# SLOVENSKI STANDARD
# SIST EN 50341-2-7:2024

**01-januar-2024**

**Nadomešča:**

**SIST EN 50341-2-7:2016**

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**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)



**Ta slovenski standard je istoveten z:** **EN 50341-2-7:2023**



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**ICS:**

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|---|---|---|
| 29.240.20 | Daljnovodi | Power transmission and distribution lines |

**SIST EN 50341-2-7:2024** **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 50341-2-7

September 2023

ICS 29.240.20

Supersedes EN 50341-2-7:2015

English Version

# 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 2023-08-30.

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



CENELEC

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

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**



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# European foreword

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

SESKO Electrotechnical Standardization in Finland
Standardization committee SK 11, High Voltage Overhead Lines
Addr. Takomotie 8, 00380 Helsinki, Finland
Tel. +358 50 571 6048
Email asiakaspalvelu@sesko.fi

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 the modification works, earlier norms and standards may also be used, if allowed by the valid Electrical Safety Act. In that case it shall especially be verified that changes in actions do not cause significant increase in the loads of the line. Modification work means e.g. relocation of some supports or an extension to a line by 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 considered.



(ncpt) **FI.2 Installation of other equipment**

Only equipment belonging to the line (electric or telecommunication line) can be installed on the overhead line supports. 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.

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



If other equipment is installed on the supports, the requirements of safe working practices shall be considered. 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 to the line shall be considered.

# 2 Normative references, definitions and symbols

## 2.1 Normative references

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

Sähköturvallisuuslaki (1135/2016)
*Electrical Safety Act*

Valtioneuvoston asetus sähkölaitteistoista (1434/2016)
*Governmental Degree on electrical installations*

Traficomin määräys M 43 tietoliikenneverkon sähköisestä suojaamisesta
*Decree nr M 43 of Traficom on the electrical protection of a telecommunication network*

Traficomin määräys AGA M3-6, Lentoesterajoitukset ja lentoesteiden merkitseminen. *Aviation regulation AGA M3-6 of Traficom on the Aviation obstacle limitations and marking of objects.*

Traficomin ohje 23/2014 Ilmajohtojen sekä kaapeleiden ja putkijohtojen asettaminen ja merkitseminen vesialueella.

*Publication 23/2014 of Traficom: 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 Sähkötyöturvallisuus (perustuu standardiin EN 50110-1/2)
*Safety at electrical work (based on standard EN 50110-1/2)*

# 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 | Important lines, i.e. all 400 kV lines |



### 3.2.5 Strength coordination



(ncpt) **FI.1 Angle and tension supports**

The partial factors $\gamma_M$ for the resistance of the structural elements of angle (line 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:

$X_d = X_K / (\gamma_M \gamma_S)$ 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 resist 10 % higher loads than the support, the loads from the support to foundations shall be multiplied by the factor 1,1. See also Clause 8.1/FI.3.

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 applicable 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 |
| I | Sheltered coastal areas, 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 (also towns, suburban areas and permanent forests) | 0,300 | 0,214 |
| NOTE 1 Typical Finnish inland terrain with forests and small hills can be considered as category III. If the forest works or storms can have impact on this assumption, then category II or II+ should be applied.<br>NOTE 2 In mountainous areas category II should be applied, unless otherwise specified in the Project Specification. | | | |



(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 measured from the level of the surrounding flat terrain in the direction of the coming wind.

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 temperature and altitude**

When calculating the wind pressure, the effect of temperature on the air density shall be considered. If necessary, also the effect of the site altitude above sea level can be considered.

At the reference condition the temperature is 0 °C and air density 1,292 kg/m$^3$ 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**

If not otherwise specified in the Project Specification, the effective height of a conductor in tension calculations shall be at least the average height of the conductor at the reference condition within the tension section concerned.

In tower load calculations it shall be at least the average height of the conductor in the swung position at the span concerned. On a flat terrain the height of the attachment point of the insulator may be used as a conservative value.

**4.4.1.2 Structural factor**

(ncpt) **FI.1 Span factor**

If not otherwise specified in the Project Specification, the section length shall be used as the span length, when calculating the structural factor for the conductor tension analyses. However, the span length used in these calculations shall not be longer than 5000 m. The resulting gust wind load shall not be less than the mean wind load.

When calculating the span factor in the tower load analysis, the actual lengths of the spans concerned shall be used.

**4.4.1.3 Drag factor**

(ncpt) **FI.1 Drag factor of conductors**

In the case of conductors or earth-wires 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 to be applied to the average diameter of the 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:

$A_{ins} = L_{ins}\, D_{ins} \sin\alpha_{ins}$

$L_{ins}$ = Effective length of the insulator string

$D_{ins}$ = Outer diameter of the insulator unit

$\alpha_{ins}$ = Angle between the directions of the insulator and wind at the loaded position. A conservative value $\alpha_{ins} = 90^o$ 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**

Method 1 (see Part 1) is used in the wind load calculation of vertical body structures with rectangular cross-section made of angle profiles by dividing the tower into sections (panels). Also Method 2 can be used here, if not otherwise specified in the Project Specification.

Method 2 (see Part 1) shall be used in the wind load calculation of following lattice structures:

- Cross-arms and extensions (also portal tower bridges)
- Y-sections of Y-towers
- Inclined legs in guyed portal towers
- Structures with triangular cross-sections
- Structures containing different profile shapes (i.e. tubular legs and angle bracings)
- Other lattice structures not mentioned above

(ncpt) **FI.2 Structural factors**

In Method 1 the structural factor $G_t$ = 1,0 for tower body and $G_{tc}$ = 1,0 for cross-arms.

In Method 2 the structural factor $G_m$ = 1,0 for all members.

(ncpt) **FI.3 Drag factors**

In Method 1, the drag factors are calculated according to Part 1.

In Method 2, an individual drag factor is used for each member depending on the type of the cross-section of profile and on the type of the structure, which may be either a compact panel-type sub-structure including shielding effects between members, or spacious sub-structure without shielding effects between members (see Table 4.4/FI.1).

**Table 4.4/FI.1 — Drag factors of single members $C_m$**

| Cross-section shape | Structure type | |
|---|---|---|
| | Panel structure | Spacious structure |
| Circular<br>Flat sided | 1,0<br>1,4 | 1,2<br>2,0 |

(ncpt) **FI.4 Wind forces on ancillaries fixed at the support**

Method 2 shall be used in the wind load calculation of ancillaries and devices fixed at the support when applicable. Possible shielding effects can be considered as well.

If relevant, reference can be made also to standard SFS-EN 1993-3-1:2005 in the calculation of effective wind areas. Additional instructions can be given in the Project Specification.

### 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 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. In areas, which are traditionally prone to heavy precipitation of snow in Finland, higher ice loads than those given in Table 4.5/FI.1 have been detected based on experience.

(snc) **FI.2 Ice loads on conductors**

Values of ice load parameters for conductors are given in Table 4.5/FI.1. In icing categories II and III intermediate values based on the 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 given for evaluation to meteorological specialists.

Type of the ice on conductors is rime. The density of ice shall be taken as 500 kg/m$^3$.

**Table 4.5/FI.1 — Conductor ice load**

| Icing category | Relative altitude [m] | Characteristic ice load $I_{50}$ [N/m] |
|---|---|---|
| I<br>II<br>III<br>IV | 0 - 50<br>50 - 100<br>100 - 200<br>> 200 | 10<br>10-25<br>25-50<br>>50 |

(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.