenance and operation of the mechanical and electrical devices of the drive system and other mechanical devices for cableway installations designed to carry persons.

It includes requirements relating to the prevention of accidents and protection for workers.

It does not apply to installations for the transportation of goods, nor to inclined lifts.

Clauses 6 to 11 apply to the mechanical and electrical devices of the drive system.

Clauses 12 to 20 apply to other mechanical devices.

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 287-1, *Qualification test of welders – Fusion welding – Part 1: Steels*

EN 288, *Specification and approval of welding procedures for metallic materials*

EN 1709, *Safety requirements for cableway installations designed to carry persons – Precommissioning inspection, maintenance, operational inspections and checks* 23:2015

<https://standards.iteh.ai/catalog/standards/sist/196fe82c-1d6a-4c97-b167->

EN 1907:2005, *Safety requirements for cableway installations designed to carry persons – Terminology*

EN 1908, *Safety requirements for cableway installations designed to carry persons – Tensioning devices*

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

EN 1993-1-1, *Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings*

EN 10204, *Metallic products – Types of inspection documents*

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

EN 12408, *Safety requirements for cableway installations designed to carry persons – Quality control*

EN 12927-1, *Safety requirements for cableway installations designed to carry persons – Ropes – Part 1: Selection criteria for ropes and their end fixings*

EN 12927-2, *Safety requirements for cableway installations designed to carry persons – Ropes – Part 2: Safety factors*

EN 12927-3, *Safety requirements for cableway installations designed to carry persons – Ropes – Part 3: Long splicing of 6 strand hauling, carrying hauling and towing ropes*

EN 12927-4, *Safety requirements for cableway installations designed to carry persons – Ropes – Part 4: End fixings*

- EN 12927-5, *Safety requirements for cableway installations designed to carry persons – Ropes – Part 5: Storage, transportation, installation and tensioning*
- EN 12927-6, *Safety requirements for cableway installations designed to carry persons – Ropes – Part 6: Discard criteria*
- EN 12927-7, *Safety requirements for cableway installations designed to carry persons – Ropes – Part 7: Inspection, repair and maintenance*
- EN 12927-8, *Safety requirements for cableway installations designed to carry persons – Ropes – Part 8: Magnetic rope testing (MRT)*
- 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 bi-cable 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 13243, *Safety requirements for cableway installations designed to carry persons – Electrical equipment other than for drive systems*
- 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 20898, *Mechanical properties of fasteners*
- EN ISO 5817, *Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*
- EN ISO 4414, *Pneumatic fluid power. General rules and safety requirements for systems and their components*
- ISO 6336, *Calculation of load capacity of spur and helical gears*
- ISO 281, *Rolling bearings. Dynamic load ratings and rating life*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1907:2005 and the following apply.

- 3.1 automatic operation**
the whole journey is controlled automatically from the control console and under special conditions can be partly influenced from the control points
- 3.2 manual control**
the whole journey is controlled only by the person at the control console
- 3.3 electrical stop**
the bringing of the cableway or ski-tow to a standstill by interrupting the respective safety circuit by means of an emergency stop with the aid of the main drive motor or the auxiliary drive motor
- 3.4 emergency stop using service brake**
process in which, after the appropriate safety circuits have been broken, the service brake is applied and the energy flow to the main or auxiliary motor is interrupted
- 3.5 emergency stop using safety brake**
process in which, after one of the appropriate safety circuits has been broken or by mechanical tripping, the safety brake is applied and the energy flow to the main motor interrupted
- 3.6 braking force closed-loop control**
process during the braking procedure in which the braking force is controlled by a closed loop in accordance with a preset deceleration value so that the cableway is brought to a stop under as constant a deceleration as possible
- 3.7 braking force setting**
setting the braking force by the control system, based on the torque generated by the main drive motor immediately before the stop is initiated, where the braking force remains constant until the installation has come to rest
- 3.8 deceleration monitoring**
monitoring the deceleration caused by stopping the cableway by means of the main motor or a mechanical brake
- 3.9 ready for operation**
an installation is ready for operation when no safety function or emergency stopping device prevents departure
- 3.10 ready command**
validation signal from control posts outside the drive station for starting up the cableway
- 3.11 normal stopping point**
the normal stopping position of the carrier in the stations in cableways with reversible or pulsed movement operation

3.12**retraction distance**

the distance of the carriage from the stopping point in the station when the other carriage at the opposite station has contacted the buffer

3.13**entry monitoring**

monitoring of the speed in the station entry area

3.14**position monitor checking**

this comprises various checks of the position monitor as follows

3.14.1**fixed point checking**

checks the information provided by the position monitor on the position of the carrier in relation to a fixed point on the line

3.14.2**synchronicity monitoring**

monitors the information provided by one position monitor on the position of the carrier compared with a second position monitor

3.14.3**zero position check**

check made to confirm that the position monitors are in the starting positions when the carriers are in the station

3.15**minimum speed**

the minimum speed is a lower speed limit which, if fallen below, leads to the cableway being stopped

3.16**main carrier rail**

the structure on which carriers are moved in normal operation from the entrance to the exit of a station

3.17**continuous operation**

an operating state where the installation is operated continuously with either a full or partial load

4 General requirements**4.1 Application of the standard**

The requirements of this document, together with those of EN 1709, EN 1908, EN 1909, EN 12397, EN 12408, EN 12927 (Parts 1 to 8), EN 12929 (Parts 1 and 2), EN 12930, EN 13243, EN 13107, and EN 13796 (Parts 1 to 3) apply to all cableway installations.

4.2 Safety principles

The safety principles formulated in EN 12929-1 apply.

For the electrical equipment of the drive system, the safety principles of EN 13243 are applicable.

In addition, the following hazard scenarios and safety measures apply for the scope of this document.

prEN 13223:2013 (E)**4.2.1 Hazard scenarios**

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

- a) derailment of ropes;
- b) obstruction of the operating movement of ropes due to obstruction by mechanical devices or hooking over parts of the installation;
- c) damage to or failure of drive and braking devices and support and guiding elements of ropes due to wear, heat, corrosion or fatigue;
- d) failure of drive and braking devices and support and guiding elements of ropes and other mechanical devices in stations and on the line due to inadequate dimensioning;
- e) reduction of the force transmission from the drive sheave to the haulage rope or carrying hauling rope;
- f) reduction of the frictional force of the braking device;
- g) hooking or falling of carriers at line support structures and in stations;
- h) collision of carriers or between a carrier and an obstacle when entering into, exiting from and passing through stations;
- i) faulty attachment or detachment of carriers with detachable grips;
- j) excessive deceleration or acceleration of the haulage ropes and carrying hauling ropes and of the carriers;
- k) exceeding the maximum permissible speed;
- l) unintentional starting of the ropeway;
- m) hazards to persons in passageways and working areas, due to mechanical devices;
- n) inadmissible pitch between carriers;
- o) operation in unfavourable weather conditions (e.g. wind, frost, icing, rain);
- p) inappropriate behaviour on the part of persons (passengers, personnel, third parties).

4.2.2 Safety measures

Safety measures are required to avoid the hazard scenarios listed in 4.2.1.

The measures specified in this document are essentially construction-related and have the following aims:

- a) prevention of rope derailment;
- b) in the event of rope derailment: catching the rope, prevention of hooking or jamming the rope and bringing the installation to a standstill;
- c) prevention of derailment, falling, hooking and dangerous collision of carriers;
- d) prevention of failure of mechanical and hydraulic safety devices;
- e) detection of hazardous malfunctioning of detachable grips and bringing the carriers safely to a standstill;

- f) detection of inadmissible pitch between carriers and taking the required measures;
- g) prevention of insufficient or excessive deceleration and excessive acceleration of haulage and carrying hauling ropes and carriers;
- h) detection of exceeding of maximum permissible speed and bringing the ropeway to a standstill;
- i) detection of unintentional starting of the ropeway and taking the required measures;
- j) protection of persons against falling and against contact with moving parts;
- k) prevention of hazards to persons due to collision with carriers.

5 General requirements for hydraulic devices

The requirements of EN 1908 apply for hydraulic devices.

6 General requirements for drive systems

6.1 General principles

6.1.1 The general requirements of EN 12929-1 are to be taken into account in the design of devices in drive systems.

6.1.2 The drive system shall permit start-up and stopping several times consecutively.

6.1.3 The requirements for other electrical devices are contained in EN 13243.

6.2 Main drive system

6.2.1 The main drive system shall permit as smooth a start as possible and travel in either direction, regardless of load. It shall be designed for continuous operation with the most unfavourable loading condition and at the maximum permissible speed.

6.2.2 It shall be possible to start the installation with the main drive at an average acceleration of not less than $0,15 \text{ m/s}^2$ with the most unfavourable load. For aerial ropeways, an average acceleration of $0,5 \text{ m/s}^2$ and an instantaneous acceleration (average acceleration over $0,5 \text{ s}$) of $1,5 \text{ m/s}^2$ shall not be exceeded.

6.2.3 The speed shall be continuously adjustable over the whole range between the minimum speed and the maximum permissible speed. For test runs with no significant load, it shall be possible to maintain a speed of approximately $0,3 \text{ m/s}$ during the period required to travel the whole length of the line.

6.2.4 It shall be possible to maintain the predetermined speed accurately enough and keep it stable for all load conditions occurring during normal operation.

6.2.5 Deviations from the speed setpoint shall not exceed $\pm 5 \%$.

6.2.6 If the cableway has to be brought to a stop, the power supply to the main motor shall be shut off automatically by two circuits (redundancy) of which at least one shall be galvanic or of an equivalent system. In the case of an emergency stop using service brake or an emergency stop using safety brake, the power supply shall be shut off immediately, otherwise it shall be shut off no later than the time when the installation comes to rest.

6.2.7 In the case of a multiple-motor drive, the motors shall be loaded in accordance with their power in every operating condition.

prEN 13223:2013 (E)**6.3 Auxiliary drive**

6.3.1 The auxiliary drive shall be capable of maintaining operation at a speed that complies with the requirements.

6.3.2 In addition, the other requirements of 6.2.1 shall be met.

6.4 Recovery drive and evacuation drive

6.4.1 The recovery drive is used only to recover the carriers (see EN 1909).

6.4.2 The recovery drive shall be designed to operate for three times the duration of the maximum required recovery time and at a travelling speed of not less than 0,5 m/s.

6.4.3 The recovery drive shall be provided with the safety devices which are required for safe recovery at the requisite speed.

6.4.4 For the recovery drive to remain capable of operation even in the case of failure of all safety devices, it shall be possible to bypass these in accordance with EN 13243.

6.4.5 The electrical devices of the emergency and evacuation drive shall be as simple as possible in construction. It shall be possible to ensure their operability in a simple manner.

6.4.6 The electrical equipment of these drives shall be separate from each other and from that of the main drive so that any interactions between the various drives are kept to a minimum.

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6.4.7 In addition, the following apply for recovery drives:

- a) it shall be possible to put the recovery drive into operation within 15 min;
- b) it shall not be possible for serious faults to occur during changeover;
- c) errors on the part of the controller of the recovery drive, e.g. wrong direction of travel, shall not result in any overloading of mechanical parts or grips;
- d) continued operation of the recovery drive shall be possible in the case of failure of any remote control.

6.5 Types of control systems

6.5.1 The installation may be started and its operation partly controlled:

- a) by the engineer from the control console (control console control system);
- b) by personnel from the control points in the carriers (carrier control system);
- c) by personnel from the control points on the station platforms (platform control system);
- d) by means of special devices (for example, timers, passenger counters) or by passengers (automatic control system);
- e) on service runs, by personnel from a control point at the counter station or return station (service run control system).

6.5.2 Regardless of the other types of control system available, each cableway shall be provided with a control console control system.

6.5.3 Only one type of control system shall be operational at any time. In particular, the travel command shall only be capable of being given from the control points belonging to the corresponding control system.

6.5.4 Switching from one type of control system to another shall only be possible with the cableway at a standstill and it shall be possible to make such a change rapidly.

6.6 Safety functions and control devices

6.6.1 If a safety function is initiated or an emergency stop device is operated, the cableway shall automatically be brought safely to a stop (electric stop, emergency stop using service brake or emergency stop using safety brake) and/or start-up shall be automatically blocked by breaking the relevant safety circuit.

NOTE Bringing safely to a stop also means that, after a safety function has been initiated, if no more torque is to be applied by the main or auxiliary drive, an emergency stop using service brake or, if appropriate, an emergency stop using safety brake should be initiated.

6.6.2 Failure of the main power supply shall not impair the action of the safety functions or shall result in the cableway being put into a safe state. This shall not prevent the recovery drive from being used.

6.6.3 After the initiation of a safety function or if an emergency stop device has been operated, start-up shall only be possible after manual resetting in the control room or at other points with equivalent operating and indicating devices and resetting:

- a) shall only be effective when the cableway is at a standstill;
- b) shall not adversely affect the operability of the safety function or of the emergency stop device itself.

6.6.4 Operation of a maintenance switch (safety switch) shall: