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Safety requirements for cableway installations designed to carry persons - Civil engineering works

Sicherheitsanforderungen an Seilbahnen für den Personenverkehr - Bauwerke

Prescriptions de sécurité pour les installations à câbles transportant des personnes - Ouvrages de génie civil

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

Prescriptions de sécurité pour les installations à câbles
transportant des personnes - Ouvrages de génie civil

Sicherheitsanforderungen an Seilbahnen für den
Personenverkehr - Bauwerke

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

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Foreword

This document (prEN 13107:2013) 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 for CEN comment.

This document replaces the EN 13107:2004.

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 Directives.

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

This European Standard forms part of a series of European Standards concerning safety requirements for cableway installations designed to carry persons. This series of standards comprises the following parts:

- 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 equipment
- 7) Safety requirements for cableway installations designed to carry persons - Carriers
- 8) Safety requirements for cableway installations designed to carry persons - Electrical equipment other than for 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 - Pre-commissioning 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 control

All of these standards form a complete set with regard to the design, manufacture, assembly, maintenance and operation of all installations for cableway installations designed to carry persons.

With respect to ski-tows, the drafting of this European Standard has been guided by the works of the International Organisation for Transportation by Rope (OITAF).

1 Scope

This European Standard specifies the safety requirements applicable to civil engineering works for installations for cableway installations designed to carry persons. In doing so, the various types of cableway installations and their environment are taken into consideration.

It includes requirements relating to the prevention of accidents and the protection of workers, notwithstanding the application of national regulations.

National regulations of a building regulations or federal / state regulations nature or which serve to protect particular groups of people remain unaffected.

It does not apply to cableway installations for transportation of goods nor to lifts.

This European Standard is applicable to:

- new cableway installations designed to carry persons;
- alterations to existing cableway installations, as far as the safety of civil engineering works or parts of them is involved and no contrary specifications apply.

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.

2.1 Safety requirements for cableway installations designed to carry persons.

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

EN 1907, *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 12385-8, *Steel wire ropes — Safety — Part 8: Stranded hauling and carrying-hauling ropes for cableway installations designed to carry persons*

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 control*

EN 12927-1, *Safety requirements for cableways installation designed to carry persons — Ropes — Part 1: Selection criteria for ropes and their end fixing*

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

EN 12927-3, *Safety requirements for cableways installation 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 person — 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 cableways installations designed to carry persons — Ropes — Part 7: Inspection, repair and maintenance*

EN 12927-8, *Safety requirements for cableways installation designed to carry persons — Ropes — Part 8: Magnetic rope testing (MRT)*

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

EN 12929-2, *Safety requirements for cableways 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 13223, *Safety requirements for cableways installations designed to carry persons — Drive systems and other mechanical equipment*

EN 13243, *Safety requirements for cableways installation 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 tests for grips*

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

EN 15700, *Safety for conveyor belts for winter sport or leisure use*

2.2 Structural Eurocodes.

EN 1990, *Eurocode: Basis of structural design*

EN 1990/A1, *Eurocode: Basis of structural design (amendment)*

EN 1991-1-1, *Eurocode 1: Actions on structures — Part 1-1: Densities, self-weight and imposed loads for buildings*

EN 1991-1-2, *Eurocode 1: Actions on structures — Part 1-2: General actions — Actions on structures exposed to fire*

EN 1991-1-3, *Eurocode 1: Actions on structures — Part 1-3: General actions — Snow actions*

EN 1991-1-4, *Eurocode 1: Actions on structures — Part 1-4: General actions — Wind actions*

EN 1991-1-5, *Eurocode 1: Actions on structures — Part 1-5: General actions — Thermal actions*

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- EN 1991-1-6, *Eurocode 1: Actions on structures — Part 1-6: General actions — Actions during execution*
- EN 1991-1-7, *Eurocode 1: Actions on structures — Part 1-7: General actions — Actions — Accidental actions*
- EN 1991-2, *Eurocode 1: Actions on structures — Part 2: Traffic loads on bridges*
- EN 1991-3, *Eurocode 1: Actions on structures — Part 3: Actions induced by cranes and machinery*
- EN 1992-1-1, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*
- EN 1992-1-2, *Eurocode 2: Design of concrete structures — Part 1-2: General rules — Structural fire design*
- EN 1992-2, *Eurocode 2: Design of concrete structures — Part 2: Concrete bridges — Design and detailing rules*
- EN 1993-1-1, *Eurocode 3: Design of concrete structures — Part 1-1: General rules and rules for buildings*
- EN 1993-1-2, *Eurocode 3: Design of concrete structures — Part 1-2: General rules — Structural fire design*
- EN 1993-1-9, *Eurocode 3: Design of concrete structures — Part 1-9: Fatigue*
- EN 1993-1-10, *Eurocode 3: Design of concrete structures — Part 1-10: General rules — Material toughness and through thickness properties*
- EN 1993-2, *Eurocode 3: Design of concrete structures — Part 2: Steel bridges*
- EN 1993-3-1, *Eurocode 3: Design of concrete structures — Part 3-1: Towers, masts and chimneys — Towers and masts*
- EN 1993-5, *Design of steel structures — Part 5: Piling*
- EN 1994-1-1, *Eurocode 4: Design of composite steel and concrete structures — Part 1-1: General rules and rules for buildings*
- EN 1994-1-2, *Eurocode 4: Design of composite steel and concrete structures — Part 1-2: General rules — Structural fire design*
- EN 1994-2, *Eurocode 4: Design of composite steel and concrete structures — Part 2: General rules and rules for bridges*
- EN 1995-1-1, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings (consolidated version)*
- EN 1995-1-2, *Eurocode 5: Design of timber structures — Part 1-2: General rules — Structural fire design (consolidated version)*
- EN 1995-2, *Eurocode 5: Design of timber structures — Part 2: Bridges*
- EN 1996-1-1, *Eurocode 6: Design of masonry structures — Part 1-1: General rules for reinforced and unreinforced masonry structures (consolidated version)*
- EN 1996-1-2, *Eurocode 6: Design of masonry structures — Part 1-2: General rules — Structural fire design*
- EN 1996-2, *Eurocode 6: Design of masonry structures — Part 2: Design considerations, selection of materials and execution of masonry*
- EN 1997-1, *Eurocode 7: Geotechnical design — Part 1: General rules*

EN 1998-1, *Eurocode 8: Design of structures for earthquake resistance — Part 1: General rules, seismic actions and rules for buildings (consolidated version)*

EN 1998-2, *Eurocode 8: Design of structures for earthquake resistance — Part 2: Bridges (consolidated version)*

EN 1998-3, *Eurocode 8: Design of structures for earthquake resistance — Part 3: Assessment and retrofitting of buildings*

EN 1998-5, *Eurocode 8: Design of structures for earthquake resistance — Part 5: Foundations, retaining structures and geotechnical aspects*

EN 1998-6, *Eurocode 8: Design of structures for earthquake resistance — Part 6: Towers, masts and chimneys*

EN 1999-1-1, *Eurocode 9: Design of aluminium structures — Part 1-1: General structural rules*

EN 1999-1-2, *Eurocode 9: Design of aluminium structures — Part 1-2: Structural fire design (consolidated version)*

EN 1999-1-3, *Eurocode 9: Design of aluminium structures — Part 1-3: Structures subjected to fatigue*

EN 1999-1-4, *Eurocode 9: Design of aluminium structures — Part 1-4: Cold-formed structural sheeting (consolidated version)*

EN 1999-1-5, *Eurocode 9: Design of aluminium structures — Part 1-5: Shell structures (consolidated version)*

2.3 Further applicable standards.

ISO 8930, *General principles on the reliability for structures — List of equivalent terms*

ISO 12494, *Atmospheric icing of structures*

ISO 80000-1, *Quantities and units — Part 1: General*

EN 1090-2, *Execution of steel structures and aluminium structures — Part 2: Technical requirements for steel structures*

EN 1090-3, *Execution of steel structures and aluminium structures — Part 3: Technical requirements for aluminium structures*

EN 1536, *Execution of special geotechnical works — Bored piles*

EN 1537, *Execution of special geotechnical work (special geotechnical work): Ground anchor*

EN 12699, *Execution of special geotechnical work (special geotechnical work): Displacement piles*

EN 13670, *Execution of concrete structures*

EN 14199, *Execution of special geotechnical works (special geotechnical work) — Micropiles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1907, EN 1990 and EN 1991 apply. Some definitions are listed in B.2.

4 Units and symbols

SI units shall be used in accordance with ISO 80000-1.

Symbols used in this standard conform to the Structural Eurocodes EN 1991 to EN 1999 and are defined where they appear for the first time in the text.

5 General requirements

5.1 Application of this standard

The requirements of this European Standard apply to all cableway installations along with EN 1709, EN 1908, EN 1909, EN 12397, EN 12408, EN 12927-1, EN 12927-2, EN 12927-3, EN 12927-4, EN 12927-5, EN 12927-6, EN 12927-7, EN 12927-8, EN 12929-1, EN 12929-2, EN 12930, EN 13223, EN 13243, EN 13796-1, EN 13796-2, EN 13796-3.

5.2 Safety principles

The safety principles set out in EN 12929-1 apply. The design and execution of all cableway installations shall meet the *essential requirements* as specified in the EU Cableways Directive 2000/9/EC and the EN 1990.

NOTE More information is given in B.3.

5.3 Safety analysis

5.3.1 Reliability differentiation

The reliability required for the civil engineering works of cableways shall be obtained by design and execution according to EN 1990 to EN 1999 and this European Standard.

NOTE More information is given in B.4.

5.3.2 Design situations

Design situations are classified as follows:

- persistent situations which refer of the conditions of normal use;
- transient situations which refer to temporary conditions applicable to the structure, e.g. during construction or repair;
- accidental situations which refer to exceptional conditions applicable to the structure or to its environment, e.g. to fire, derailment, impact, avalanches, local failure;
- seismic situations, which refer to conditions applicable to the structure when subjected to seismic events.

5.3.3 Design working life

5.3.3.1 The design working life is the assumed period for which a structure is to be used for its intended purpose with anticipated maintenance but without major repair being necessary.

NOTE At the time of specification, the current “state of the art” needs to be taken into consideration. As a minimum the expected fatigue loads is taken as a basis for the verification of fatigue in the considered period.

5.3.3.2 It is recommended to adopt the following periods for the civil engineering works of cableways and to define them in the utilization plan (requirements specification):

- 20 years for interchangeable / renewable components (e.g. seals, joints, drainage systems, bearings etc.);
- 30 years in general and for all components which absorb actions induced by ropes;
- 50 years for buildings as well as for support structures of bicable, multi-cable and funicular railways.

5.3.4 Durability

5.3.4.1 The durability of civil engineering works shall be assessed according to the requirements of EN 1990.

5.3.4.2 The relevant EN 1990 to EN 1999 as well this European Standard specify the appropriate measures.

NOTE More information is given in B.4.

6 Combinations of actions and safety measures

6.1 Combinations of actions

For the purpose of this European Standard, the actions and combinations of actions are specified in Clauses 7 and 9. Each combination of actions is made up of the permanent actions, one dominating, variable action (main action) or one accidental action, possibly combined with accompanying variable actions (accompanying actions). In the safety certification, each combination of actions leads to a design situation, which shall be verified.

6.2 Safety measures

Safety measures shall be taken into account in order to avoid or to limit the consequences of hazards and hazard scenarios. Particular regard shall be paid to the maintenance of civil engineering works.

NOTE More information is given in B.5.

7 Actions and environmental influences

7.1 General

7.1.1 Principal classifications

7.1.1.1 An action (F) is:

- a) a direct action, e.g. a force or load applied to the structure; or
- b) an indirect action, e.g. an imposed or constrained deformation, or an imposed acceleration caused, for example, by temperature changes, moisture variation, uneven settlement or earthquakes.

7.1.1.2 Actions are classified:

- a) by their variation in time
 - 1) permanent actions (G), e.g. self-weight of the structure, immovable fittings, ancillary and fixed equipment or ground actions;

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- 2) variable actions (Q), e.g. imposed loads, actions induced by ropes, traffic loads, wind actions or snow actions; where a distinction has to be made as to whether these actions take place *in operation* or *out of operation*;
 - 3) accidental actions (A), e.g. due to onboard brakes and jammed grips, derailment, avalanches, explosions or impact from vehicles.
- b) by their spatial variation
- 1) fixed actions, e.g. self-weight;
 - 2) free actions, e.g. imposed loads, wind actions and snow actions;
- c) by their nature and/or the structural response
- 1) static actions, which do not cause significant acceleration of the structure or structural member;
 - 2) dynamic actions, which cause significant acceleration of the structure or the structural member.

7.1.2 Characteristic and representative values of actions

7.1.2.1 The characteristic value of an action is its main representative value.

7.1.2.2 Characteristic values of actions (F_k) are specified:

- in EN 12930;
- in EN 1991-1-1 to EN 1991-1-7 as well as EN 1991-2 and EN 1991-3 as a mean value, a higher or a lower value, or a nominal value (which does not refer to a known statistical distribution);
- in the design, provided that the provisions specified in EN 1990 are observed by competent persons.

7.1.2.3 For permanent actions the characteristic value (G_k) shall be determined as follows:

- a) if the variability of G is small, one single value G_k (nominal value) may be used;
- b) if the variability of G is not small, two values shall be used; an upper value $G_{k,sup}$ and a lower value $G_{k,inf}$.

7.1.2.4 For variable actions, the characteristic value Q_k corresponds to:

- a) either an upper value, with an intended probability of not being exceeded, or a lower value with an intended probability of not falling below during some reference period;
- b) or a nominal value, which may be specified in cases where a probability distribution is not known.

7.1.2.5 For accidental actions, the representative value is generally a characteristic value (A_k), that corresponds to a specified value (nominal value).

7.1.2.6 For variable multi-component actions, the characteristic action is represented by a group of values, to be considered alternatively in the design calculation. Actions, which are directly dependent of each other in the considered load state, form a group of values which is to be treated as a single, variable action.

7.1.2.7 In most common cases the other representative values of a variable action are:

- the combination value, generally represented as a product $\psi_0 Q_k$;
- the frequent value, generally represented as a product $\psi_1 Q_k$;

— the quasi-permanent value, generally represented as a product $\psi_2 Q_k$.

7.1.3 Environmental influences

The environmental influences which can affect the durability of the structure shall be considered in the choice of structural materials, their specification, the structural concept and detailed design. EN 1992 to EN 1999 specify the relevant measures.

NOTE Full information on the subjects mentioned in 7.1 is given in EN 1990 and its annexes.

7.2 Actions for aerial ropeways

7.2.1 General

Actions for aerial ropeways are classified according to 7.1.1.2 a):

- a) permanent actions;
- b) variable actions;
- c) accidental actions.

7.2.2 Permanent actions

7.2.2.1 General

Permanent actions act throughout a given design situation; their variation in magnitude with time is negligible in relation to the mean value, or their variation is always in the same direction (monotonic) until the action attains a certain limit value.

As a general rule, the following actions are considered to be permanent actions:

7.2.2.2 Self-weight

The self-weight of a structure includes the loads arising exclusively from the mass of the structural elements and can be represented in most cases by a single characteristic value, calculated on the basis of the nominal dimensions and the densities (weights) given in EN 1991-1-1.

The self-weight of non-structural elements as far as their position is fixed shall be considered as characteristic values. This refers, for example, to partition walls and panelling, railings, safety barriers, lifts and moving staircases, fittings as well as ancillary and fixed equipment. Whenever one of the elements listed above is movable, the corresponding actions shall be considered as variable actions (imposed loads).

7.2.2.3 Ground actions

These actions include the pressure on basement walls and foundations induced by earth loads as well as pore water pressure and other ground actions.

As a general rule, the characteristic values of ground actions shall be taken in accordance with EN 1997-1.