SLOVENSKI STANDARD
SIST EN 12930:2015

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Varnostne zahteve za žičniške naprave za prevoz oseb - Izračuni

Safety requirements for cableway installations designed to carry persons - Calculations

Sicherheitsanforderungen für Seilbahnen für den Personenverkehr - Berechnungen

Prescriptions de sécurité pour les installations à câbles destinées au transport de personne - Calculs

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45.100	Oprema za žičnice	Cableway equipment

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Safety requirements for cableway installations designed to carry persons - Calculations

Prescriptions de sécurité pour les installations à câbles destinées au transport de personne - Calculs

Sicherheitsanforderungen an Seilbahnen für den Personenverkehr - Berechnungen

This European Standard was approved by CEN on 8 November 2014.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 12930:2015) has been prepared by Technical Committee CEN/TC 242 “Safety requirements for cableway systems for passenger transportation”, the secretariat of which is held by AFNOR.

This European Standard shall maintain the status of a National Standard, either with the publication of an identical text or by recognition up to July 2015, and any opposing National Standards shall be withdrawn by July 2015.

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 held responsible for identifying any or all such patent rights.

This document is intended to replace EN 12930:2004.

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 the EU Directive 2000/9/EC.

For the relationship with the EU Directive 2000/9/EC, see informative Annex ZA, which is an integral part of this document.

The following main changes have been made to EN 12930:2004:

— In Clause 3 the term and definition “curvature ratio” has been replaced with the term “diameter ratio” and is defined in EN 1907.

— In Clause 3 the term and definition “safety component” has been removed, as the term and definition is defined in EN 1907 and/or in the Directive 2009/9/EC.

— In 5.2.2, 6.2 b) and 7.4.1 a) for the combinations of actions, the reference to their compatibility has been included.

— In 6.2 the requirement on calculation methods with regard to precision has been added.

— In 6.5 the wind force and the dynamic pressure are shown in simplified form and the possible deviation as a result of cableway-specific circumstances has been added.

— In 6.5 the usually assumed minimum dynamic pressure out of operation has been specified as 1,20 kN/m².

— In 6.5 consistency with EN 12929-1 has been achieved with regard to the reduction coefficient.

— In 6.5.5.3 the requirements for the ice load dependent on the nominal rope diameter have been changed, whereby provisions of international and national Standards (ISO 12494, EN 50341) have been taken into account.

— In 7.1.1 the non-essential details concerning the precision of the calculation of rope angles have been removed and the information concerning the step size for the calculation of longitudinal profile has been simplified with concentrated loads.

— In 7.1.4 due to the technical development of calculation programmes, the use of simplified calculation methods has been restricted.

— In 7.1.5 consistency with EN 1908 has been achieved.

— In 7.1.6 requirements to avoid rope spans which are too long and a too heavy concentration of carriers has been explained in more detail. The requirements for uni-directional aerial ropeways which are also operated with individual carriers have been compared with the requirements for group ropeways and cableways with carrier groups.

— In 7.2.3 the assumed friction coefficients for the line and rope calculations have been added.

— In 7.2.4 the reduction factor for the wind force in the “out of operation” load case has been added to the requirements.

— In 7.3 consistency with series EN 12927 has been achieved.

— In 7.4.1 b) the technically unfounded restriction on track ropes with fixed ends has been removed.

— 7.4.4 has been revised in order to clarify the previous requirements.

— In 7.5.2 the restriction of the smallest permissible tension safety factor whilst taking into consideration the wind and ice out of operation and in the case of cord tension as a result of differing groove diameters of multi-grooved drive sheaves has been added.

— In 7.5.2 c) and 7.6.2 c) the maximum tension safety factor on the long splicing has been restricted.

— In 7.5.4 the requirements concerning the verification of safe support of moving ropes in the case of suspended haul rope supports have been added.

— In 7.6.1 b) the partially incomplete specifications with regard to load positions for the approximation methods have been removed.

— In 7.6.2 the restriction of the smallest permissible tension safety factor whilst taking into consideration the wind and ice out of operation has been added.

— In 7.7.4 the technically unfounded requirement of the smallest bearing force for compression line support structures in the area of the loading area of ski-tows has been removed.

— The former 7.9.2 regarding the limit profile of the ropes of evacuation railways has been moved to EN 12929-1 to the remaining specifications with regard to the limit profile.

— In 7.9.2 a) the smallest permissible tension safety factor for endless evacuation ropes has been amended.

— The identification of the smallest nominal diameter of endless evacuation ropes has been moved to the new 7.9.3.

— The former 7.10.1 regarding the limit profile of the conductor, restraint and marker ropes has been moved to EN 12929-1 to the remaining specifications with regard to the limit profile.

— In 8.2.1 the list of the permissible friction values on the drive sheaves in the case of a complete loss of pressure in the hydraulic tensioning devices has been added.

— In 10.9.3 and 10.9.4 the actions as a result of a derailment on the towing ropes has been restricted.

— In 10.9.5 the actions as a result of a complete deropement have been specified in more detail and simplified.

— 10.9.6 has been removed as an accidental action, as if with detachable cableways which have a garaging possibility, the empty carriers on the rope are subjected to a wind “out of operation”, no further standardised specifications have been made.

— In Annex A the A-deviation for Germany has been removed.

— Annex ZA has been updated.

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:

EN 1907 – *Terminology*

EN 12929 (all parts) – *General requirements*

EN 12930 – *Calculations*

EN 12927 (all parts) – *Ropes*

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 – *Precommissioning inspection, maintenance and operational inspection and checks*

EN 1909 – *Recovery and evacuation*

EN 12397 – *Operation*

EN 12408 – *Quality assurance*

Together these form a series of Standards regarding 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).

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

1 Scope

This European Standard specifies the general safety requirements applicable to the calculations for cableway installations designed to carry persons. This document is applicable to the various types of cableway installations and takes into account their environment.

It contains:

— general requirements for calculations and their presentation;

— general requirements relating to the actions that shall be taken into account in the calculation of components as a basis for the requirements of the standards EN 13223, EN 13107, EN 12927 (all parts) and EN 1908;

— requirements relating to verification of ropes by calculation;

— requirements relating to the determination of the drive power;

— requirements for the actions of the ropes and carriers on the support structures and for the deformations of these support structures.

It does not apply to installations for the transportation of goods nor to 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 1709, *Safety requirements for cableway installations designed to carry persons — Precommissioning 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 1990, *Eurocode: Basis of structural design*

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

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

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 (all parts), *Safety requirements for cableway installations designed to carry persons — Ropes*

EN 12929 (all parts), *Safety requirements for cableway installations designed to carry persons — General requirements*

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 13796 (all parts), *Safety requirements for cableway installations designed to carry persons — Carriers*

3 Terms and definitions

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

3.1
rope calculation
calculation for designing the ropes on the basis of the tension forces determined from the calculation of the longitudinal profile

3.2
calculation of longitudinal profile
calculation to determine the tension forces in the rope and their actions on the rope supports and rope anchorages

3.3
empty rope
track rope or towing rope without carriers

3.4
unloaded rope
track rope or towing rope only carrying empty carriers at the required carrier pitch

3.5
loaded rope
track rope or towing rope carrying fully laden carriers at the required carrier pitch

3.6
angle of deflection of rope
angle through which a rope is deflected, measured between the tangent to the rope at the start of the deflection and the tangent to the rope at the end of the deflection in the same plane as the deflected rope

4 Symbols and abbreviations

Symbols and abbreviations are explained with the formula to which they apply throughout this document.

5 General requirements

5.1 Application of this 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 13107, EN 13223, EN 13243 and EN 13796 (all parts) apply to all cableway installations.

5.2 Safety principles

5.2.1 General

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

In addition, the following hazard scenarios and safety requirements relative to the scope of this document are also applicable:

5.2.2 Hazard scenarios

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

a) lack of or incorrect assessment of the actions on the individual components of the installation;

b) use of inappropriate calculation methods or formulae;

c) lack of or inadequate consideration of dynamic effects and fatigue effects on individual components;

d) lack of or incorrect assessment of the most unfavourable combinations of actions on each other when dimensioning and carrying out calculations;

e) erroneous assumptions in the calculations.

5.2.3 Safety measures

This document stipulates the necessary general requirements for minimising the hazard scenarios listed in 5.2.2 when carrying out verification by calculation and when designing the complete installation as well as individual components, in particular when calculating the longitudinal profile and the rope, and for avoiding hazardous situations.

6 General requirements for calculations

6.1 General comments

The calculations to be submitted shall demonstrate that the safety requirements for cableways defined in this document and those in the other standards listed in 5.1 are fulfilled. In doing so, the anticipated operating conditions of the installation shall be taken into account.

The safety components of the installation shall be verified by calculations, where necessary with respect to static stresses, fatigue stresses, stability and suitability for use.

6.2 Calculation methods

All methods used in the calculations shall either be indicated directly or be explained by precise bibliographic references.

Methods of approximation and calculation models shall provide results which are sufficiently precise and conservative.

The following shall always apply:

a) in any calculation of a mechanical system, structure or component, it shall be clear from the documentation what the magnitudes and directions of the actions are assumed to be and which cross-sections have been examined;

b) the calculations shall be made taking into account the combinations of actions set out in the standards and other specifications. Should such information not be available, the most unfavourable interacting loading conditions shall be used as a basis and both the directions and magnitudes of the actions and their combinations shall be specified.

6.3 Presentation of calculations

The calculation documents shall be clear and perfectly comprehensible without any additional information. Their origin and date of production shall be stated.

The results of computer calculations shall be accompanied by a sheet on which the calculation model, the methods employed and the assumptions are described. Symbols and abbreviations used shall be explained. The version of the computer program used shall be stated. Input values and output values (results) shall be related to each other.

6.4 Verification by tests

Verification by tests alone may be carried out if this document or other Standards contain no indications concerning the calculation and calculation in accordance with recognised methods is not possible.

In exceptional cases, e.g. complex components or dynamic actions, additional verification by tests may be required to supplement calculations in order to verify the characteristics of safety components. The test programme and methods shall produce test conditions which are as close as possible to actual service conditions.

6.5 Actions

6.5.1 General

The following groups of actions shall be taken into account in the calculations:

— self weight and imposed loads;

— dynamic actions;

— actions resulting from tension forces in the ropes;

— actions due to climatic conditions;

— other actions (e.g. due to avalanches, earthquakes, installation conditions).

The combinations of actions applicable to each component are specified in the standards EN 1908, EN 13223, EN 13107 and EN 13796-1.

6.5.2 The self-weight of components shall be assessed in accordance with EN 1991-1-1 or, if no Standard applies, according to information from the supplier.

With regard to the mass of a person to be adopted for the calculation of the longitudinal profile, 7.2.1 b) shall apply.

With regard to the mass of a person to be adopted for dimensioning the carriers, see EN 13796-1.

6.5.3 The actions from the ropes shall be calculated in accordance with Clause 7. For the dimensioning of structures, Clause 10 and EN 1991-1-1 shall apply.

6.5.4 Actions from wind shall be defined by the resultant wind force F_w in accordance with the following provisions:

The resultant wind force shall generally be calculated in accordance with EN 1991-1-4 on the basis of formula (1):

$$F_{\mathrm{w}} = q \times c_{\mathrm{f}} \times A_{\mathrm{ref}} \qquad (1)$$