BS EN 13223:2015+A1:2022

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

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National foreword

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The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by ▌A1⟩ ⟨A1▌.

The UK participation in its preparation was entrusted to Technical Committee MCE/20, Aerial ropeways.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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EN 13223:2015+A1

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

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Foreword

This document (EN 13223:2015+A1:2022) 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 European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2023, and any conflicting national standards shall be withdrawn at the latest by June 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be responsible for identifying any or all such patent rights.

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 Regulation (EU) 2016/424.

For the relationship with Regulation (EU) 2016/424, see informative Annex ZA, which is an integral part of this document.

This document supersedes EN 13223:2015 .

With respect to EN 13223:2004, the following significant amendments have been made:

— In Clause 1, an addition about employee protection has been added.

— In Clause 3, terms and conditions have been removed.

— In 4.2.2, clauses l) and p) have been defined more precisely.

— In 6.2.6, the requirement for the interruption of the power flow to the main drive motor has been amended.

— In 6.3.1, the requirement for the speed of the auxiliary drive has been removed.

— In 6.8.4, it has been defined more precisely that only the safety components must be calculated with the mentioned safety factors.

— 6.9.2.3 has been expanded.

— In 7.3.1, the requirement has been narrowed in terms of the need for monitoring the types of control systems.

— In 8.2.2, the allowable difference in the speed value has been defined with 10 % of the nominal speed.

— In 8.3.2, the response effect of the 10 % overspeed trigger has been defined more precisely.

— In 8.3.3, the response effect of the 20 % overspeed trigger has been defined more precisely.

— In 8.4.2, the reference to Appendix A has been removed.

— 8.4.3 has been rewritten to uniformly define the safety requirement for braking systems.

— In 8.6.7, the requirement for sufficient static friction has been added.

— In 8.6.9, the monitoring requirement has been extended to all DC motors.

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— 9.1.1 has been expanded.

— In 9.1.2, the requirement for the minimum delay has been redefined.

— 9.1.3 has been clarified.

— 9.3.1 has been clarified.

— In 9.3.6, the requirement of 20 % overspeed trigger has been removed.

— In 9.4, the reference standards for pneumatic systems have been added.

— 10.3.4 has been defined more precisely.

— 11.7.2 has been defined more precisely.

— 11.8.7 has been defined more precisely.

— In 11.9.1, the reference to the appendices has been removed.

— In 12.1.3, content has been revised. The safety factor for calculating fatigue has been defined.

— In 12.2.6, the requirement has been extended to all sheaves.

— In 12.2.8, the response effect of the monitoring has been defined more precisely. The requirement for evacuation ropes has been defined.

— 13.1.2 has been redrafted. The slip resistance has been defined.

— In 14.2 the requirement for evacuation ropes has been defined.

— 14.3 has been redrafted.

— 15.1.2 has been defined more precisely.

— In 17.1.1.4, the requirement was removed that the devices must be located in the stations.

— 17.8.3 has been defined more precisely.

— 17.9 has been clarified.

— In 18.1.1.2, the exceptions have been expanded to the station area of all types of systems.

— In 18.1.1.3, the exceptions have been expanded to the station area of aerial ropeways.

— In 18.1.1.4, the requirement for new and unformed linings has been applied.

— In 18.1.3.5, the option of using an appropriate safety device has been introduced.

— In 18.2.3, the requirement has been expanded to the entire track rope shoe.

— In 18.2.8, the option has been introduced to not require rope catching devices on the track rope shoes.

— 18.2.10 has been clarified.

— In 18.3.2 the requirement has been removed, because the reference to EN 12929-1 is sufficient.

— 20.3.2 has been redrafted.

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— Annex A has been changed to “Informative”. The content of Table A. 1 has been revised.

— Annex B has been changed to “Informative”. The content of Table B. 1 has been revised.

— Annex ZA has been revised.

A1 This European Standard is part of a series of standards on safety requirements for cableway installations designed to carry persons. This series consists of the following standards:

— EN 1907, *Terminology*

— EN 12929 (all parts) , *General requirements*

— EN 12930, *Calculations*

— EN 12927, *Cables*

— EN 1908, *Tensioning devices*

— EN 13223, *Drive systems and other mechanical equipment*

— EN 13796 (all parts), *Carriers*

— EN 13243, *Electrical equipment other than for drive systems*

— EN 13107, *Civil engineering works*

— EN 1709, *Pre-commissioning inspection, maintenance, operational inspections and checks*

— EN 1909, *Recovery and evacuation*

— EN 12397, *Operation*

— EN 12408, *Quality control*

— EN 17064, *Prevention and fight against fire*

All of these standards form a single package for the planning, manufacture, assembly, maintenance and operation of cableway installations designed to carry persons. A1

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).

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

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1 Scope

This European Standard 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 European Standard applies to the design, manufacture, installation, 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 concerning the prevention of accidents and the protection of workers without prejudice to the application of national regulations.

National regulations regarding building or construction or that are designed to protect particular groups of people, remain unaffected.

It does not apply to installations for the transportation of goods, or to 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.

[A1⟩ EN 1709:2019, *Safety requirements for cableway installations designed to carry persons – Precommissioning inspection, maintenance and operational inspections and checks*

[A1⟩ EN 1907:2017 ⟨A1], *Safety requirements for cableway installations designed to carry persons – Terminology*

EN 1908:2015, *Safety requirements for cableway installations designed to carry persons – Tensioning devices*

[A1⟩ EN 1909:2017 ⟨A1], *Safety requirements for cableway installations designed to carry persons – Recovery and evacuation*

[A1⟩ EN 1993 1-1:2005 ⟨A1], Eurocode 3*: Design of steel structures – Part 1-1: General rules and rules for buildings*

[A1⟩ EN 10204:2004 ⟨A1], *Metallic products – Types of inspection documents*

[A1⟩ EN 12397:2017 ⟨A1], *Safety requirements for cableway installations designed to carry persons – Operation*

[A1⟩ EN 12408:2004 ⟨A1], *Safety requirements for cableway installations designed to carry persons – Quality control*

[A1⟩ EN 12927:2019 ⟨A1], *Safety requirements for cableway installations designed to carry persons – Ropes*

EN 12929-1:2015, *Safety requirements for cableway installations designed to carry persons – General requirements – Part 1: Requirements for all installations*

EN 12929-2:2015, *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*

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[A1] EN 12930:2015 [A1], *Safety requirements for cableway installations designed to carry persons – Calculations*

[A1] EN 13107:2015 [A1], *Safety requirements for cableway installations designed to carry persons – Civil engineering works*

EN 13243:2015, *Safety requirements for cableway installations designed to carry persons – Electrical equipment other than for drive systems*

[A1] prEN 13796-1:2017 [A1], *Safety requirements for cableway installations designed to carry persons – Carriers – Part 1: Grips, carrier trucks, on-board brakes, cabins, chairs, carriages, maintenance carriers, towhangers*

[A1] EN 13796-2:2017 [A1], *Safety requirements for cableway installations designed to carry persons – Carriers – Part 2: Slipping resistance test for grips*

[A1] EN 13796-3:2017 [A1], *Safety requirements for cableway installations designed to carry persons – Carriers – Part 3: Fatigue tests*

[A1] ISO 898-1:2013, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*

ISO 898-2:2012, *Fasteners – Mechanical properties of fasteners made of carbon steel and alloy steel – Part 2: Nuts with specified property classes – Coarse thread and fine pitch thread*

ISO 898-3:2018, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 3: Flat washers with specified property classes* [A1]

[A1] EN ISO 4414:2010 [A1], *Pneumatic fluid power — General rules and safety requirements for systems and their components ([A1] ISO 4414:2010 [A1])*

[A1] EN ISO 5817:2014 [A1], *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections ([A1] ISO 5817:2014 [A1])*

[A1] EN ISO 9606-1:2019 [A1], *Qualification testing of welders — Fusion welding — Part 1: Steels* (ISO 9606-1)

[A1] ISO 281:2007 [A1], *Rolling bearings — Dynamic load ratings and rating life*

[A1] ISO 6336:2019 [A1] (all parts), *Calculation of load capacity of spur and helical gears*

3 Terms and definitions

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

3.1
automatic operation
whole route, which is controlled automatically from the control console and which in special circumstances can be partly influenced from the control points

3.2
manual control
whole route, which is controlled solely by the operator at the control console

3.3

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electrical stop
emergency main drive motor
emergency auxiliary drive motor
bringing the cableway 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
normal stopping point
normal stopping position of the carrier in the stations in cableways with reversible or pulsed movement operation

3.10
retraction distance
distance of the carriage from the stopping point in the station when the other carriage at the opposite station has contacted the buffer

3.11
entry monitoring
monitoring of the speed in the station entry area

3.12
position monitor checking
various checks of the position monitor, which are distinguished as follows:

3.12.1
fixed point checking
checking the information provided by the position monitor on the position of the carrier in relation to a fixed point on the line

3.12.2

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

3.12.3
zero position check
check made to confirm that the position monitors are in the starting positions when the carriers are in the station

3.13
minimum speed
minimum speed

3.14
main carrier rail
structure on which carriers are moved in normal operation from the entrance to the exit of a station

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3.15
continuous operation
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 (all parts), EN 12929 (all parts), EN 12930, EN 13243, EN 13107, and EN 13796 (all parts) apply to all cableway installations.

4.2 Safety principles

4.2.1 General

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

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

4.2.2 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;

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n) inadmissible pitch between carriers;

o) operation in unfavourable weather conditions (e.g. wind, frost, icing, rain);

p) foreseeable misconduct of personnel (passengers, operating personnel, third parties).

4.2.3 Safety measures

Safety measures shall be taken to avoid the hazard scenarios listed in 4.2.2.

The measures specified in this document are essentially construction-related and should achieve 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 shall be observed 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.

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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 m/s^2 with the most unfavourable load. For aerial ropeways, an average acceleration of 0,5 m/s^2 and an instantaneous acceleration (average acceleration over 0,5 s) of 1,5 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 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 ± 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.

6.3 Auxiliary drive

6.3.1 The auxiliary drive shall be capable of maintaining operation at a speed corresponding to 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 (in accordance with 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.

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) emergency drives with remote control shall also be operable in case of failure of this device.

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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 shall be applied by the main or auxiliary drive, an emergency stop using service brake or, if appropriate, an emergency stop using safety brake is 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:

a) initiate stopping of the cableway by means of a brake acting on the drive sheave or on a sheave with sufficient static friction, i.e. the corresponding safety circuit shall be interrupted; and

b) prevent restart by means of a brake acting on the drive sheave.

6.6.5 For the suspension of safety functions, EN 13243 shall be observed.

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6.7 Motors

6.7.1 General requirements

The operating conditions, climatic conditions and height above sea level shall be taken into account in the dimensioning and design of motors.

6.7.2 Internal combustion engines

6.7.2.1 Internal combustion engines shall be stationary installations and shall be provided with a battery-powered starter.

6.7.2.2 Exhaust gases from internal combustion engines shall be led to the open air. The supply of air to and from the motor shall be ensured.

6.7.2.3 At least the oil pressure and the motor temperature shall be monitored.

6.8 Gearboxes

6.8.1 Gearboxes shall be designed for all intended operational loading conditions.

6.8.2 Gearbox casings and their fixings, insofar as they transmit rope loads, shall be designed with a safety factor of 3,5 with respect to the elastic limit.

6.8.3 The lubrication of gearboxes shall be ensured over the whole range of operating speeds and ambient temperature which may occur in operation. This applies also for the auxiliary drive and the recovery drive, as well as when operating in reverse.

6.8.4 Gear teeth shall be designed in accordance with recognised standards (especially ISO 6336 (all parts)), taking operating conditions into account; for gearboxes which are classified as safety components, the fatigue failure safety factor at the base of the gear tooth shall be not less than 1,7. The safety factor for the tooth flank shall be not less than 1,0.

6.9 Power transmission devices

6.9.1 Mechanical power transmission

6.9.1.1 Flat belts may not be used for power transmission. Chain drives may be used for the main and auxiliary drive only in closed housings with continuous lubrication.

6.9.1.2 Devices for power transmission such as couplings, transmission shafts, etc., shall be designed for all intended operating load conditions.

6.9.1.3 The end positions of clutches shall be able to be mechanically locked and shall be electrically monitored.

6.9.2 Hydraulic power transmission

6.9.2.1 The general requirements of EN 1908 shall be observed.

6.9.2.2 It shall be possible, in all operating conditions, to start the installation smoothly and to bring it to a stop in either direction.

6.9.2.3 On application of the brakes, the oil pump shall automatically be placed in the neutral position (interruption of the oil supply) or brought to idle; for recovery drives, this may be done manually.

6.9.2.4 At least the oil pressure and the oil temperature shall be monitored.

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