SLOVENSKI STANDARD
SIST EN 50341-2-21:2023

01-december-2023

Nadzemni električni vodi za izmenične napetosti nad 1 kV - Nacionalna normativna določila (NNA) za Slovenijo (na podlagi EN 50341-1:2012)

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

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29.240.20	Daljnovodi	Power transmission and distribution lines

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English Version

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

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

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European foreword

The following statements 1 to 6 are required from CLC/TC 11 for all NNAs.

1 The Slovenian National Technical Committee is identified by the following address:

Slovenski Inštitut za Standardizacijo (SIST)
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Name of the relevant technical body: SIST/TC NVV *Technical Committee for Overhead lines and conductors.*

2 The Slovenian NC and its technical body NVV "*Overhead power lines and conductors*" of SIST prepared this Part 2-21 of EN 50341, listing the Slovenian National Normative Aspects (NNA) under its sole responsibility, and duly passed it through the CENELEC and CLC/TC 11 procedures.

NOTE: The Slovenian NC also takes sole responsibility for the technically correct co-ordination of this EN 50341-2-21 with EN 50341-1:2012. It performed the necessary checks in the frame of quality assurance/control. However, it is noted that this quality control was made in the framework of the general responsibility of a standards committee under the national laws/regulations.

3 This EN 50431-2-21, hereafter referred to as Part 2-21, is normative in Slovenia and informative in other countries.

4 This Part 2-21 shall be read in conjunction with EN 50341-1, hereafter referred to as Part 1. All clause numbers used in this NNA correspond to those of Part 1. Specific subclauses, which are prefixed "SI", shall be read as amendments to the relevant text in Part 1. Any necessary clarification regarding the application of this NNA in conjunction with Part 1 shall be referred to the Slovenian NC who will, in co-operation with CLC/TC 11, clarify the requirements.

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

5 In case of "boxed values" defined in Part 1, amended values, (if any) which are defined in Part 2-21 shall be considered in Slovenia.

However, any "boxed value", whether in Part 1 or in this Part 2-21, shall not be amended in the direction of greater risk in a Project Specification.

6 The Slovenian National standards/regulations related to overhead electrical lines exceeding 1 kV AC are listed in subclause 2.1 SI.1 of this Part 2-21.

NOTE All national standards referred to in this Part 2-21 will be replaced by the relevant European Standards as soon as they become available and are declared by the Slovenian NC to be applicable and thus reported to the secretary of CLC/TC 11.

1. Scope

1.1 General

(A-dev) **Sl.1 Definition of the new overhead power line**

A new overhead power line is defined as a functionally completed installation for the transmission of electricity between points A and B (i.e. the new construction of all conductors, their supports together with foundations, earthing system, insulators, accessories and fittings).

The overhead lines currently being designed (starting of a design to obtain a building permit) or being under construction may be completed in accordance with the standards in force at the time of the start of the design or construction of the overhead line.

In the case of maintenance and renovation works with major structural changes to overhead lines, this standard shall be applied in accordance with the project specification. E.g., for the construction of new support on new foundations in the existing overhead line, the provisions of this standard shall be applied to support and foundations but for the other elements of the overhead line don’t need to be complied with this standard.

For the design and construction of DC overhead lines, the requirements of this standard are also applicable to the design of structures, but not for electrical requirements, which have to be specified in the project specification.

1.2 Field of application

(ncpt) **Sl.1 Conductors with optical fiber wires**

This standard is also applicable for designing and construction of conductors with fiber optic wires (OPPC), optical ground wires (OPGW) and ADSS (All Dielectric Self Supporting) cables.

(ncpt) **Sl.2 Use of cover conductors and overhead insulated cable networks**

In overhead lines with covered conductors, insulated by artificial mass and overhead insulated cable networks up to and including 45 kV, project requirements shall be defined in the project specification.

(ncpt) **Sl.3 Use for the installation of other equipment on supports**

This Standard also applies to all other equipment intended for installation of new overhead line supports. Other equipment shall be considered as the equipment which does not belong to the basic elements of the overhead line, e. g. equipment for the passage of overhead line into cable, disconnectors, telecommunications equipment, meteorological equipment, measuring equipment and more. Static verification of the support and foundation of the overhead water must be carried out due to the impact of the self-weight of other equipment and the impact of wind and ice on other equipment.

2. Normative references, definitions, and symbols

2.1 Normative references

All standards referred to in the text in this Standard are listed in EN 50341-1:2012. In addition to these standards, the design and construction of overhead lines above 1 kV in Slovenia must consider the applicable national legislation and regulations related to spatial placement and safety, and quality.

(A-dev) **Sl.1 National normative acts and regulations**, to be taken into account when designing and building overhead lines in Slovenia are:

Energy Act, (Uradni list RS, št. 60/19, 65/20, 158/20 – ZURE, 121/21 – ZSROVE, 172/21 – ZOEE, 204/21 – ZOP in 44/22 – ZOTDS)

Building Act (Uradni list RS, št. 199/21 in 105/22 – ZZNŠPP)

Rules on technical conditions for the construction of overhead high voltage lines of alternating current from 1kV to 400 kV (Uradni list RS, št. 52/14 in 67/22)

Spatial Planning Act (Uradni list RS, št. 33/07, 70/08 – ZVO-1B, 108/09, 80/10 – ZUPUDPP, 43/11 – ZKZ-C, 57/12, 57/12 – ZUPUDPP-A, 109/12, 76/14 – odl. US, 14/15 – ZUUJFO, 61/17 – ZUreP-2 in 199/21 – ZUreP-3)

Decree on the assessment and management of environmental noise (Uradni list RS, št. 121/04, 59/19, 44/22 – ZVO-2 in 53/22)

Spatial Management Act Uradni list RS, št. 199/21)

Rules on electromagnetic compatibility (Uradni list RS, št. 39/16 in 9/20)

Rules on the first measurements and operational monitoring of the sources of electromagnetic radiation and the terms of its implementation (Uradni list RS, št. 70/96, 41/04 – ZVO-1, 17/11 – ZTZPUS-1 in 44/22 – ZVO-2)

Reference	*Title*
EN 338	Structural timber - Strength classes
EN 1090-1+A1	Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components
EN 1090-2	Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures
EN 1991-1-4	Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions
EN 1991-1-4:2005/A101:2008	Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions - National annex
EN 1993-1-1:2005	Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings
EN 1995-1-1	Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings
EN 1995-1-2	Eurocode 5: Design of timber structures - Part 1-2: General - Structural fire design
EN 1997-1:2005	Eurocode 7: Geotechnical design - Part 1: General rules
EN 10025-1:2004	Hot rolled products of structural steels - Part 1: General technical delivery conditions
EN 10025-2:2019	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels
EN 50182	Conductors for overhead lines - Round wire concentric lay stranded conductors

EN 50183	Conductors for overhead lines - Aluminium-magnesium-silicon alloy wires
EN 50189	Conductors for overhead lines - Zinc coated steel wires
EN 50341-1:2012	Overhead electrical lines exceeding AC 1 kV - Part 1: General requirements - Common specifications
EN 50443	Effects of electromagnetic interference on pipelines caused by high voltage a.c. electric traction systems and/or high voltage a.c. power supply systems
EN 50522:2011	Earthing of power installations exceeding 1 kV a.c.
EN 60071-1	Insulation co-ordination - Part 1: Definitions, principles and rules
EN 61232	Aluminium-clad steel wires for electrical purposes
EN 61284	Overhead lines - Requirements and tests for fittings
IEC/TR3 61597	Overhead electrical conductors - Calculation methods for stranded bare conductors
EN ISO 898-1	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 898-1)

2.2 Definitions

The definitions listed in EN 50341-1:2012 are supplemented and detailed for the purpose of this Part 2-21 as follows:

2.2.110 Factor of ice load

Factor that determines the ice loading in a given geographical zone

2.3 Symbols

For the purpose of this Part of the Standard 2-21, the symbols listed in EN 50341-1:2012 shall be used and the following:

f_{zl} the factor of ice load

3. Basis of design

3.2 Requirements of overhead lines

3.2.2 Reliability requirements

(ncpt) **Sl.1 Reliability of overhead line**

The minimum reliability level is 1 considering a 50-year return period and based on the provisions of EN 50341-1:2012. Higher levels of reliability can be determined in the project specification.

(ncpt) **Sl.2 Impact of wind on the temporary overhead lines**

In accordance with SIST EN 1991-1-4:2005/A101:2008 for temporary overhead lines should be considered seasonal coefficient c_{season} = 1,0

(ncpt) **SI.3 Impact of ice loads to the temporary overhead lines**

When designing temporary overhead lines that route will take place in an area with the altitude of less than 800 m and their use is foreseen between 1 June and 30 September, then ice loads is not to be considered.

3.3 Limit states

3.3.1 General

(ncpt) **SI.1 Simplified interpretation of limit states**

Ultimate limit states shall be analysed when the mechanical properties of the support, foundations, conductors, insulating chains and equipment are checked.

Factored values shall be used to determine the impact values.

Serviceability limit states shall be analysed when checking the supports, foundations, conductors, insulator chains and equipment adoption. For example, checking support deformations if they are within the limits of the permissible shift/buckling (polygonal supports, concrete poles), the distance of the insulating chain to the structure is checked due to wind influence, the sag controls, and so on.

Non-factored values shall be used to determine the impact values.

4. Actions on lines

4.1 Introduction

(ncpt) **SI.1 Selection of the method**

For assessing weather data in determining the numerical values of actions, **approach 1** shall be used for wind loads, which provides for the application of European and national standards to reference data, such as the basic wind speed set out in the national appendix to EN 1991-1-4 and applied together with the provisions in chapter 4.

For the assessment of the ice loads, shall be used **approach 3**, which is based on the use of data identified by a long and successful history of the design of overhead lines.

4.2 Permanent loads

(ncpt) **SI.1 Self-weight of other equipment on the support**

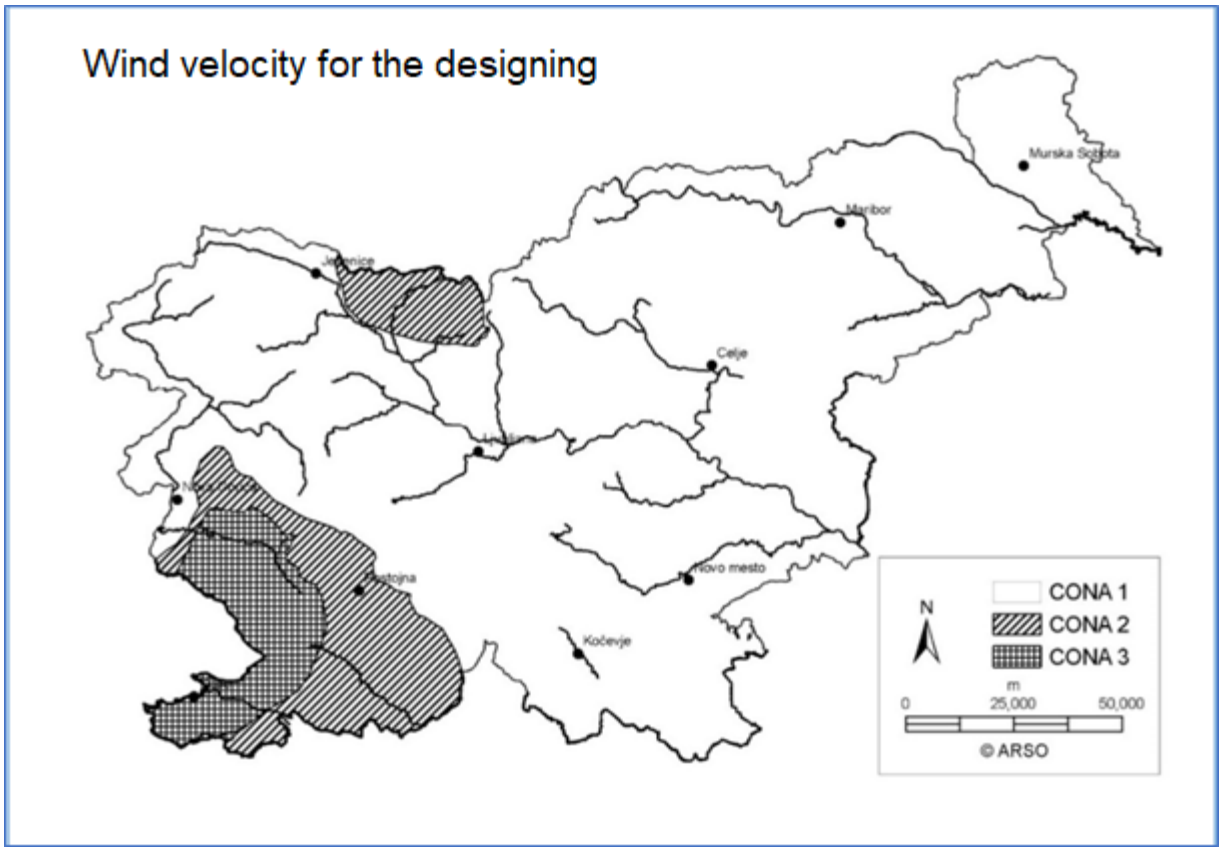
The self-weight of the other equipment intended to be fitted to the support acts as a constant weight.

4.3 Wind loads

4.3.1 Field of application and basic wind velocity

(A-dev) **SI.1 Basic wind speed, $v_{b,0}$**

Basic wind velocity $v_{b,0}$ is defined according to EN 1991-1-4. On the territory of Slovenia, the zones for the basic values of wind velocity $v_{b,0}$ are defined according to Figure 4.3/SI.1.



WIND VELOCITY FOR DESIGNING

Figure 4.3/SI.1: Zones for basic wind velocity values $v_{b,0}$ (source: SIST EN 1991-1-4:2005/A101:2008)

In zone 1, shell be considered a velocity of 20 m/s up to an altitude of 800 m, 25 m/s for altitude between 800 and 1 600 m, 30 m/s for altitude between 1 600 m and 2 000 m and above 30 m/s (e.g. 40 m/s) for an altitude above 2 000 m.

In zone 2, shell be considered a velocity of 25 m/s. It covers the fen area under the *Kamniško-Savinjske* Alps and the *Trnovski gozd* area as well as area of *Notranjska*. For altitudes between 1 600 m and 2 000 m, the project velocity value shall be 30 m/s and above 2 000 m above 30 m/s (e.g. 40 m/s).

In zone 3, shell be considered a velocity of 30 m/s. It covers the areas of *Primorje*, the Karst and part of the *Vipava Valley*.

4.3.2 Mean wind velocity

(ncpt) **SI.1 Wind directional factor, c_{dir}**

The value of the wind orientation factor c_{dir} is assumed to be 1.0.

(ncpt) **SI.2 Consider of terrain categories**

For overhead lines above 45 kV, category II shall be considered unless otherwise specified in the project specification.

For overhead lines up to 45 kV, category II and III shall be considered unless otherwise specified in the project specification.

The land roughness factor z_0 and the land factor k_r shall be considered according to Table 4.1 of EN 50341-1:2012.

(ncpt) **SI.3 Orography factor, c_o**

Recommended value for the orography factor c_o is assumed to be 1.0.

4.3.3 Mean wind pressure

(ncpt) **Sl.1 Height and temperature effect**

The effect of temperature and altitude on air density is not considered when calculating the mean wind pressure. The calculations shall consider the conservative air density value of q_h = 1.25 kg/m^3.

4.3.4 Turbulence intensity and peak wind pressure

(ncpt) **Sl.1 Peak pressure for lines not exceeding 45 kV**

For lines with a voltage level up to 45 kV and a supports height of up to 15 m, the peak pressure values shall be taken into account by zone and terrain category according to Table 4.1/Sl.1.

For lines with supports height above 15 m, the equation in Sl.2 shall be considered.

Table 4.1/Sl.1: Peak pressure for lines not exceeding 45 kV, in N/m^2

Wind loads zones	Land category	
	II	III
Zone 1	425	583
Zone 2	663	909
Zone 3	952	1305

(ncpt) **Sl.2 Calculation of peak pressure of wind for overhead lines over 45 kV**
Peak wind pressure q_p (h) should be consider in accordance with EN 50341-1:2012.

4.4 Wind forces on overhead line components

4.4.1 Wind forces on conductors

4.4.1.1 General

(ncpt) **Sl.1 Reference height above ground**

When calculating the wind force on conductors, the height of conductors or grounding conductor mounted in the insulator chains, calculated using method 6 (mean arithmetic height) in Table 4.3 of EN 50341-1:2012, shall be taken as the reference height.

4.4.1.2 Structural factor

(ncpt) **Sl.1 Span Factor for overhead lines above 45 kV**

Span factor G_c shall be calculated in accordance with EN 50341-1:2012.

For peak factor value assumes to be k_p = 3.

For resonance response factor value should be taken R^2 = 0.

(ncpt) **Sl.1 Span Factor for overhead lines up to 45 kV**

Span factor G_c for supports up to 15 m height shall be consider as follows:

G_c=0.80 for terrain category II, and

G_c=0.75 for terrain category III.

For overhead lines with supports higher than 15 m, G_c should be calculate in accordance with EN 50341-1-2012.

4.4.1.3 Drag Factor

(ncpt) **SI.1 Drag factor for conductors of overhead lines up to 45 kV**

For drag factor C_c, the Table 4.2/SI.1 shell be used.

Table 4.2/SI.1: Drag Factor, *Cc*

Element of the overhead line	C_c
Conductors with a diameter of up to 12.5 mm	1.2
Conductors with a diameter of 12.5 to 15.8 mm	1.1
Conductors with a diameter exceeding 15.8 mm	1.0
Non-round diameter conductors	1.3
Radar markers and flight warning spheres of a diameter between 300 mm and 1 000 mm	0.4

(ncpt) **SI.2 Drag factor for conductors of overhead lines above 45 kV**

For drag factor shell be used value C_c = 1.0.

4.4.2 Wind loads on insulator sets

(ncpt) **SI.1 Reference height of insulator set above the ground**

As reference height of the insulator set should be consider the height of compression point of the insulator to the support.

(ncpt) **SI.2 Wind loads on insulator sets**

The wind loads on insulator sets acts in direction of the wind action and is equal to

$$Q_{Wins} = q_p\,(h) \cdot G_{ins} \cdot C_{ins} \cdot A_{ins}$$

Where are:

q_p (h) peak wind pressure according to 4.3.4

G_{ins} structural factor for insulator sets

C_{ins} drag factor for insulator sets = 1.2

A_{ins} area of an insulator set exposed to the wind

4.4.3 Wind forces on lattice towers

4.4.3.1 General

(ncpt) **SI.1 Method selection**

Method 1 shall be followed for the calculation of the wind force on the lattice towers. The reference height of each section of the tower or of each element of the tower shall be the height of the section of the geometric centre of gravity of the section of tower or element above the ground.

4.4.3.2 Method 1

(ncpt) **SI.1 Wind on tower body**

The reference height h must be determined in accordance with 4.4.3.1/SI.1.

For the design factors for the support and consoles, the value Gt = Gtc = 1.0 shall be taken into account.