



SLOVENSKI STANDARD

SIST EN 50341-2-7:2016

01-april-2016

Nadzemni električni vodi za izmenične napetosti nad 1 kV - 2-7. del: Nacionalna normativna določila (NNA) za Finsko (na podlagi EN 50341-1:2012)

Overhead electrical lines exceeding AC 1 kV - Part -2-7: National Normative Aspects (NNA) for FINLAND (based on EN 50341-1:2012)

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**Overhead electrical lines exceeding AC 1 kV -
Part -2-7: National Normative Aspects (NNA) for FINLAND
(based on EN 50341-1:2012)**

This European Standard was approved by CENELEC on 2015-08-11.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

- 1 The Finnish National Committee (NC) is identified by the following address:

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- 2 The Finnish NC has prepared this Part 2-7 of EN 50341 listing the Finnish national normative aspects (NNA), under its sole responsibility, and duly passed it through the CENELEC and CLC/TC 11 procedures.

NOTE: The Finnish NC also takes sole responsibility for the technically correct co-ordination of this NNA with EN 50341-1. It has performed the necessary checks in the frame of quality assurance/control. However, it is noted that this quality control has been made in the framework of the general responsibility of a standards committee under the national laws/regulations.

- 3 This NNA is normative in Finland and informative for other countries.

- 4 This NNA has to be read in conjunction with Part 1 (EN 50341-1). All clause numbers used in this NNA correspond to those of Part 1. Specific sub-clauses, which are prefixed "FI", are to be read as amendments to the relevant text in Part 1. Any necessary clarification regarding the application of this combined NNA in conjunction with Part 1 shall be referred to the Finnish NC who will, in co-operation with CLC/TC 11, clarify the requirements.

When no reference is made in this NNA to a specific sub-clause, then Part 1 applies.

- 5 In the case of "boxed values" defined in Part 1, amended values (if any), which are defined in this NNA, shall be taken into account in Finland.

However, any boxed value, whether in Part 1 or in this NNA, shall not be amended in the direction of greater risk in a Project Specification.

- 6 The national Finnish standards/regulations related to overhead electrical lines exceeding 1 kV AC are listed in 2.1/FI.1-2.

NOTE: All national standards referred to in this NNA will be replaced by the relevant European Standards as soon as they become available and are declared by the Finnish NC to be applicable and thus reported to the secretary of CLC/TC 11.

1 Scope

1.1 General

(ncpt) FI.1 Application of the standard in Finland

In Finland the standard EN 50341-1 (Part 1) can only be applied using this NNA (EN 50341-2-7) containing National Normative Aspects for Finland.

The requirements of the standard are applied also for low voltage (below 1 kV AC) overhead lines. The requirements of the structural design are applicable also for DC overhead lines, where the electrical requirements are given in the Project Specification.

This standard is applicable for new overhead lines only.

(ncpt) FI.2 Application for existing overhead lines

Overhead lines complying with the mechanical and electrical requirements of its original date of construction can be operated and maintained, if they do not cause obvious danger.

The reparation and overhaul of lines can be done according to the previous requirements. Reparation means that a component which has been damaged is substituted with a similar new one. Overhaul means a wider improvement of the line for extending its lifetime. The basic structure remains same as before.

This standard should be used for all modification works on existing lines. In modification works earlier norms and standards may also be used. In that case it shall especially be verified that changes in actions do not have significant impact on the loads of lines. Modification work means e.g. relocation of some supports or an extension to a line when this supplement has been taken into account in the original design, e.g. addition of a circuit or changing of the conductors to existing supports.

1.2 Field of application

(ncpt) FI.1 Application to covered conductors and aerial cables

The standard includes requirements for the design and construction of overhead lines equipped with covered conductors and aerial cables. Additionally, the requirements of the equipment standards and manufacturers' instructions shall be followed.

(ncpt) FI.2 Application to cables for telecommunication

The standard includes requirements for the application of telecommunication cables installed on common supports with electrical lines.

(ncpt) FI.3 Installation of other equipment

Only equipment belonging to the line (electric or telecommunication line) can be installed on the overhead lines. However, equipment serving communal services or environmental protection like telecommunication equipment, road signs, warning signs or warning balls may also be installed with the permission of the owner of the line.

Other equipment than those mentioned above can also be installed on supports equipped with aerial cables with the permission of the owner of the line.

If other equipment is installed on the supports, the requirements of safe working practices shall be taken into account. The installation height of equipment meant to be installed and maintained by an ordinary person shall be such that the work can be done without climbing the support and the distances of safe electrical work can be followed (see standard SFS 6002).

The additional loads due to other equipment on the line supports shall be taken into account.

2 Normative references, definitions and symbols

2.1 Normative references

(A-dev) FI.1 National normative laws, government regulations

Sähköturvallisuuslaki (410/1996)

Electrical Safety Act

Sähköturvallisuusasetus (498/1996)

Electrical Safety Decree

Kauppa- ja teollisuusministeriön päätös sähkölaitteistojen turvallisuudesta (1193/1999)

Decision of Ministry of Trade and Industry on Safety of electrical installations

Viestintäviraston määräys M 43 tietoliikenneverkon sähköisestä suojaamisesta

Decree nr M 43 of the Finnish Communications Regulatory Authority on the electrical protection of a telecommunication network

Liikenteen turvallisuusviraston määräys AGA M3-6, Lentoesterajoitukset ja lentoesteiden merkitseminen. *Aviation regulation AGA M3-6 of the Finnish Transport Safety Agency on the Aviation obstacle limitations and marking of objects.*

Liikenneviraston ohje 23/2014 Ilmajohtojen sekä kaapeleiden ja putkijohtojen asettaminen ja merkitseminen vesialueella. *Publication 23/2014 of the Finnish Transport Agency: Installation and marking of overhead lines, cables and pipelines in waterways.*

(ncpt)

FI.2 National normative standards

- SFS 2662 Ilmajohtotarvikkeet. Puupylväs
Overhead line materials. Wood pole
- SFS 5717 Maakaasun siirtoputkiston sijoittaminen suurjännitejohdon tai kytkinlaitoksen läheisyyteen
Placing of the natural gas transmission pipeline close to a high-voltage line or substation
- SFS 6000 Pienjännitesähköasennukset
Low voltage electrical installations
- SFS 6001 Suurjännitesähköasennukset
High voltage electrical installations
- SFS 6002 Sähkötöyturvallisuus (perustuu standardiin EN 50110-1/2)
Safety at electrical work (based on standard EN 50110-1/2)
- RIL 202/by 61 Betonirakenteiden suunnitteluohje (perustuu standardiin SFS-EN 1992-1-1)
Design guide for concrete structures (based on standard SFS-EN 1992-1-1)
- RIL 207 Geotekninen suunnittelu (perustuu standardiin SFS-EN 1997-1)
Geotechnical design (based on standard SFS-EN 1997-1)
- RIL 254 Paalutusohje
Piling instructions

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3 Basis of design

3.2 Requirements of overhead lines

3.2.2 Reliability requirements

(ncpt)

FI.1 Selection of reliability levels

The minimum reliability levels based on the nominal voltage and importance of the lines are defined in Table 3.1/FI.1 below. The level shall be given in the Project Specification.

Table 3.1/FI.1 - Reliability levels of overhead lines in Finland

Level	Nominal voltage	Type of line
1	$U_n \leq AC\ 45\ kV$	Normal lines
	$U_n > AC\ 45\ kV$	Temporary or unimportant lines
2	$U_n \leq AC\ 45\ kV$	Special lines
	$U_n > AC\ 45\ kV$	Normal lines
3	all	Very important lines, i.e. all 400 kV lines

3.2.5 Strength coordination

(ncpt)

FI.1 Angle and tension supports

The partial factors γ_M for the resistance of the structural elements of angle (angle ≥ 10 degrees), tension and terminal supports shall be multiplied by an additional factor $\gamma_S = 1,1$. This requirement needs not to be applied at construction load cases.

In these cases, when determining the structural design resistance R_d in the basic design formula $E_d \leq R_d$, the design value X_d of a material property shall be calculated from formula:

$$X_d = X_K / (\gamma_M \gamma_S) \quad \text{See Clauses 3.6.3 and 3.7.2 of Part 1.}$$

This clause shall be applied only for lines with nominal voltages $> 45\ kV$, if not otherwise required in the Project Specification.

(ncpt)

FI.2 Foundations

As the foundation should be 10 % stronger than the support, the loads from the support to foundations shall be multiplied by the factor 1,1.

At angle, tension and terminal supports of lines with nominal voltage > 45 kV the loads shall be multiplied by an additional factor 1,1. Thus, in these cases the total factor will be 1,21. This requirement needs not to be applied at construction load cases.

Alternatively, the strength coordination of the foundations can be executed by applying the factors 1,1 and 1,21 to the partial factors of the resistances and properties of materials.

4 Actions on lines**4.3 Wind loads****4.3.1 Field of application and basic wind velocity**

(snc)

FI.1 Basic wind velocity

The basic wind velocity $V_{b,0} = 21$ m/s is normally applied in all areas of Finland.

Other basic wind velocity values may be used, if they are based on the local conditions and reliable statistics. These values shall be given in the Project Specification.

NOTE: Local values are given e.g. in the research report "Mitoitustuuli Suomessa, 2007" by the Finnish Meteorological Institute.

4.3.2 Mean wind velocity

(snc)

FI.1 Terrain categories

The terrain categories in Finland are specified in Table 4.1/FI.1.

Table 4.1/FI.1 - Terrain categories, roughness length z_0 and terrain factor k_r

Terrain category	Description	z_0 [m]	k_r
0	Open sea, outer archipelago and open coastal areas	0,003	0,180
0+	Scattered inner archipelago and sheltered coastal areas	0,003	0,167
I	Dense inner archipelago, large lake districts and wide agricultural areas	0,010	0,169
II	Reference terrain: Area with low vegetation and isolated obstacles (trees, buildings)	0,050	0,189
II+	Variable inland terrain (forests, forest-openings, small fields and lakes, single buildings or building-groups)	0,095	0,195
III	Area with regular vegetation or with isolated obstacles (such as buildings, villages, suburban terrain, permanent forest)	0,300	0,214
IV	Cities and towns, i.e. area in which at least 15 % is covered with buildings with average height > 15 m. This category shall not be applied in Finland.	1,000	0,233
NOTE 1: Typical Finnish inland terrain with forests and small hills can be considered as category III. If possible tree cuttings or storms can have impact on this assumption, then category II or II+ should be applied.			
NOTE 2: In mountainous areas category II should be applied, unless otherwise specified in the Project Specification.			
NOTE 3: The table values of the constants z_0 and k_r deviating from those given in SFS-EN 1991-1-4 are marked in <i>italics</i> .			

(ncpt)

FI.2 Terrain orography

If the slope of a single hill or ridge exceeds 5 % and its height from the level of the surrounding flat terrain exceeds 10 m, the effect of terrain orography (hill effect) shall be taken into account.

The orography factor c_0 for wind speed can be calculated according to SFS-EN 1991-1-4, Annex A.3.

Alternatively, the hill effect can be taken into account by taking the wind speed at the height H measured from the level of the surrounding flat terrain in the direction of the coming wind.

However, the gust effect shall be determined by using the height h measured from the level of the top of the hill. For heights $h < 10$ m the gust factor at height $h = 10$ m shall be used.

Additional guidance and requirements on the effects of the topography on the determination of the wind loads can be given in the Project Specification.

NOTE: The terrain category and the local wind velocity may depend on the direction of the wind. If necessary, meteorological specialists should be consulted in assessing the terrain category, orography and wind velocity.

4.3.3 Mean wind pressure

(ncpt) FI.1 Effects of altitude and temperature

When calculating the wind pressure, the effects of temperature and altitude on the air density shall be taken into account.

At the reference condition the temperature is 0 °C and air density 1,292 kg/m³ at sea level.

4.4 Wind forces on overhead line components

4.4.1 Wind forces on conductors

4.4.1.1 General

(ncpt) FI.1 Effective height of conductor

The effective height of a conductor shall be taken as the height of the centre of gravity of the conductor (Method 1 in Part 1). In cases, where the shape of the terrain is uneven or, if so required in the Project Specification, the height of the attachment point of the conductor at the insulator shall be used (Method 4 in Part 1). In the sag and tension analyses the average height of each tension section shall be used.

Additionally, the terrain orography shall be taken into account, if the wind speed will be determined from the level of the surrounding flat terrain (see Clause 4.3.2/FI.2).

If the same constant height will be used for all conductors and earth wires, it shall be calculated according to the height of the uppermost phase conductor.

4.4.1.2 Structural factor

(ncpt) FI.1 Span factor

When calculating the span factor for the sag and tension analysis, the ruling span shall be used as the span length. When calculating the span factor for the tower load analysis, the average length of the adjacent spans of the support concerned shall be used as the span length.

4.4.1.3 Drag factor

(ncpt) FI.1 Drag factor of conductors

In the case of conductors or earthwires the drag factor shall be taken as 1,0 for each sub-conductor (Method 1 in Part 1).

In the case of bundled aerial cables the drag factor shall be taken as 1,2 for the average diameter of the bundled cable.

4.4.2 Wind forces on insulator sets

(ncpt) FI.1 Wind load of insulator

The recommended values in Part 1 for height, structural and drag factors shall be used. The wind load of an insulator set shall be calculated according to Part 1. The projected wind area of the insulator shall be calculated from:

$$A_{\text{ins}} = L D \sin \alpha$$

L = Effective length of the insulator string

D = Outer diameter of the insulator unit

α = Angle between the directions of the insulator and wind at the loaded position. A conservative value $\alpha = 90^\circ$ may also be used.

(ncpt) FI.2 V-insulator set dimensions

The dimensions of a V-insulator set configuration shall be such that the direction of the resulting force due to the transversal loads from conductors will stay inside the angle between the two arms of the insulator set in the following service conditions (without partial load factors):

- Extreme wind load (mean wind with 50 year return period)
- Minimum temperature (3 year return period value, see Table 4.7/FI.1)

4.4.3 Wind forces on lattice towers

4.4.3.1 General

(ncpt) FI.1 Calculation method of wind loads

Wind loads shall be calculated by dividing the tower into sections (Method 1 in Part 1).

4.4.3.2 Method 1

(ncpt) FI.1 Structural factors

Structural factor shall be $G_t = 1,0$ for tower body and $G_{tc} = 1,0$ for cross-arms.

(ncpt) FI.2 Drag factors

Wind forces on rectangular towers shall be calculated according to Part 1. Drag factors of other types of lattice towers (towers with triangular body or towers containing mixed profile shapes, i.e. tubular legs and angle bracings) shall be calculated according to SFS-EN 1993-3-1.

4.4.4 Wind forces on poles

(ncpt) FI.1 Calculation of wind loads on poles

Wind loads on poles shall be calculated by dividing the pole into sections (Method 1 in Part 1).

Structural factor shall be $G_{pol} = 1,0$.

4.5 Ice loads

4.5.1 General

(snc) FI.1 Icing categories and ice load parameters

The philosophy in defining ice loads is based on ISO 12494. The characteristic ice load on a conductor depends on the relative altitude, which is defined as the altitude difference between the conductor and the average level of the surrounding terrain within a distance of 10 km from the site. Values for characteristic ice loads are given in Table 4.5/FI.1.

If higher load values based on long term statistics or experience on the local conditions are available, they shall be applied and given in the Project Specification.

(snc) FI.2 Ice loads on conductors

Values for ice load parameters for conductors are given in Table 4.5/FI.1. In categories II and III intermediate values based on linear interpolation shall be used.

For spans in the same tension section, ice load value based on the uppermost height level of the spans concerned shall be used in conductor tension calculations. Ice load parameters in icing category IV should be evaluated by meteorological specialists.

Table 4.5/FI.1 - Conductor ice load

Icing category	Relative altitude [m]	Characteristic ice load I_{50} [N/m]	Density [kg/m ³]	Drag factor	Type of ice
I	0 - 50	10	500	1,15	rime
II	50 - 100	10-25	500	1,15	rime
III	100 - 200	25-50	500	1,15	rime
IV	> 200	>50	500	1,15	rime

(ncpt) FI.3 Ice loads on structures and insulators

No ice needs to be considered on structures or insulators, if not otherwise specified in the Project Specification.

4.6 Combined wind and ice loads

4.6.2 Drag factors and ice densities

(ncpt) FI.1 Drag factors of iced conductors and ice densities

Drag factors for iced conductors as well as ice densities are given in Table 4.5/FI.1.

4.7 Temperature effects

(snc) FI.1 Reference condition (EDS-condition)

Reference condition is specified as still air condition with no ice at temperature 0 °C. The temperatures in different load conditions are given in Table 4.13/FI.1.